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# **Human and Artificial Intelligence for the Society of the Future**

Inspiring Digital Education for the Next STE(A)M  
Student Generation

EDEN 2020 Online Annual Conference

hosted by

Politehnica University of Timisoara, Romania

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Edited by

Sandra Kucina Softic, Diana Andone, András Szucs  
on behalf of the European Distance and E-Learning Network

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## Introduction

“Education is back where it belongs – at the top of the European policy agenda” stated the European Commission. We intend that Europe will be considered a strong and allied partner to future generations, and that the EU education system must make our societies future proof.

Education is often envisioned in terms of innovation, excellence and competitiveness. But learning is also about reaching personal perfection, using a holistic approach that supports personal and professional development, learner needs and self-realization across different learning environments. Creativity contributes to diversity and innovation, thus Europe’s cultural and creative sector is recognized as a substantial resource and driver for innovation and growth.

Digital education has proven to change learning and working practices in the society of today. Intelligence, human and artificial, is in focus, and understanding students and their learning and application of new technologies in education inspires further development.

Skills in Science, Technology, Engineering and Mathematics (STEM) represent an important part of basic literacy in today’s knowledge economy. With the inclusion of a critical component – the human being, STE(A)M Education integrates the arts – humanities, languages, dance, drama, music, visual arts, design and digital media. Increasingly, higher education institutions, as well as adult and professional learning are being transformed by intelligent systems that are helping humans learn better and achieve. A balanced relation between Artificial and Human intelligence can create trusted, flexible, personalized and inclusive digital learning eco-systems.

For EDEN, the Annual Conference has always been the most important event of the year. It is held every year in June, and our members and partners look forward to it: meeting friends and colleagues, sharing experiences and knowledge, getting new ideas to take with to their workplaces.

In 2020, due to the COVID-19 pandemic, the 29<sup>th</sup> Annual Conference was held fully online, and albeit completely virtual, We trust that this did not make the conference any less good or interesting than the face to face event.

Because of the pandemic, educators had to adopt new solutions and technologies and to use tools powered by artificial intelligence. The lockdowns and the forced move to online teaching and learning have changed the role of physical space in education and has put pressure on teachers to design new learning environments that are flexible, adaptable, and suitable for a multitude of different users at the same time.



Challenges, brought to all of us by the pandemic, have forced us to move from our safe comfort zones into the unknown. Things we have been talking about for many years have suddenly become necessary and possible and have swiftly pushed teachers, students, and educational institutions into the digital era.

Although the situation has been forced upon us, the pandemic also offers an opportunity to take up the challenge. Let us take advantage of it and jointly find ways for making education and our lives better!

Andras Szucs  
EDEN Secretary General

Diana Andone  
EDEN Vice President

Sandra Kucina Softic  
EDEN President

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## REFRAMING WORKING, RETHINKING LEARNING: THE FUTURE SKILLS TURN

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### Abstract

Research on *Future Skills* is one of the current hot topics in education, management and organizational research. In times of global networked organizations and steadily accelerating product cycles, the model of qualification for future jobs seems debatable. Can we really prepare graduates and employees for the future by the predominant model of knowledge acquisition? Do we already have adequate concepts for competence development in higher education and work environments? An international study led to the identification of the change processes that the working and learning world are undergoing as well as of the *Future Skills* that will be needed in highly emergent future contexts – including digital competences, but transcending them. This calls for new strategies and concepts concerning structural, teaching and learning aspects and a new way of embracing lifelong learning concepts. “Future organizations” have been identified that have already set out for dealing with those new demands. By learning about their innovative approaches concerning employees’ competence and skills acquisition, a veritable turn away from specialist knowledge and towards *Future Skills* can be observed – and cannot be ignored by higher education. Keywords: Future Skills, Higher Education, Learning, Competence, Delphi Survey, Education Research

### Introduction to the Field of Future Skill Research

The *NextSkills* ([www.nextskills.org](http://www.nextskills.org)) studies show that a veritable turn away from specialist knowledge and towards *Future Skills* can be observed: Research on *Future Skills* is one of the current hot topics in management and organizational research (Ehlers, 2020; Ehlers & Kellermann, 2019). In times of global networked organizations and steadily accelerating product cycles, the prevailing model of qualification for future jobs seems debatable. The vast majority of employers surveyed for the “Future of Jobs Report” of the World Economic Forum (WEF, 2018), released in 2018, expects that by 2022, the skills required to perform most jobs will have shifted significantly.

Can graduates really be prepared for the future by predominantly acquiring knowledge? Do we already have adequate concepts for competence development in higher education? Or do we need something new, something radical? Our research shows that the discourse on *Future Skills* is becoming more prominent (Ehlers, 2020). Examples are lists of skills for living and working in 2030 (OECD, 2018) or the analysis of work area-related qualifications (Deming, 2017) (for a complete analysis of the state-of-the-art research see Ehlers, 2020). What is needed, however, is to go a step further and conduct in-depth research.

Starting point for the research on *Future Skills* reported in this paper is an analysis of factors which influence our lives, the way we work and live, learn and develop. Such descriptions, by dealing with the future, carry a certain degree of vagueness, while being as precise as possible in capturing aspects that can be seen as influencing factors for the future: future ways of living, future ways of work, future ways of learning, etc. (e.g. OECD, 2017; 2018; 2019). Analysing the currently existing papers on important skills and abilities for the future work life, at least two converging primary factors crystallize:

- Increasingly fast technological advancements and their effects on all spheres of our lives, work and societies lead to an excess of information and options.
- Increased global cooperation, exchange and communication are no longer an option but a necessary ingredient of every process of society, work and life.

Resulting from that, a number of connected changes can be observed:

- Due to the changes in work structures, there will be a new demand for (higher) education studies and innovation in learning pathways and qualification structures including certification and credentialing schemes.
- The rising demand for higher education will turn industrial societies into education societies where education is the means by which one can manage risks.
- The very essence of how learning and studying is organized is evolving into new concepts – from static to reflection in action in complex situations.

In order to find reference models which are capable of capturing the intertwined and networked nature of these developments, we base our *NextSkills* studies in ecosystem theory and cybernetics. Combining these approaches with an educational science as well as with a sociological point of view, our research is rooted in the assumption that there are ongoing changes within the structure, nature, and profile of competences and skills (Ehlers, 2020). Our studies show that the changing skill requirements can be described and analysed.

In order to be able to research the articulation, extent, nature and contexts of such *Future Skills*, we designed a threefold long-term research project, starting in 2015, called “Future Skills – Future Learning and Future Higher Education”. In this paper we shortly outline

the methodology of the studies to arrive to the 17 *Future Skills* profiles. We then report about the *Future Skills* turn and state good practice examples of organizational concepts to support the development of *Future Skills* with students and employees.

## **Methodological Design and Research Context of the Delphi Study**

The research focus is on identifying *Future Skills* in a broad and holistic sense, incorporating digital skills but going beyond them, and determining which changes in the working world are causing these new skill demands. Moreover, we identified so-called *future organizations* (future organizations are defined as organizations which already have a well-developed and explicitly formulated understanding for the promotion of the capacity to act) that already promote their employees' skill enhancement in innovative ways which could inspire higher education. Our research aims at defining *Future Skills*, the way they are being perceived and promoted in so-called *future organizations*, as well as asking how higher education can support their development (Ehlers, 2020). In order to address this complex field systematically, we asked three questions within three different, but interrelated areas:

- Future Skills: Which skills are necessary for future employees? Which skills will be necessary to shape the future and society in a sustainable way?
- Future learning concepts: How can organizations and firms support the development of *Future Skills* (learning and management approaches)?
- Future higher education: How can we design higher education concepts in order to support the development of *Future Skills*?

Part 1 of the research initiative was about identifying innovative and future-oriented future organizations, based on their human resource development strategies. In part 2 of the research, we analysed the nature of these competence concepts and the competence demands of the future organizations through in-depth interviews and we were able to model a set of 17 competence profiles which we refer to as *Future Skills*, each containing a number of sub-competences and embedded in a three-dimensional competence frame. In part 3, in order to validate our findings and to determine the impact of the demand for *Future Skills* on higher education, we designed an international Delphi study, drawing on the assessments and opinions of almost 50 experts from all over the world. The experts were asked to reflect and evaluate within three areas which were identified as important for future higher education: (a) drivers of change shaping future higher education, (b) scenarios of future higher education, and (c) *Future Skills*. For each of the areas we were interested in the degree of relevance of the respective issues, as well as in the experts' opinion about when they would gain relevance.



Seventeen *Future Skills* profiles (Figure 1), each containing further subskills, have been defined and can be differentiated in three skills dimensions as follows:

- The first *Future Skill* dimension is the subjective dimension of *Future Skills* profiles. It is relating to an individual's subjective, personal abilities to learn, adapt and develop in order to improve its opportunities to productively participate in tomorrow's working world, actively shape it and get involved with designing societies to cope with future challenges. It contains seven *Future Skill* profiles.
- The second *Future Skill* dimension is relating to an individual's ability to act in a self-organized way in relation to an object, a task or a certain subject-related issue. It is emphasizing a new understanding of knowledge, going beyond pure expertise and towards connecting knowledge with motivation, values and the capacity to act in the concerned field of knowledge. It contains three *Future Skill* profiles.
- The third *Future Skill* dimension is relating to an individual's ability to act self-organized in relation to its social and organizational environment. It is emphasizing the individual's dual role as the curator of its own social portfolio of membership in several organizational spheres of rethinking organizational spaces and recreating organizational structures for the future. It contains five *Future Skill* profiles.

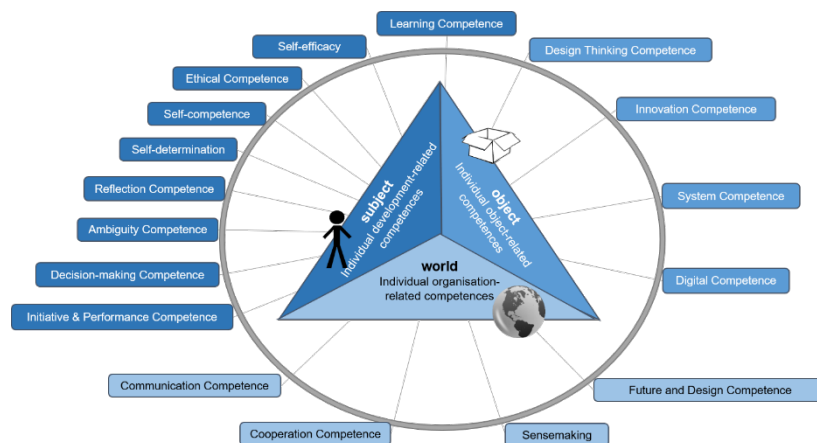


Figure 1. The 17 Future Skill profiles

## The Future Skills Turn in Practice

### ***Leadership and learning in networked systems***

William Ross Ashby's works "An Introduction to Cybernetics" (1956) and "Design for a Brain" (1952) have been influential in the sciences of complex systems since their appearance in the 1950s, when they were known as cybernetics. Ashby's law bears his name and provided the scientific basis for the "homeostatic" principle and the principles of self-organisation. The "Law of Requisite Variety" is one of the central insights of cybernetics (Ashby, 1956).

This law states that a system that controls another can compensate the more for disturbances in the control process the greater the variety of its action: the greater the variety of a system, the more it can reduce the variety of its environment by controlling. Consequently, the variety of the control system must be at least as great as the variety of the malfunctions that occur in order to be able to control it. Following this idea, this means that whenever it is a question of dealing successfully with highly complex and dynamic situations, the acting system must have at least the same complexity and dynamics as the system in which action takes place. Transferring this thought to today, it means: As markets continue to network, it becomes more and more important to allow and promote free networking within one's own organization. Otherwise, one risks getting lost.

The very meaning of leadership in companies and organisations then changes: it no longer means thinking ahead or steering the activities of employees, but ensuring that the people in the company can develop the necessary *Future Skills* in order to recognise interrelationships and thus be able to organise themselves in line with market requirements. It can be observed that the individual has an increasingly greater responsibility within the organisation. Less responsibility can be transferred to *central* management structures. The question of which *Future Skills* are actually important and needed in order to successfully work on the respective tasks in the “network organisation” can only be answered in a very personalised way and in the respective context – and the learning of these skills must also be done by the individual itself.

Examining today's institutions, this connection becomes immediately apparent. Those interviewed for the *Future Skills* Study are aware that the development of the necessary skills is so volatile and constantly changing that 80 percent of the necessary learning takes place “on the job” (Ehlers, 2020). The externally organised, formal and explicit training plays an ever less important role. The ability of one's own individual information management is not only a question of subjective knowledge management, i.e. how one organises one's own knowledge area. It is also about having the ability to validate data and information.

The French philosopher and mathematician Marquis de Condorcet already pointed out an important additional condition in the 18<sup>th</sup> century. The Condorcet jury theorem states: “If the amount of knowledge distributed in the minds of the set of decision-makers involved in an estimation task is a little below chance, then the hit rate of the overall decision is extremely low”. If, on the other hand, the individual's knowledge is only a little above chance, then the group will rock itself to a surprisingly high marksmanship. With regard to organisations, this means that the distributed knowledge is limited in principle by information monopolies, relationship networks or hierarchical thresholds. It is therefore an important task to ensure that this does not happen and that knowledge is freely

available and without the typical knowledge restrictions (e.g. information monopolies) in the organisation.

### ***The Relativity of Knowledge and Expertise***

With regard to professional competence and knowledge, the *Future Skills* Study shows that many organisations are increasingly realising that the ability to take the initiative, i.e. to follow up on and implement the impulses and ideas arising individually from one's own initiative, and the self-competence closely associated with this, plays an equally important, if not perhaps even more important role than specialist knowledge. However, this polarization of *knowledge* on the one hand and *competence* on the other is only an apparent contradiction – *knowledge* being a central building block for *competence*. Competence, however, goes far beyond knowledge. Self-competence, for example, can be described as the

*“Willingness and ability as an individual personality to clarify, think through and assess the development opportunities, demands and restrictions in family, career and public life, to develop one's own talents and to draw up and further develop life plans. It includes qualities such as independence, critical ability, self-confidence, reliability, sense of responsibility and duty. This includes in particular the development of well thought-out moral concepts and the self-determined attachment to values.”*  
(KMK, 2011)

This insight is often the subject of a seeming contradiction, which repeatedly emerges in the recent debate about knowledge/expertise vs. action competence and skills and requires fundamental reflection. It is expressed in statements by large Tech-Companies (Times Higher Education, 2015) about the relativization of formal certificates as well as in controversial debates among teachers on the question of whether competences are a realistic goal for learning processes at all, when there is so much knowledge to learn at first.

In the organizations surveyed, personnel development instruments were increasingly geared towards supporting individual competence development and in particular the development of subject competences. The development of self-organized learning as *the* future competence par excellence in turn requires new and special models of training, support and development for employees.

### ***Future Skills in Practice***

A veritable turn towards *Future Skills* can be observed. This is also expressed in the instruments that are increasingly being used in human resource development. In

personnel development, more and more importance is attached to how cooperation and networking can be promoted. This is also reflected in the range of continuing training opportunities and measures, less *catalogue-oriented* but increasingly aimed at networking – and thus at self-organisation. This is expressed quite practically, for example, in the fact that a human resources manager reports that today there are about 200 offers of personnel development per year, and 80-85 percent of these are organized as *colleague trains colleague* (medium-sized medical device manufacturer). In some organisations there are also explicit departments that emphasise the importance of learning for work and interlink both issues, for example a *learning and work* team in one of the participating organisations (large drugstore chain).

The shift in *Future Skills* – away from specialist knowledge towards *Future Skills* – is also reflected in the fact that coaching, consulting and mentoring are playing an increasingly important role alongside traditional personnel development tools. Coaching stands for open-ended and solution-focused support of personal contexts, consulting for a format in which the main focus is on targeted support for a given problem, while mentoring can also take place between colleagues with different expertise. The dissolution of the boundaries between the private and the professional is a trend-setting development.

The following practice examples briefly illustrate how organizational structure, values, leadership and communication structures must interact in order to build an organizational culture for *Future Skills*.

#### *The Competence workshop: A method to strengthen networking and self-organization*

Employees of all departments and hierarchical levels can register in a one-year competence workshop. The aim of the competence workshop is to tackle a personal learning or development task. This format also serves to support networking of employees within the organization. A new network of employees is created, which runs through the entire organization and connects employees who have not previously had any contact or connection with each other.

#### *The end of instruction: Learners and Students as Experts*

A large drugstore chain adopts the view that learning does not function through instructing or teaching, but is a self-active and self-controlled process. Trainers are learning facilitators, certificates or examinations are documented in a personal learning passport, learning facilitators receive special training as learning facilitators, which is intended in particular to support learning as a self-organized process. Similarly, a world market leader in the IT service sector is turning the tide – it is no longer trainees and (dual) students who need to be trained and further educated, but the company wants to benefit from the perspectives of young people and their unbiased view. Individual departments can apply

to students with project ideas within authentic problem contexts, i.e. real problems that are relevant for the company.

#### *Creativity in distributed teams*

Experts of a globally leading technology group point out that it is important for an organization to build competence on how skills can be put together as "shared expertise" in departmental and project teams – sometimes even worldwide. The approach is based on the point of view of the organization it is important to have a complete spectrum of competences distributed within a team as far as possible.

#### *Flexibilization and self-organization*

In all surveyed organizations, learning and working take place in contexts that allow flexibility in workflows, roles, function descriptions and definitions. Examples include the organization of working time on the shop floor or the abolition of working time regulations (for a large chemical group).

#### *Create space, change perspective, enable innovation and creativity*

How do you get the members of an organization to think beyond their particular situation and develop suggestions for new products, new business ideas or processes? A world market leader in the medical devices sector has initiated an internal competition for this purpose. All members of the company were invited to submit suggestions to the management on what a new corporate strategy could look like. From all the proposals, some were selected that were particularly far-reaching and diverse. Those who had brought them in were then sent into a seven-week retreat as a team.

#### *Strengthening self-organization and self-responsible learning*

In cooperation with a University of Education, a large chemical company has developed its own approach to strengthening learning skills. A radical change has been initiated, away from the structured presence in continuing education towards self-responsible learning via e-learning in virtual worlds where employees themselves are increasingly becoming the managers and designers of their own learning experiences.

#### *Empowering personalities and self-confidence*

How can employees strengthen their own self-confidence in order to enhance *Future Skills* learning? Targeted coaching measures are required that lead to more self-organization ability, autonomy and the ability to act, especially in contexts in which employees have to deal more and more with uncertainty and ambiguity. An organization participating in the *NextSkills* study conducts theatre workshops with employees for this purpose. It is often a matter of bringing together exactly those in organizations that have nothing else to do with each other, i.e. acting across departments or business units, often in completely new and

external environments, in order to strengthen employees' self-confidence, self-competence as well as autonomy and performance motivation.

### *Creating (free) spaces*

Development needs freedom, needs recognition and the knowledge that one's own commitment is well received and that design proposals can be implemented. One of the organizations participating in *NextSkills* lives this as a practical reality, taking their employee suggestion scheme seriously. Employees can contribute their ideas online and then gradually implement them through participatory selection processes. The identity of the individual employees with their actions within their organization can thus be further strengthened.

### *FUSE: Participation-oriented strategy development*

An example from the academic world shows what real participatory design of future organizational strategies can look like. FUSE was a crowdsourcing initiative of Dublin City University to develop key ideas for the university's future five-year strategy – together with all stakeholders of the university. FUSE is conceived as a brainstorming event in which all 17,000 students, 80,000 alumni and 1,200 university members had the opportunity to contribute their ideas online – for 30 hours. It is a hallmark of future organizations to allow participation in design processes.

## **Conclusion**

A veritable turn away from specialist knowledge towards *Future Skills* can be observed not only in research but also in working environments and organization's approaches to competence and lifelong learning. So-called "future organizations" already take innovative approaches in order to foster their employees' *Future Skills* learning and to deal with new work-related requirements. Higher education institutions can learn from this in order to also become future organizations, preparing their graduates for the challenges of uncertain and emergent future work and society contexts. This calls for new strategies and concepts concerning structural, teaching and learning aspects and a new way of embracing lifelong learning concepts.

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## **ECCOE: TOWARD A ROBUST SOLUTION FOR THE CROSS-INSTITUTIONAL RECOGNITION AND VALIDATION OF PRIOR LEARNING**

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### **Abstract**

ECCOE, the European Credit Clearinghouse for Opening up Education, aims to facilitate the endorsement and appropriation of open, online and flexible higher education by increasing trust in technology-enabled credentials among students, higher education institutions (HEIs) and employers. To this end, the project is developing a complete solution in the form of the ECCOE-system, with publicly reviewed credential descriptors, Model Credit Recognition Agreements (MCRAs), an online catalogue of over 60 disciplinary and transversal modules, and a robust solution for technology-enabled credentials and a network of stakeholder users. In this paper the analysis and classification of existing prior learning agreements (at higher education institutions) is presented as a first step towards a generic recognition structure that subsumes all types of recognition and can form the basis for the MCRA template. The result of this work was the identification of four characteristics present in each type of recognition agreement: its type, the objective of applying it, the process steps that need to be followed, and constraints for a successful application.

### **Introduction**

ECCOE, the European Credit Clearinghouse for Opening up Education (ERASMUS+ KA203 2019-1-FR01-KA203-062951), supports the drive towards more open, online and flexible higher education. Policy makers at European and national level are responding to the needs of an increasingly diversified student population with calls for a more modular approach to credentials, and employers are focusing more and more on the actual competences that graduates are able to demonstrate. Furthermore, in the current political climate, transnational mobility, whether physical, virtual or a combination of the two, is a powerful vehicle for increasing cross-cultural awareness.

For this vision to become reality, there is a great need for a solid, trustworthy system supporting the cross-institutional recognition of credits at the level of courses or modules.



Over and above the technology, such recognition will not take off without appropriate quality mechanisms and the demonstration that the overall process, the ECCOE-system, has been tried and tested with a critical mass of stakeholders. As pointed out in the European Commission (2018) proposal for a Council Recommendation on promoting automatic mutual recognition of higher education and upper secondary education diplomas and the outcomes of learning periods abroad:

*“There are still too many cases in higher education where complicated, expensive, time-consuming recognition procedures hinder the free movement of learners. In some cases, these procedures can take several months and be very costly, with inconsistency and a lack of transparency adding to the difficulties learners face. One of the reasons for this is that decisions on recognition are often left to the discretion of the higher education institution to which the learner is applying, with varying institutional practices and a lack of uniformity in criteria.”*

The main goal of ECCOE is thus to facilitate the endorsement and appropriation of open, online and flexible higher education (Orr, Weller, & Farrow, 2018). In support of this overarching objective, the project aims at increasing trust in technology-enabled credentials among students, higher education institutions (henceforth, HEIs) and employers. To facilitate sustainable take-up, ECCOE is committed to the use of open metadata based on ESCO (European Skills, Competences, Qualifications and Occupations) (European Commission, 2019), open source codes and Creative Commons licences.

The benefits for HEIs include greater efficiency, quality and transparency for lifelong learning. Students will benefit from flexible opportunities in support of transnational mobility as well as improvements in employability, being able to demonstrate competency-based credentials both for degree-level qualifications and for recognition by employers. In terms of societal impact, the quality-based ECCOE-system will open up opportunities for citizens to develop intercultural skills through flexible, transnational lifelong learning.

## **Progress and problems in the recognition of prior learning**

Since the 1950s, with the increase of student mobility in Europe, the recognition of prior learning has been a goal in Europe. However, as Teichler (2003) argues, cross-border recognition using the European Credit Transfer System (henceforth, ECTS) could be improved, since it arguably depends on the limited mutual acceptance of course structures and content from other institutions, in the shape of credits. While the ECTS has become a standard in Europe, its adoption has proved to be far from easy. For example, Tovar (2004) discusses the difficulties encountered when the ECTS was implemented in Spanish

universities, including the need to balance the curriculum between the number of hours spent in a classroom and their equivalent value in ECTS. Both lecturers and students struggled with the change and it took some time to overcome these. It is the objective here that ECCOE should prove easier to adopt and apply.

In a similar way to ECTS, other attempts have been made to facilitate the recognition of prior learning. For example, the “credit bank” transfer system proposed by Sun (2018). The author notes that more work is required to overcome problems that have appeared in the development and use of this system, such as the organisational complexity regarding policies and regulations, the lack of unified standards, differences between educational institutions (even those of a similar type), and the need to make the use of such a bank more attractive for students.

The recognition of prior learning is not just problematic for standard degree and master’s programmes. Non-formal learning such as MOOCs has also proved challenging for students wishing to have their courses or other types of learning scenarios (such as work experience) accredited in a broader academic context. Pressure from the high number of students who have undertaken MOOCs to obtain this has led to a range of digital credentials and badges, that can be obtained in a variety of circumstances, for example, when students complete 80% of the activities, when they pass a final text. As Jobe (2014) argues, students accept the difficulties with these credentials and are forced to accept non-formal recognition as a complement to traditional educational credits. Anything is better than nothing!

As Castle and Attwood (2001) argue in general terms, the cross institutional recognition of prior learning is a complex and difficult process due basically to the difficulty of establishing equivalencies between the diversity of the kinds of experience, knowledge and learning that adults may have acquired. In ECCOE these problems are being addressed in terms of two essential components: a series of quality descriptors, based on open metadata-based standards and essentially closed vocabularies, used to quantitatively instantiate the quality of a given digital credential, and a Model Credit Recognition Agreement (henceforth, MCRA), that will facilitate the cross-institutional recognition of digital credentials between HEIs. In this paper the analysis and classification of existing prior learning agreements is presented with a view to establishing a generic recognition structure than subsumes all types of recognition and can form the basis for the MCRA.

## **Recognition elements for an MCRA**

To specify an MCRA it is necessary to undertake an analysis of existing processes at the partner HEIs that are collaborating in this project, specifically on the ways prior learning

is already “recognised” or “validated” (the use of these terms here is based upon Rampelt et al., 2018), where recognition essentially refers to formal learning undertaken at HEIs and validation to competences earned outside of a university. In order to gather the data two types of templates were prepared, one for existing recognition agreements and another for institutional expert interviews. The information gathered from the latter is particularly valuable since it complements that which is present in the former with the experiences of those who undertake the processes. The partners used these to record the information about their institutions. Subsequently, the data was transformed during this analysis and classification process into Mind Maps (Politecnico di Milano – METID had also provided data in Mind Map format that greatly helped the work undertaken here). This visual representation enables the data to be grouped and ungrouped, linked and unlinked, and underlying patterns to be identified in a way that is much easier than working directly with the completed templates.

The data collection was conducted within four European HEIs: Duale-Hochschule Baden-Württemberg (DHBW) in Germany, Politecnico di Milano (POLIMI) in Italy, Universidad Nacional de Educacion a Distancia (UNED) in Spain, and Vytautas Magnus University in Lithuania.

The high-level map of the prior learning recognition and validation pathways identified in this analysis (for DHBW, POLIMI, UNED & VMU) can be seen in Figure 1. During this process it became obvious that there was more than one way to structure the data. There are arguably at least two dimensions in the data that could have formed the base of the classification discussed here, namely where the recognition and validation takes place at an HEI (two levels were identified: at faculty level and at institutional level) and what type of learning is being recognised (three types have been identified: non-formal [open learning], formal learning [undertaken on taught courses awarding credits], and cross-institutional agreement scenarios). Not all of these scenarios lead to results that can be recognised or validated as part of other programmes, but some do, which justifies their inclusion here. Since the objective of Output 2 is to produce a model credit recognition agreement, then the former (where the recognition takes place) was chosen over the latter (what type of learning is being recognised). Anticipating what will be seen in this article, it should be noted that this initial structuring of the data, which made analysis easier to begin with, has not arguably affected the overall result of the analysis, and is therefore, not so important, but it is illustrative.

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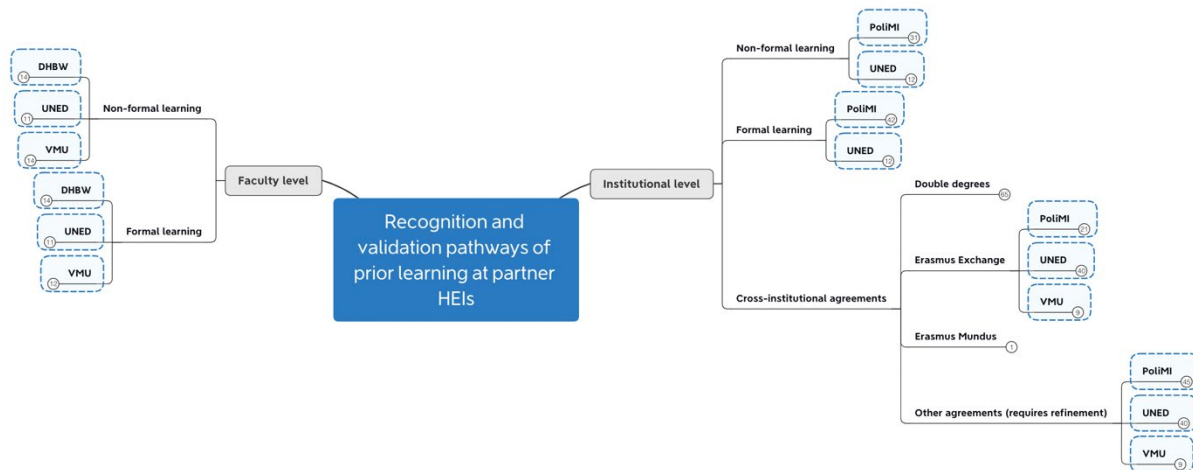


Figure 1. A high-level view of the pathways for the cross-institutional recognition and validation of prior learning

### Analysing the recognition and validation pathways

During the analysis of the faculty level validation of non-formal learning (including but not restricted to MOOCs) and recognition of formal learning undertaken at HEIs. For each institution four characteristics were commonly identified: the type of recognition/validation, its objective, the process steps followed, and any constraints that might influence the result. An example from UNED can be seen in Figure 2. It should be noted that three of the four partners (DHBW, UNED and VMU) undertake recognition/validation at a faculty level. This appears not to be the case for POLIMI. In the case of UNED, for example, the process detailed for MOOC and for formal learning are exactly the same. Both types of courses can be accredited in terms of ECTS, either specific ones, corresponding to actual subjects or so-called “free elective credits” (these are credits that a student can bring from outside the course s/he is studying). This mechanism is complemented by another one (not included in the map) for students who want to transfer their studies to UNED and present a range of courses from their original institution that they want to have accredited in substitution for studying the equivalents at UNED as part of the degree they want to study. Here it is the subject teachers that decide whether there is a match between the external courses and the internal ones, and facilitate the recognition, or not, on a case by case basis. In the case of VMU.

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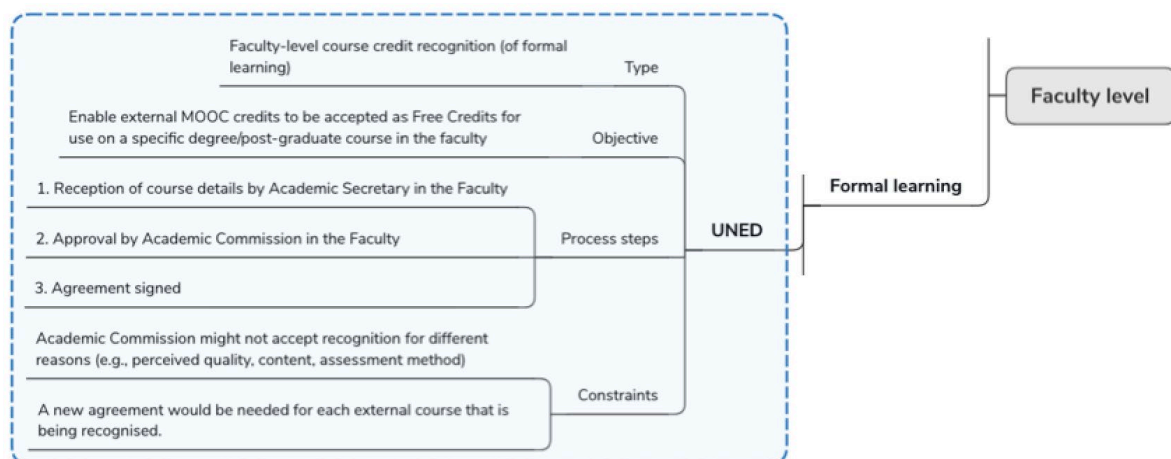


Figure 2. Example of the four characteristics underlying recognition/validation processes

Finally, there is an “other agreements” type included, that is a catch-all for agreements that need to be refined and included separately in future research. It should be noted that these agreements do not follow the same structure as the previous figures (i.e., they do not contain the four characteristics of type, objective, process steps, and constraints), since they contain a very diverse type of scenarios (this does not imply that such characteristics could not be identified for each of them post hoc). Furthermore, not all of these scenarios lead to results that can be accredited as part of other programmes, but some do. Specifically, POLIMI include a series of such agreements (Athens, UNITECH International Society, Global Engineering Education Exchange, QTEM Quantitative Techniques for Economics and Management, MEDes, and Magalhães), and while UNED does not list such agreements, it does detail the 12 steps that need to be followed by any HEI (or other institution) that wants to establish a bilateral collaborative agreement with UNED. This process is very clearly detailed since these types of agreements have been developed and undertaken for nearly 50 years. There are over 16,000 signed agreements in the university register that can testify to this process. The only limitation with these agreements is that they are typically specified to last for only a certain number of years. Therefore, as time passes, they typically cease to be active and need to be renewed, if there is still institutional commitment.

As has been seen in this section, each of the accreditation processes, independently of where the recognition/validation takes place in the institution, it can consistently be characterised in terms of four elements: its “type”, the “objective” of applying it, the “process steps” that need to be followed, and “constraints” for a successful application. The next logical step would be to instantiate these characteristics into a procedure that will be detailed in the MCRA. However, it can be noted here that the use of these elements would give rise to a relatively flat classification, although it might prove necessary to deepen it as the project develops.

## **Discussion**

In the previous section an analysis of the prior learning recognition and validation pathways identified at the partner HEIs has been presented for three types of prior learning (non-formal learning, formal learning, and cross-institutional agreement-based scenarios), that are processed at two different levels (faculty and institutional). As was noted at the beginning, this structure has been adopted because it reflects what the partner institutions have presented, and seems appropriate for the MCRA, but does not ignore the fact that the data can be classified in other ways. The prominence given to the “level” at which such accreditation is undertaken, over “which type of learning” is being accredited, was considered to be important initially, to help structure the data make classification easier. However, after the analysis has taken place, it can be argued to be less important, since the four characteristics identified in the analysis to be key for the MCRA, do in fact encapsulate the notion of level where the accreditation takes places, so such a separation of where it takes place, at faculty or institutional level (or even possibly at other levels in other institutions, e.g., departmental), is not really important.

As we move forward from this work and consider the next steps that have to be undertaken for the MCRA it can be appreciated that each of these characteristics need to be carefully defined in terms of the results highlighted previously. Considering the first two characteristics, type and objective, given their reduced scope, it should be possible to specify them using closed vocabularies. Process steps would need to be generated by following an algorithm that would be designed in order to reflect the results presented here and would lead to a “cooking recipe” for each institution and its governing organisms, where a sequential set of steps would identify the necessary causal details of the process (e.g., documents, actors, decisions). The “constraints” characteristic has been adopted as a kind of “catch all” to try to unify the different recognition and accreditation processes, and will inevitably, require careful refinement for the MCRA. It should be possible, for the sake of the algorithm, to achieve a sub-classification of elements that make up constraints, although it might be a little optimistic to assume that we can achieve a closed vocabulary.

The approach proposed here, of defining all recognition and accreditation in the MCRA in terms of four characteristics, and an associated algorithm for specifying the process steps is argued to be an appropriate and potentially effective solution for the project and the cross-institutional recognition and validation of the online catalogue of potential courses, MOOCs or modules identified in the project. It should as such, illustrate a wide range of cases of how such processes might work for future HEIs that want to be incorporated in to the ECCOE system. In the future, HEIs who want to use the ECCOE system would need to complete and sign a copy of the MCRA detailing such processes in their own institutions.

However, we shouldn't be lulled into a sense of success where an obvious problem can be identified, i.e., the question of scalability if this accreditation process has to be followed on a student by student basis. As the use of the ECCOE system gains size and momentum, and more institutions wish to subscribe, then the MCRA could arguably become harder to apply, for questions of scalability and the implications that the recognition processes can have for human resources at the HEIs. We should, therefore, consider how this problem might be addressed before the MCRA is drafted and it becomes too late.

### **Conclusion: toward an “ECCOE Fast Track” recognition and validation process**

The problem highlighted in the previous section requires a solution that moves the question of the recognition and validation of credentials away from the need to study individual student cases, where HEI staff have to study each application for such accreditation on a one by one basis. Such an approach is inherently unscalable and would eventually threaten the integrity of the ECCOE system. A better and more ambitious approach is required.

While a solution to this problem will require significant thought and discussion by project partners, as the project moves forward, a possible first generation solution could be offered here, in the spirit of exploration of the conceptual space of possibilities, namely to encapsulate the recognition and validation process into what could be defined as a generic “ECCOE Fast Track”, whereby any prior learning credential from an HEI that carries the ECCOE quality stamp (defined as a faithful representation of the quality characteristics mentioned above) would be automatically recognised and accredited by the partner institutions, in as wide a sense as possible, without any further analysis or administrative intervention in the recognition process. This approach would both make the process more agile, scalable, and at the same time, not burden the human resources at the partner HEIs.

To this end, meetings have been held with the members of the university governing team responsible for recognition and validation of prior learning at UNED regarding the possibility of establishing such a fast track. As a result, and thanks to the importance given to such innovation by the team, a prototype of this fast track mechanism is being developed and will be tested at UNED for all MOOC credits that carry the “ECCOE quality stamp”. Hence any student that presents a credential that comes from a course that carries the ECCOE quality stamp, will have its credit value automatically recognised and accredited as free credits that can be used on any degree programme offered by the institution. It is suggested that other HEI partners consider following a similar approach, thereby lightening the administrative load, and adding considerable agility and scalability to the processes specified in the MCRA.

Finally, as food for thought, it is argued that the key to the success of this type of automatic accreditation process are the details contained in the constraints section of each process, our ability to define them in a controlled manner, and HEIs willingness to accept them, while at the same time recognising the need to find a balance between streamlining such recognition and validation processes and ensuring ownership by learners and teachers through transparency. As the saying goes, the devil is in the details!

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## ETHICAL CODES AND LEARNING ANALYTICS

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### Abstract

The growth and development of learning analytics has placed a range of new capacities into the hands of educational institutions. At the same time, this increased capacity has raised a range of ethical issues. A common approach to address these issues is to develop an ethical code of conduct for practitioners. Such codes of conduct are drawn from similar codes in other disciplines. Some authors assert that there are fundamental tenets common to all such codes. This paper consists of an analysis of ethical codes from other disciplines. It argues that while there is some overlap, there is no set of principles common to all disciplines. The ethics of learning analytics will therefore need to be developed on criteria specific to education. We conclude with some ideas about how this ethic will be determined and what it may look like.

### Introduction

What distinguishes ethical codes from other forms of ethics generally is that while they may assign duties and responsibilities, these are assumed voluntarily by virtue of being a member of the profession. To become a nurse is, for example, to adopt as a personal code the ethical norms and values that define that particular profession.

The purpose of this chapter is to showcase the wide range of ethical codes that are employed in different professions, some of which are directly related to the use of analytics in that profession, and others which describe ethics in the profession generally. This diversity is not widely recognized; there is often a presumption, if not an explicit assertion, that the values in these ethical codes, and in ethics generally, are common, core, and universal.

This statement from Metcalf (2014) is typical: “There are several principles that can be found at the core of contemporary ethics codes across many domains:

- respect for persons (autonomy, privacy, informed consent),
- balancing of risk to individuals with benefit to society,
- careful selection of participants,

- independent review of research proposals,
- self-regulating communities of professionals,
- funding dependent on adherence to ethical standards.”

Whether or not one actually believes these principles are foundational, it remains a matter of empirical fact that they are not universal and not core. The same can be said for similar assertions of universality made elsewhere (for example: Pitofsky, (1998; p.7), Singer and Vinson (2002), CPA (2017)).

This chapter is a substantial survey of dozens of ethical codes. Though every attempt has been to keep this treatment brief, it is nonetheless not brief. By laying out the evidence I endeavour to show, rather than argue, that there is no common foundation to the ethical codes that govern different professions.

We'll begin with a quick overview of what we mean by ethical codes, discussing the purpose and operation of ethical codes, some of the components of ethical codes, and the ways in which these codes differ from each other. Then we'll take an extended look at the issues raised by the codes. First we look at what problems the codes are trying to solve, or in other words, what the purpose was for writing the codes. Then we look at a length list of values and priorities revealed in the codes. After this examination, we consider the question, to whom are the professionals described in the codes obligated? Finally, we ask what bases and foundations underlie the recommendations in the codes.

The full set of ethical codes is displayed, with readers invited to notice the ways in which they differ from each other, in Appendix 1: An Ethical Codes Reader, with references linking back to the full code in question, for further study as desired by the reader.

## **Standards of Conduct**

### ***Why Ethical Codes?***

The need for professional ethics encompasses a number of factors. There is the need to be able to trust a person in a position of trust. There is the need to make good decisions and to do the right thing. And then there are various intangibles. The Project Management Institute (PMI, 2020) states, “Ethics is about making the best possible decisions concerning people, resources and the environment. Ethical choices diminish risk, advance positive results, increase trust, determine long term success and build reputations. Leadership is absolutely dependent on ethical choices.”

But these are not the only reasons advanced to justify professional ethics. There is the concern that without a statement of ethics, unethical conduct will abound. “The absence of a formal code could be seen almost as a guarantee that if such cases did exist they would

be swept under the carpet, left to others (probably the law) to sort out,” writes Sturges (2003).

Others are less concerned about good behaviour per se than they are about the bottom line. Alankar Karpe (2015), for example, writes in “Being Ethical is Profitable” that “Shortcuts and sleazy behaviour sometimes pay handsomely, but only for the short term. Organizations must remember that any benefits from lying, cheating, and stealing usually come at the expense of their reputation, brand image, and shareholders.” And, as he notes, “There is one and only one social responsibility of business – to use it[s]resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition.”

Additionally, there are services and institutions that require professional ethics in order to function. For example, the CFA Institute (2017) states, “ethical conduct is vital to the ongoing viability of the capital markets.” It notes, “compliance with regulation alone is insufficient to fully earn investor trust. Individuals and firms must develop a ‘culture of integrity’ that permeates all levels of operations.” Indeed, it is arguable that society as a whole could not function without professional ethics. Thus, the “CFA Institute recently added the concept ‘for the ultimate benefit of society’ to its mission.”

Certain disciplines see ethical codes as essential to being recognized as a profession. Hence, for example, for librarians, “Keith Lawry set the idea of a code in a particularly positive view of the professionalization process in British librarianship. He linked the Library Association’s possession of a code of professional conduct with the potential for statutory recognition of the association’s control of who might and who might not practise librarianship” (Sturges, 2003)

Finally, practitioners need them. As Rumman Chowdhury, Accenture’s Responsible AI Lead, said, “I’ve seen many ‘ethics codes’ focused on AI, and while many of them are very good they’re more directional than prescriptive – more in the spirit of the Hippocratic Oath that doctors are expected to live by. Meanwhile, many data scientists are hungry for something more specific and technical. That’s what we need to be moving toward” (De Bruijn, et al., 2019)

### ***Ethical Codes as Standards of Conduct***

While ethics commonly applies to people in general, there is a specific class of ethics that applies to people by virtue of their membership in a professional group. There are different approaches, but in general, “professional ethics are principles that govern the behaviour of a person or group in a business environment. Like values, professional ethics provide rules

on how a person should act towards other people and institutions in such an environment” (Government of New Zealand, 2018).

Professional ethics can be characterized as imposing a higher standard of conduct. The reasons for this vary, but (as we discuss below) a higher standard is demanded because professionals are in positions of power, they have people in their care, and they are expected to have special competencies and responsibilities. Additionally, professional ethics may require that practitioners put the interests of others ahead of their own. This may include duties not only to those in one’s care, but also to clients, organizations, or even intangibles like “the Constitution” or “the public good”.

As such, professional ethics are often expressed in terms of codes of conduct (indeed, it is hard to find a sense of professional ethics where such a code is not employed). Though the code is normative (“breaches of a code of conduct usually do carry a professional disciplinary consequence” (Ibid.)) usually the intent of the code is to remind professionals of their duty and prompt them regarding specific obligations.

### ***Ethical Codes as Requirements***

In the world of software engineering, in addition to ethical standards as codes of conduct, ethical codes can be seen as defining requirements. This is proposed, for example, by Guizzardi et al. (2020), they write, “Ethical requirements are requirements for AI systems derived from ethical principles or ethical codes (norms). They are akin to Legal Requirements, i.e., requirements derived from laws and regulations.” Ethical requirements are drawn from stakeholders in the form of principles and codes. From these, specific requirement statements are derived. “For example, from the Principle of Autonomy one may derive “Respect for a person’s privacy”, and from that an ethical requirement “Take a photo of someone only after her consent” (Ibid; p.252).

An important distinction between the idea of ethical codes as standards of conduct and ethical codes as requirements is that in the former case, the AI is treated as an ethical agent can reason and act on the basis of ethical principle, while in the latter case, the AI is not. “Rather, they are software systems that have the functionality and qualities to meet ethical requirements, in addition to other requirements they are meant to fulfill” (Ibid; p.252).

### ***As Opposed to Legal Requirements***

We stated above that “ethics is not the same as the law”. This is a case where that principle applies. What we are interested in here is the sense of an ethical code as a principle of ethics, not as a legal document. It reflects the fact that a person chooses a profession for themselves, and thereby voluntarily enters into a set of obligations characterized by that

profession. “Professions must be ‘professed’ (that is, declared or claimed)” (Davis, 2010; p.232).

Thus we may say that ethics may be influenced by, but are distinct from, the following (all from Government of New Zealand, 2018):

- Fiduciary duties – fiduciary duties are “special obligations between one party, often with power or the ability to exercise discretion that impacts on the other party, who may be vulnerable” (Wagner Sidlofsky, 2020). Examples of fiduciary relations include those between lawyer and client, trustee and beneficiary, director and company, power of attorney and beneficiary and accountant and client.
- Contractual obligations – these require the professional to perform the terms of the contract, and “includes a duty to act with diligence, due care and skill, and also implies obligations such as confidentiality and honesty” (New Zealand, 2018).
- Other laws – for example, In New Zealand this could include the Consumer Guarantees Act 1993.

What distinguishes legal requirements, arguably, from ethical principles is the element of choice. In the case of legal requirements, the law compels you to behave in a certain way, with increasing penalties for non-compliance. In an important sense, it doesn’t matter whether the law or the principle in question is ethical or not. You are penalized if you do not comply.

It may be argued that the relation between ethics and law is such that in a treatment of the ethics of learning analytics we ought also to be concerned with the law in relation to learning analytics. We will see this come up in two ways: first, in the argument that “obeying the law” is part of the ethical responsibility of a practitioner, and second, in the argument that the law regarding learning analytics is or ought to be informed by ethical principles.

### ***Principles and Values***

“Values are general moral obligations while principles are the ethical conditions or behaviors we expect” (Gilman, 2005; p.10). Values and principles are connected. As Terry Cooper (1998:12) explains, “An ethical principle is a statement concerning the conduct or state of being that is required for the fulfillment of a value; it explicitly links a value with a general mode of action.” For example, we may state that we value “justice”, but we would need a principle like “treat equals equally and unequals unequally” to explain what we mean by “justice”.

All ethics codes encompass both principles and values, though (as we shall see below) usually more implicitly than explicitly. Values (such as honesty and trustworthiness) are

often assumed tacitly, as not needing to be stated. Sometimes they are expressed in a preamble to the code, not as an explicit list, but rather in the sense of establishing a context. For example, the Canadian Code of Public Service ethical code has a preamble describing the role of the public service, as well as a listing of the fundamental values (TBS, 2011).

### ***The Value of Professional Codes***

Codes of professional ethics or conduct are widely used. They bring a utilitarian value to the conversation. They provide a framework for professionals carrying out their responsibilities. They clearly articulate unacceptable conduct. And they provide a vision toward which a professional may be striving (Gilman, 2005; p.5). Having a code, it is argued, is key to the prevention of unacceptable conduct. That's why, for example, the United Nations Convention Against Corruption included a public service code of conduct as an essential element in corruption prevention, says Gilman (Ibid). Yet the convention is an interesting example: there is no code of conduct for the private sector. Why?

At the same time, it is argued that "Codes are not designed for 'bad' people, but for the persons who want to act ethically" (Ibid; p.7). That is, they provide guidance for a person who wants to act ethically, but who may not know what is right. Therefore, codes are preventative only in the sense that they prevent conduct that is accidentally unacceptable. They may seem to be unnecessary in the case of a well-developed profession and body of professionals, but in a new environment, such as data analytics in education, there is much that is not yet clearly and widely understood.

Moreover, argues Gilman, a code of ethics will change the behaviour of bad actors, even if it does not incline them toward good. "When everyone clearly knows the ethical standards of an organization they are more likely to recognize wrongdoing; and do something about it. Second, miscreants are often hesitant to commit an unethical act if they believe that everyone else around them knows it is wrong. And, finally corrupt individuals believe that they are more likely to get caught in environments that emphasize ethical behavior." (Ibid; p.8)

### ***Study of Ethical Codes***

More than 70 ethical codes were studied as a part of this review. The selection methodology undertaken was designed to encourage as wide a range of ethical codes as possible. To begin, ethical codes referenced in relevant metastudies (such as) were evaluated. Codes referenced by these ethical codes were studied, to establish a history of code development within a discipline. Documents from relevant disciplinary associations were studied, to find more ethical codes. The selection of ethical codes includes the following major disciplinary groups (and the number of individual codes studied).

## **Ethical Codes and Learning Analytics**

- Professional ethics – broad-based ethical codes (4);
- Academic ethics – codes of conduct for professors and staff in traditional academic institutions (3);
- Teacher ethics – codes governing teachers and the teaching profession (7);
- Ethics for librarians and information workers – ethics of information management (2);
- Public service ethics – codes of conduct for government employees (2);
- Research ethics – includes international declarations and government policy (6);
- Health care ethics – including codes for doctors and nurses (6);
- Ethics in social science research – research ethics (1);
- Data ethics – government and industry declarations on the use of study and survey data (7);
- Market research ethics – codes describing the ethical use of data in advertising and market studies (2);
- Journalism ethics – codes of conduct governing the use of public information by journalists (3);
- Ethics for IT professionals – system administration and software development ethics (3);
- Data research ethics – related specifically to the use of data in research (1);
- Ethics for artificial intelligence – government, industry and academic codes (15);
- Information and privacy – principles specifically addressing individual rights (1);
- Ethics in educational research – policies governing educational researchers specifically (3);
- Ethics in learning analytics – government, academic and industry guidelines and codes (7).

### ***How the Codes Differ***

Metcalf (2014) identifies a number of the reasons ethical codes vary across professions, and even within professions (quotes in the list below are all from Metcalf):

- Motivation: The events that prompt the development of ethical codes; for example, “in biomedicine, ethics codes and policies have tended to follow scandals” while by contrast “major policies in computing ethics have presaged many of the issues that are now experienced as more urgent in the context of big data.”
- Purpose: “Analyses of ethics codes note a wide range of purposes for ethics codes (Frankel, 1998; Gaumintz and Lere, 2002; Kaptein and Wempe, 1998).”
- Interests: “Frankel (1989) notes that all ethics codes serve multiple interests and therefore have multiple, sometimes conflicting, dimensions. He offers a taxonomy of aspirational, educational, and regulatory codes.”

## **Ethical Codes and Learning Analytics**

- Burden: who does the ethical code apply to? Metcalf notes that “greater burdens are placed on individual members to carry out the profession’s ethical agenda,” but different burdens may fall on different groups of people.
- Enforcement: “Organizations, institutions and communities tend to develop methods of enforcement that reflect their mission.”

Each code of ethics was subjected to an analysis that includes the following criteria:

- What ethical issues is it attempting to address (for example, is focused on malpractice, on conflict of interest, on violation of individual rights, etc.)?
- What are its core values or highest priorities (as opposed to the detailed specification of ethical principles described, as defined by Cooper (1998; p.12), Gilman (2005; p.10))?
- Which ethical issues from the literature of learning analytics issues do they address?
- Who is governed, and to whom are they obligated? (e.g., AITP (2017) list six separate groups to which information professionals have obligations).
- What is the basis (if any) for the statement of ethical values and principles (for example, the Royal Society’s recommendations are based in a “public consultation” (Drew, 2018)), while numerous other statements are based in principles such as “fairness” and “do no harm”.

## **Applications of Learning Analytics**

Analytics is thought of generally as “the science of examining data to draw conclusions and, when used in decision making, to present paths or courses of action.” (Picciano, 2012). This includes not only the collection of the data but also the methods of preparation and examination employed, and the application of the data in decision-making. Thus the term *analytics* can be thought of as the overall process of “developing actionable insights through problem definition and the application of statistical models and analysis against existing and/or simulated future data” (Cooper, 2012).

The focus of this paper is the use of analytics as applied to learning and education (typically called *learning analytics*). Learning analytics is typically defined in terms of its objective, which is to improve the chance of student success (Gasevic, Dawson, & Siemens, 2015). Accordingly, when founding the Society for Learning Analytics (SoLAR) George Siemens defined learning analytics as “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs” (Siemens, 2012).

We apply a broad definition of learning analytics. A wider definition not only avoids the difficulties of establishing a more narrow definition, but also ensures we do not disregard potential ethical implications simply because the practice is “outside the scope of learning



analytics”. Arguing for a broader definition of analytics necessarily leads us to consider including artificial intelligence (AI) in the conversation. However you define the terms, artificial intelligence plays a significant role in analytics, and vice versa, so we will treat them together as one thing (Adobe Experience Cloud Team, 2018). If a distinction is necessary during the course of the discussion, we will apply it.

Potential applications of learning analytics are based on what analytics can do and how they work. Modern analytics is based mostly in machine learning and neural networks, and these in turn provide algorithms for pattern recognition, regression, and clustering. Built on these basic capabilities are four widely-used categories (Brodsky et al., 2015; Boyer & Bonnin, 2017) to which we add additional fifth and sixth categories, generative analytics and deontic analytics:

- descriptive analytics, answering the question “what happened?”;
- diagnostic analytics, answering the question “why did it happen?”;
- predictive analytics, answering the question “what will happen?”;
- prescriptive analytics, answering the question “how can we make it happen?”; and
- generative analytics, which use data to create new things, and
- deontic analytics, answering the question “what should happen?”.

Within each of these categories we can locate the various applications that fall under the heading “learning analytics”.

### ***Descriptive Analytics***

Descriptive analytics include analytics focused on description, detection and reporting, including mechanisms to pull data from multiple sources, filter it, and combine it. The output of descriptive analytics includes visualizations such as pie charts, tables, bar charts or line graphs. Descriptive analytics can be used to define key metrics, identify data needs, define data management practices, prepare data for analysis, and present data to a viewer. (Vesset, 2018). Tracking is an important part of descriptive analytics. The purpose of tracking is to measure systems performance and institutional compliance. Relative costs and benefits are compared to find the most cost-effective solution (Ware et al., 1973; p.9).

Higher education institutions also use descriptive analytics to construct student profiles. A person’s learning activities, for example, can be graphed and displayed in comparison with other learners. This analysis can contain fine-grained detail, for example, attention metadata (Duval, 2011). Today, a standardized format, the Experience API, is used to collect and store activity data in a Learning Record Store (LRS) (Corbí & Solans, 2014; Kevan & Ryan, 2016). These support dashboards such as LAViEW (Learning Analytics Visualizations & Evidence Widgets) that helps learners analyse learning logs and provide evidence of learning. (Majumdar et al., 2019)

Similar functionality is also provided by IMS Global's Caliper learning analytics (Oakleaf et al., 2017)

### ***Diagnostic Analytics***

Diagnostic analytics look more deeply into data in order to detect patterns and trends. Such a system could be thought of as being used to draw an inference about a piece of data based on the patterns detected in sample or training data, for example, to perform recognition, classification or categorization tasks. Diagnostic analytics are applied in a wide range of applications.

Security applications are common. To support physical security, facial and object recognition technology is being used in schools and institutions. For example, a New York school district is using an application called AEGIS to identify potential threats (Klein, 2020). For digital security, analytics applications that help filter unwanted messages (whether sent by humans or bots) are generally available and widely used. Users can learn to train their own machine learning to filter spam (Gan, 2018) or use commercial systems such as Akismet (Barron, 2018). Automated fakes detection systems are becoming more widely used (Li & Lyu, 2019).

Diagnostic analytics is also employed to ensure academic discipline. Pattern recognition, for example, is used for plagiarism detection Amigud et al. (2017). Video recognition and biometrics are also used for security purposes and exam proctoring (Rodchua, 2017). "For instance, Examity also uses AI to verify students' identities, analyze their keystrokes, and, of course, ensure they're not cheating. Proctorio uses artificial intelligence to conduct gaze detection, which tracks whether a student is looking away from their screens" (Heilweil, 2020).

There is a large literature devoted to automated grading, beginning with Page (1966), continuing through the Hewlett competition (Kaggle, 2012), and today the technology has at least "developed to the point where the systems provide meaningful feedback on students' writing and represent a useful complement (not replacement) to human scoring" (Kaja & Bosnic, 2015). Ultimately, AI could replace grading altogether. Rose Luckin argues, "logging every keystroke, knowledge point and facial twitch, then the perfect record of their abilities on file could make such testing obsolete" (Beard, 2020). This creates the possibility of assessing competencies from actual performance data outside educational environments, for example, using technologies like analytics-based assessment of personal portfolios (van der Schaaf et al., 2017) or using data-driven skills assessment in the workplace (Lin et al., 2018).

***Predictive Analytics***

Numerous products and studies are based on the idea that “analytics tools can identify factors statistically correlated with students at risk of failing or dropping out.” (Scholes, 2016; Gasevic, Dawson, & Siemens, 2015). For example, a Jisc report describes several such projects, including one at New York Institute of Technology (NYIT) that used four data sources: “admission application data, registration / placement test data, a survey completed by all students, and financial data” (Sclater, Peasgood, and Mullan, 2016). Student retention is also supported by predictive analytics. Predictive analytics is also used to assist in learning design, including adaptive learning design. “Findings indicated that the primary predictor of academic retention was how teachers designed their modules, in particular the relative amount of so-called ‘communication activities’.” (Rientes & Jones, 2019; p.116)

Analytics can also draw from campus information sources to support student advising. For example, the Berkeley Online Advising (BOA, 2020) project at the University of California at Berkeley “integrates analytical insights with relationship and planning tools for advisors of large cohorts and the students they support” (Heyer & Kaskiris, 2020). Additionally, the Comprehensive Analytics for Student Success (COMPASS) project at the University of California, Irvine, “focuses on bringing relevant student data to campus advisors, faculty, and administrators... to improve undergraduate student outcomes” (UCI Compass, 2020). As O’Brien (2020) writes, “These tools provide advisors with information that allows for proactive outreach and intervention when critical student outcomes are not met.” Combining these approaches is an initiative called “precision education”. Yang and Ogata (2020) suggest that analogous to precision medicine, precision education systems consider a wider array of variables than learning analytics, “students’ IQ, learning styles, learning environments, and learning strategies.”

***Prescriptive Analytics***

An oft-cited application is the potential of learning analytics to make content recommendations, either as a starting point, or as part of a wider learning analytics-supported learning path. For example, the Personalised Adaptive Study Success (PASS) system supports personalisation for students at Open Universities Australia (OUA) (Sclater, Peasgood, & Mullan, 2016). Students report desiring recommendations regarding potential learning activities, and suggestions for potential learning partners. (Schumacher, 2018) Content and learning path recommendations are based not only on the discipline being studied but also on the individual learning profile, academic history, and a variety of contextual factors. (Ifenthaler & Widanapathirana, 2014)

Adaptive learning is a step beyond learning recommendations in the sense that the learning environment itself changes (or “adapts”) to events in the learning experience (Sonwalkar, 2007). For example, “Adaptive learning systems – like IBM Watson and Microsoft Power BI – have the advantage of continually assessing college students’ skill and confidence levels.” (Neelakantan, 2019). Early adaptive learning applications were expert systems based on explicit knowledge representations and user models, that is, they were based on statements and rules (Garrett & Roberts, 2004). More recently, the “black box” methods characteristic of contemporary analytics, such as neural networks, have been employed (Almohammadi et al., 2017).

### **Generative Analytics**

Generative analytics is different from the previous four categories in the sense that it is not limited to answering questions like “what happened” or “how can we make it happen”, but instead uses the data to create something that is genuinely new. In a sense, it is like predictive and prescriptive analytics in that it extrapolates beyond the data provided, but while in the former two we rely on human agency to act on the analytics, in the case of generative analytics the analytics engine takes this action on its own.

In addition to emulating human conversation, chatbots will generate additional human responses, such as gestures and emotions. For example, there’s Magic Leap’s Mica, an AI-driven being “that comes across as very human” (Craig, 2018). “What is remarkable about Mica is not the AI, but the human gestures and reactions (even if they are driven by AI).” Meanwhile, though “fictionalized and simulated for illustrative purposes only”, products like Samsung’s Neon are being called “artificial humans”, “a computationally created virtual being that looks and behaves like a real human, with the ability to show emotions and intelligence.” (Craig, 2020)

Analytics engines, provided with data, can generate content. The Washington Post uses an AI called Heliograf to write news and sports articles; in its first year it wrote around 850 items. “That included 500 articles around the election that generated more than 500,000 clicks.” (Moses, 2017) Analytics and AI have self-generated computer science papers (Stribling et al., 2005), music (Galeon, 2016), art (Shepherd, 2016), books (Springer Nature, 2019) and inventions (Fleming, 2018). There are now commercial AI-based applications that generate educational resources, including articles (e.g., AiWriter), textbooks, test questions (e.g. WeBuildLearning), and more.

Such technology can make educational content more interesting and engaging. For example, In 2015, an algorithm called DeepStereo developed for Google Maps was able to generate a video from a series of still photographs (Flynn et al., 2015). Also, “With deep fakes, it will be possible to manufacture videos of historical figures speaking directly to

students, giving an otherwise unappealing lecture a new lease on life” (Chesney & Citron, 2018; p.1769). Chesney and Citron write, “The educational value of deep fakes will extend beyond the classroom. In the spring of 2018, BuzzFeed provided an apt example when it circulated a video that appeared to feature Barack Obama warning of the dangers of deep-fake technology itself. One can imagine deep fakes deployed to support educational campaigns by public-interest organizations such as Mothers Against Drunk Driving (Chesney & Citron, 2018; p.1770).

It may seem far-fetched, but some pundits are already predicting the development of artificial intelligences and robots teaching in the classroom. In a recent celebrated case, a professor fooled his students with Jill Watson, an artificial tutor (Miller, 2016). “Yuki’, the first robot lecturer, was introduced in Germany in 2019 and has already started delivering lectures to university students at The Philipps University of Marburg.” (Ameen, 2019). While most observers still expect AI and analytics to be limited to a support role, these examples suggest that the role of artificial teachers might be wider than expected.

### ***Deontic Analytics***

There is an additional question that needs to be answered, and has been increasingly entrusted to analytics: “what ought to happen?” Recently the question has been asked with respect to self-driving vehicles in the context of Philippa Foot’s “trolley problem”. (Foot, 1967). In a nutshell, this problem forces the reader to decide whether to take an action to save six and kill one, or to desist from action to save one, allowing (by inaction) six to be killed. It is argued that automated vehicles will face similar problems.

It may be argued that these outcomes are defined ahead of time by human programmers. But automated systems have an impact on what content is acceptable (and what is not) in a society. We see this in effect on online video services. “On both YouTube and YouTube Kids, machine learning algorithms are used to both recommend and mediate the appropriateness of content” (UC Berkeley Human Rights Center Research, 2019). Though such algorithms are influenced by input parameters, their decisions are always more nuanced than designed, leading people to adapt to the algorithm, thereby redefining what is acceptable.

What counts as “appropriate” behaviour may be shaped by analytics and AI. These and additional implications are being investigated by HUMAINT, “an interdisciplinary JRC project aiming to understand the impact of machine intelligence on human behaviour, with a focus on cognitive and socio-emotional capabilities and decision making” (Tuomi, 2018; HUMAINT, 2020). An AI can select between what might be called “good” content and “bad” content, displaying a preference for the former. For example, in response to violence in conflict zones, researchers “argue the importance of automatic identification

of user-generated web content that can diffuse hostility and address this prediction task, dubbed ‘hope-speech detection’” (Palakodety et al., 2019).

There is another line of research that proposes that AI can define what’s fair. An early example of this is software designed to optimize the design of congressional voting districts in such a way that minimizes gerrymandering (Cohen-Addad, Klein, & Young, 2018). In another study, research suggested that “an AI can simulate an economy millions of times to create fairer tax policy” (Heaven, 2020). A tool developed by researchers at Salesforce “uses reinforcement learning to identify optimal tax policies for a simulated economy.” The idea in this case was to find tax policy that maximized productivity and income equality in a model economy.

It should be noted that discussion of generative and deontic analytics lie outside most traditional accounts of analytics and ethics. And it is precisely in these wider accounts of analytics that our relatively narrow statements of ethical principles are lacking. It is possible to apply analytics correctly and yet still reach a conclusion that would violate our moral sense. And it is possible to use analytics correctly and still do social and cultural harm. An understanding of ethics and analytics may begin with ethical principles, but it is far from ended there.

## **Ethical Issues in Learning Analytics**

We will follow Narayan (2019), who classifies the ethical issues in learning analytics under three headings: issues that arise when analytics works, issues that arise because analytics are not yet reliable, and issues that arise in cases where the use of analytics seems fundamentally wrong. To these three sets of issues we will add a fourth describing wider social and cultural issues that arise with the use of analytics and AI, and a set of issues related specifically to bad actors.

Many of these issues will be familiar to readers, for example, the potential misuse of facial recognition, surveillance and tracking, AI-based assessment, misrepresentation and prejudice, explainability, filter bubbles and feedback effects. Others are less frequently discussed but raised equally serious ethical issues, for example, the mechanisms for appealing AI-based evaluations, systems consistency reliability, stalking, alienation, network effects (i.e., winner takes all), and environmental impact.

### ***When Analytics Works***

Modern AI and analytics work. As Mark Liberman (2019) observes, “Modern AI (almost) works because of machine learning techniques that find patterns in training data, rather than relying on human programming of explicit rules.” This is in sharp contrast to earlier rule-based approaches that “generally never even got off the ground at all.”

Analytics and AI require data above all, and so in order to support this need institutions and industries often depend on surveillance. However, “when in wrong hands, these systems can violate civil liberties.” (UC Berkeley, 2019) Once surveillance becomes normal, its use expands (Marx, 2020). Private actors, as well, employ surveillance for their own purposes. For example, Amazon-owned Whole Foods is tracking its employees with a heat map tool that ranks stores most at risk of unionizing (Peterson, 2020). Analytics makes tracking accessible to everyone. “Miniature surveillance drones, unseen digital recognition systems, and surreptitious geolocational monitoring are readily available, making long-term surveillance relatively easy and cheap” (Cavoukian, 2013; p.23).

Analytics also erodes our ability to be anonymous. This is partially because of spying and tracking, and partially because data about individuals can be cross-referenced. “When Facebook acts as a third-party tracker, they can know your identity as long as you’ve created a Facebook account and are logged in – and perhaps even if you aren’t logged in” (Princiya, 2018). And analytics arguably creates a social need to eliminate anonymity. As Bodle argues, “A consensus is growing among governments and entertainment companies about the mutual benefits of tracking people online.” Hence, provisions against anonymity, he argues, are being built into things like trade agreements and contracts.

Recent debate has focused on the use of facial recognition technologies, with IBM, Microsoft and Amazon all announcing they will cease efforts. A startup called Clearview AI makes the risk clear. “What if a stranger could snap your picture on the sidewalk then use an app to quickly discover your name, address and other details? has made that possible” (Moyer, 2020). Mark Andrejevic and Neil Selwyn (2019) outline a number of additional ethical concerns involving facial recognition technology in schools: the dehumanising nature of facially focused schooling, the foregrounding of students’ gender and race, the increased authoritarian nature of schooling, and more.

The previous sections each raise their own issues, but all touch on the issue of privacy generally. While it may be argued that privacy protects the powerful, at the expense of the weaker (Shelton (2017), “Personal privacy is about more than secrecy and confidentiality. Privacy is about being left alone by the state and not being liable to be called to account for anything and everything one does, says or thinks” (Cavoukian, 2013; p.18). We might say people should be able to live their lives in “quiet enjoyment” of their possessions, property and relationships (Andresi, 2019).

In education learning analytics used for assessment can score student work with accuracy and precision. Students recognize this. But students have mixed feelings about such systems, preferring “comments from teachers or peers rather than computers.” (Roscoe et al., 2017) It is arguable that students may prefer human assessment because they may

feel more likely to be seen as an individual with individual flair, rather than erroneously deviating from the expectations of the analytics engine. As one college official says, “Everyone makes snap judgments on students, on applicants, when first meeting them. But what worries me about AI is AI can’t tell the heart of a person and the drive a person has.”

Humans often use discretion when applying the rules. “Organizational actors establish and re-negotiate trust under messy and uncertain analytic conditions” (Passi & Jackson, 2018) In the case of learning analytics, Zeide (2019) writes that a human instructor might overlook a student’s error “if she notices, for example, that the student clearly has a bad cold.” By contrast, “Tools that collect information, particularly based on online interactions, don’t always grasp the nuances.” The impact of a lack of discretion is magnified by uncertainties in the data that might be recognized by a human but overlooked by the machine (Passi & Jackson, 2018; Malouff & Thorsteinsson, 2016). There is a need for a principle of “remedy for automated decision” that is “fundamentally a recognition that as AI technology is deployed in increasingly critical contexts, its decisions will have real consequences, and that remedies should be available just as they are for the consequences of human actions” (Fjeld et al., 2020; p.33).

Analytics can also be used to create misleading images and videos (Chesney & Citron, 2018; p.1760) write “To take a prominent example, researchers at the University of Washington have created a neural network tool that alters videos so speakers say something different from what they originally said.” There are numerous unethical uses of content manipulation, including exploitation, sabotage, harm to society, distortion of discourse, manipulation of elections, erosion of trust, exacerbation of divisions, undermining of public safety, and undermining journalism (Ibid; pp.1772-1786).

A number of recent high-profile cases have raised the possibility of analytics being used to (illegitimately?) manipulate the thoughts, feelings and emotions of users. For example, one study experimented on Facebook users (without their knowledge or consent) to show that “emotional states can be transferred to others via emotional contagion, leading people to experience the same emotions without their awareness” (Kramer, Guillory, & Hancock, 2014). An article from RAND suggests, “Whoever is first to develop and employ such systems could easily prey on wide swaths of the public for years to come” (Paul & Posard, 2020).

Manipulation of the user can be used for beneficial purposes, as described above. However it becomes ethically problematic when the institution, rather than the user, benefits. As Kleber (2018) writes, “Casual applications like Microsoft’s XiaoIce, Google Assistant, or Amazon’s Alexa use social and emotional cues for a less altruistic purpose – their aim is to



secure users' loyalty by acting like new AI BFFs. Futurist Richard van Hooijdonk quips: "If a marketer can get you to cry, he can get you to buy." Moreover, Kleber continues, "The discussion around addictive technology is starting to examine the intentions behind voice assistants. What does it mean for users if personal assistants are hooked up to advertisers? In a leaked Facebook memo, for example, the social media company boasted to advertisers that it could detect, and subsequently target, teens' feelings of 'worthlessness' and 'insecurity', among other emotions (Levin, 2017)".

Schneier (2020) writes, "The point is that it doesn't matter which technology is used to identify people... The whole purpose of this process is for companies – and governments – to treat individuals differently." In many cases, differential treatment is acceptable. However, in many other cases, it becomes subject to ethical concerns. The accuracy of analytics creates an advantage for companies in a way that is arguably unfair to consumers. For example, the use of analytics data to adjust health insurance rates (Davenport & Harris, 2007) works in favour of insurance companies, and thereby, arguably, to the disadvantage of their customers. Analytics are used similarly in academics, sometimes before the fact, and sometimes after. For example, in a case where failure was determined by predicted learning events, the "Mount St. Mary's University... president used a survey tool to predict which freshman wouldn't be successful in college and kicked them out to improve retention rates" (Foresman, 2020).

### ***When it doesn't***

Artificial Intelligence and analytics often work and as we've seen above can produce significant benefits. On the other hand, as Liberman comments (2019), AI is brittle. When the data are limited or unrepresentative, it can fail to respond to contextual factors our outlier events. It can contain and replicate errors, be unreliable, be misrepresented, or even defrauded. In the case of learning analytics, the results can range from poor performance, bad pedagogy, untrustworthy recommendations, or (perhaps worst of all) nothing at all.

Analytics can fail because of error, and this raises ethical concerns. "Analytics results are always based on the data available and the outputs and predictions obtained may be imperfect or incorrect. Questions arise about who is responsible for the consequences of an error, which may include ineffective or misdirected educational interventions" (Griffiths et al., 2016; p.4).

Analytics requires reliable data, "as distinguished from suspicion, rumor, gossip, or other unreliable evidence" (Emory University Libraries, 2019). Meanwhile, a "reliable" system of analytics is one without error and which can be predicted to perform consistently, or in other words, "an AI experiment ought to 'exhibit the same behavior when repeated under the same conditions' and provide sufficient detail about its operations that it may be

validated (Fjeld et al., 2020; p.29; Slade & Tait, 2019). Both amount to a requirement of “verifiability and replicability” of both data and process.

Additionally, the reliability of models and algorithms used in analytics “concerns the capacity of the models to avoid failures or malfunction, either because of edge cases or because of malicious intentions. The main vulnerabilities of AI models have to be identified, and technical solutions have to be implemented to make sure that autonomous systems will not fail or be manipulated by an adversary” (Hamon, Junklewitz, & Sanchez, 2020; p.2). But it is not yet clear that learning analytics are reliable (Contact North, 2018). For example, inconsistency can magnify ethical issues, especially in real-time analytics. “‘When the facts change, I change my mind’ can be a reasonable defence: but in order to avoid less defensible forms of inconsistency, changing your mind about one thing may require changing it about others also” (Boyd, 2019).

Additionally, there are widespread concerns about bias in analytics. In one sense, it is merely a specific way analytics can be in error or unreliable. But more broadly, the problem of bias pervades analytics: it may be in the data, in the collection of the data, in the management of the data, in the analysis, and in the application of the analysis. The outcome of bias is reflected in misrepresentation and prejudice. For example, “the AI system was more likely to associate European American names with pleasant words such as ‘gift’ or ‘happy’, while African American names were more commonly associated with unpleasant words.” (Devlin, 2017) “The tales of bias are legion: online ads that show men higher-paying jobs; delivery services that skip poor neighborhoods; facial recognition systems that fail people of color; recruitment tools that invisibly filter out women” (Powles & Nissenbaum, 2018).

Another source of error is misinterpretation. Because analytical engines don’t actually know what they are watching, they may see one thing and interpret it as something else. For example, looking someone in the eyes is taken as a sign that they are paying attention. And so that’s how an AI interprets someone looking straight at it. But it might just be the result of a student fooling the system. For example, students being interviewed by AI are told to “raise their laptop to be eye level with the camera so it appears they’re maintaining eye contact, even though there isn’t a human on the other side of the lens” (Metz, 2020). The result is that the AI misinterprets laptop placement as “paying attention”.

There is a risk, writes Ilkka Tuomi (2018), “that AI might be used to scale up bad pedagogical practices. If AI is the new electricity, it will have a broad impact in society, economy, and education, but it needs to be treated with care.” For example, badly constructed analytics may lead to evaluation errors. “Evaluation can be ineffective and even harmful if naively done ‘by rule’ rather than ‘by thought’” (Dringus, 2012). Even more

concerning is how poorly designed analytics could result in poorly defined pedagogy. Citing Bowker and Star (1999), Buckingham Shum and Deakin Crick (2012) argue that “a marker of the health of the learning analytics field will be the quality of debate around what the technology renders visible and leaves invisible, and the pedagogical implications of design decisions.”

### ***Social and Cultural Issues***

This is a class of issues that addresses the social and cultural infrastructure that builds up around analytics. These are not issues with analytics itself, but with the way analytics changes our society, our culture, and the way we learn.

Analytics is ethically problematic in society when it is not transparent. When a decision-making system is opaque, it is not possible to evaluate whether it is making the right decision. You might not even know the decision was made by a machine. Analytics requires a “principle of notification” (Fjeld et al., 2020; p.45). Additionally, transparency applies to the model or algorithm applied in analytics. “Transparency of models: it relates to the documentation of the AI processing chain, including the technical principles of the model, and the description of the data used for the conception of the model. This also encompasses elements that provide a good understanding of the model, and related to the interpretability and explainability of models” (Hamon, Junklewitz, & Sanchez, 2020; p.2).

Explainability is closely related to transparency. In the case of analytics, explainability seems to be inherently difficult. We’re not sure whether we’ll be able to provide explanations. Zeide (2019) writes, “Unpacking what is occurring within AI systems is very difficult because they are dealing with so many variables at such a complex level. The whole point is to have computers do things that are not possible for human cognition.” As Eckersley et al. (2017) say, “Providing good explanations of what machine learning systems are doing is an open research question; in cases where those systems are complex neural networks, we don’t yet know what the trade-offs between accurate prediction and accurate explanation of predictions will look like.”

Numerous agencies have announced efforts to ensure that automated decisions are “accountable” (Rieke, Bogen, & Robinson, 2018). But the nature of AI might make accountability impossible. “Suppose every single mortgage applicant of a given race is denied their loan, but the Machine Learning engine driving that decision is structured in such a way that the relevant engineers know exactly which features are driving such classifications. Further suppose that none of these are race-related. What is the company to do at this point?” (Danzig, 2020).

What we don't know might hurt us. The UK House of Lords Select Committee notes that "The use of sophisticated data analytics for increasingly targeted political campaigns has attracted considerable attention in recent years, and a number of our witnesses were particularly concerned about the possible use of AI for turbo-charging this approach" (Clement-Jones et al, 2018; para260). One example is the use of bot Twitter accounts to sow division during the Covid-19 pandemic. "More than 100 types of inaccurate COVID-19 stories have been identified, such as those about potential cures. But bots are also dominating conversations about ending stay-at-home orders and 'reopening America,' according to a report from Carnegie Mellon (Young, 2020)".

An ethical issue here arises because "information is filtered before reaching the user, and this occurs silently. The criteria on which filtering occurs are unknown; the personalization algorithms are not transparent" (Bozdag & Timmermans, 2011). Additionally, "We have different identities, depending on the context, which is ignored by the current personalization algorithms" (Ibid). Moreover, algorithms that drive filter bubbles may be influenced by ideological or commercial considerations (Introna & Nissenbaum, 2000; p.177). The eventual consequence may be disengagement and alienation. "Will Hayter, Project Director of the Competition and Markets Authority, agreed: '... the pessimistic scenario is that the technology makes things difficult to navigate and makes the market more opaque, and perhaps consumers lose trust and disengage from markets'" (Clement-Jones et al, 2018; para52).

Artificial intelligence and analytics impose themselves as a barrier between one person and another, or between one person and necessary access to jobs, services, and other social, economic and cultural needs. Consider the case of a person applying for work where analytics-enabled job applicant screening is being used. However, "La difficulté, pour les candidats pris dans les rets de ces systèmes de tris automatisés, est d'en sortir, c'est-à-dire se battre contre les bots, ces gardiens algorithmiques, pour atteindre une personne réelle capable de décider de son sort (The difficulty for candidates caught in the nets of these automated sorting systems is to get out of them, that is, to fight against bots, those algorithmic guardians, to reach a real person capable of deciding on their exit)" (Guillaud, 2020).

There are ethical issues around the question of inclusion and exclusion in analytics. Most often, these are put in the form of concerns about biased algorithms. But arguably, the question of inclusion in analytics ought to be posed more broadly. For example, Emily Ackerman (2019) reports of having been in a wheelchair and blocked from existing an intersection by a delivery robot waiting on the ramp. This isn't algorithmic bias per se but clearly the use of the robot excluded Ackerman from an equal use of the sidewalk.

New types of artificial intelligence lead to new types of interaction. In such cases, it is of particular importance to look at the impact on traditionally disadvantaged groups. “There is increasing recognition that harnessing technologies such as AI to address problems identified by working with a minority group is an important means to create mainstream innovations. Rather than considering these outcomes as incidental, we can argue that inclusive research and innovation should be the norm” (Coughlan et al., 2019a; p.88).

Above, we discussed the ethics of surveillance itself. Here, we address the wider question of the surveillance culture. This refers not only to specific technologies, but the creation of a new social reality. “Focusing on one particular identification method misconstrues the nature of the surveillance society we’re in the process of building. Ubiquitous mass surveillance is increasingly the norm” (Schneier, 2020). Whether in China, where the infrastructure is being built by the government, or the west, where it’s being built by corporations, the outcome is the same.

What we are finding with surveillance culture is the “elasticity” of analytics ethics (Hamel, 2016) as each step of surveillance stretches what we are willing to accept a bit and makes the next step more inevitable. The uses of streetlight surveillance are allowed to grow (Marx, 2020). Surveillance becomes so pervasive it becomes impossible to escape its reach. (Malik, 2019). And nowhere is this more true than in schools and learning. The goal is “to connect assessment, enrollment, gradebook, professional learning and special education data services to its flagship student information system” (Wan, 2019). Or, as Peter Greene (2019) says, “PowerSchool is working on micromanagement and data mining in order to make things easier for the bosses. Big brother just keeps getting bigger, but mostly what that does is make a world in which the people who actually do the work just look smaller and smaller.”

Audrey Watters captures the issue of surveillance culture quite well. It’s not just that we are being watched, it’s that everything we do is being turned into data for someone else’s use – often against us. She says “These products – plagiarism detection, automated essay grading, and writing assistance software – are built using algorithms that are in turn built on students’ work (and often too the writing we all stick up somewhere on the Internet). It is taken without our consent. Scholarship – both the content and the structure – is reduced to data, to a raw material used to produce a product sold back to the very institutions where scholars teach and learn.” (Watters, 2019). As Watters writes, “In her book *The Age of Surveillance Capitalism*, Shoshana Zuboff calls this ‘rendition,’ the dispossession of human thoughts, emotions, and experiences by software companies, the reduction of the complexities and richness of human life to data, and the use of this data to build algorithms that shape and predict human behavior.”

The products that depend on analytics engines – plagiarism detection, automated essay grading, and writing assistance software – are built using algorithms that are in turn built on students' work. And this work is often taken without consent, or (as the lawsuit affirming TurnItIn's right to use student essays) consent demanded as an educational requirement (Masnick, 2008). And "Scholarship – both the content and the structure – is reduced to data, to a raw material used to produce a product sold back to the very institutions where scholars teach and learn." (Watters, 2019) And in a wider sense, everything is reduced to data, and the value of everything becomes the value of that data. People no longer simply create videos, they are "influencers". Courses are no longer locations for discussion and learning, they produce "outcomes".

There is the sense that analytics and AI cannot reason, cannot understand, and therefore cannot know the weight of their decisions. This, somehow, must be determined. But as Brown (2017) asks, "Who gets to decide what is the right or wrong behaviour for a machine? What would AI with a conscience look like?" On the other hand, perhaps AI can learn the difference between right and wrong for itself. Ambarish Mitra (2018) asks, "What if we could collect data on what each and every person thinks is the right thing to do? ... With enough inputs, we could utilize AI to analyze these massive data sets – a monumental, if not Herculean, task – and drive ourselves toward a better system of morality... We can train AI to identify good and evil, and then use it to teach us morality." The danger in this is that people may lose the sense of right and wrong, and there are suggestions that this is already happening. Graham Brown-Martin argues, for example, "At the moment within social media platforms we are seeing the results of not having ethics, which is potentially very damaging." (Clement-Jones et al, 2018; para247). Do right and wrong become what the machine allows it to be? This is perhaps the intuition being captured by people who are concerned that AI results in a loss of humanity. And when we depend on analytics to decide on right and wrong, what does that do to our sense of morality?

While it may be intuitive to argue that human designers and owners ought to take responsibility for the actions of an AI, arguments have been advanced suggesting that autonomous agents are responsible in their own right, thereby possibly absolving humans of blame. "Emerging AI technologies can place further distance between the result of an action and the actor who caused it, raising questions about who should be held liable and under what circumstances." (Fjeld et al., 2020; p.34)

The argument from AI autonomy has a variety of forms. In one, advanced (tentatively) by the IEEE. It draws the distinction between "moral agents" and "moral patients" (or "moral subjects") to suggest that we ought to distinguish between how an outcome occurred, and the consequence of that outcome, and suggests that autonomous self-organizing systems

may operate independently of the intent of the designer (IEEE, 2016; p.196) As Bostrom and Yubkowsky (2020) write, “The local, specific behavior of the AI may not be predictable apart from its safety ,even if the programmers do everything right.” It may seem unjust to hold designers responsible in such cases.

## **Focus on Ethical Issues**

In this section we examine the ethical issues being addressed by codes of conduct. Most often these are not stated explicitly, but must be inferred from the sorts of behaviours or outcomes being expressly discussed.

### ***The Good that Can Be Done***

While ethical codes are typically thought of as identifying wrongs, in the sense of “thou shalt not”, it should be noted that many codes reference first the “good” that can be accomplished by the discipline or profession being discussed. This is especially the case in relation to data management and data research, which are new fields, and where the benefits may not be immediately obvious.

For example, while the United Kingdom Data Ethics Framework “sets out clear principles for how data should be used in the public sector,” it is with the intention to “maximise the value of data whilst also setting the highest standards for transparency and accountability when building or buying new data technology” (Gov.UK, 2018), advising researchers to “start with clear user need and public benefit.” Also in the U.K., the list of principles outlines by the House of Lords Select Committee on AI principles reflect a purpose “for the common good and benefit of humanity” including privacy rights, the right to be educated, “to flourish mentally, emotionally and economically alongside artificial intelligence” (Clement-Jones et al, 2018; para417).

Similarly, the Sorbonne Declaration (2020) points to “the benefit of society and economic development” that accrues as a result of data research. It is motivated by the good that can be done and “recognises the importance of sharing data in solving global concerns – for example, curing diseases, creating renewable energy sources, or understanding climate change” (Merett, 2020). In some cases, the emphasis is on being able to be *more* ethical. The Society of Actuaries, “AI provides many new opportunities for ethical issues in practice beyond current practices, for example, ‘black box’ decision models, masked bias, and unregulated data” (Raden, 2019; p.9), all issues that received much less attention in the days before analytics.

In the field of learning analytics, there is often an explicit linkage drawn between the use of data and benefits for students, and thereby, of helping society benefit from education generally. The Open University, for example, asserts that the purpose of collecting data

should be “to identify ways of effectively supporting students to achieve their declared study goals” (OU, 2014; p.4.2.2). The Asilomar Convention for Learning Research in Higher Education principles were based on “the promise of education to improve the human condition”, as expressed by two tenets of educational research: to “advance the science of learning for the improvement of higher education”, and to share “data, discovery, and technology among a community of researchers and educational organizations” (Stevens & Silbey, 2014).

### ***Academic or Professional Freedom***

Ethical codes frequently point to the need for freedom or autonomy for the profession. Not surprisingly, the concept of academic freedom surfaces frequently in academic codes of ethics. It is seen as something that needs to be nurtured and protected. Thus, for example, one university’s code of ethics asserts that the defence of academic freedom is an “obligation” on faculty members, stating, “it is unethical for faculty members to enter into any agreement that infringes their freedom to publish the results of research conducted within the University precincts or under University auspices... they have the obligation to defend the right of their colleagues to academic freedom. It is unethical to act so as deliberately to infringe that freedom” (SFU, 1992). Or, good practices are those that defend academic freedom (EUI, 2019).

But university professors are not alone in asserting professional independence. Researchers generally, and especially early-career researchers (ECR) “are being pressured into publishing against their ethics because of threats relating to job security” (Folan, 2020). Librarians declare that they are “explicitly committed to intellectual freedom and the freedom of access to information. We have a special obligation to ensure the free flow of information and ideas to present and future generations” (ALA, 2008). Doctors and nurses also declare the caregiver’s right to “be free to choose whom to serve, with whom to associate, and the environment in which to provide medical care” (AMA, 2001). The same assertions of independence and autonomy can be found in journalists’ code of ethics (NUJ, 2011).

### ***Conflict of Interest***

The idea that a person would use their position to personally benefit from their position of privilege or responsibility, whether directly or through the offer of gifts or benefits, is expressly prohibited by many (but by no means all) codes of ethics (CFA, 2019; IEEE, 2020; p.7.8; SFU, 1992; CPA, 2017). Different sorts of conflict of interest are mentioned by different codes of ethics.

Some codes focus on material benefits. For example, codes of ethics in the financial sector often express prohibitions against insider trading (specifically, members that “possess



material nonpublic information that could affect the value of an investment must not act or cause others to act on the information” and against “practices that distort prices or artificially inflate trading volume with the intent to mislead market participants” (CFA, 2019). Public services ethics., meanwhile, address conflict of interest as a matter of trust where the principles include “taking all possible steps to prevent and resolve any real, apparent or potential conflicts of interest,” as well as “effectively and efficiently using the public money, property and resources managed by them” (TBS 2011).

Other codes focus on integrity. We see this in professions like journalism, where “professional integrity is the cornerstone of a journalist’s credibility” (SPJ, 1996) and journalists are urged “to remain independent (and therefore avoid conflict of interest), and to be accountable” (SPJ, 2014). The primary focus of the New York Times Ethical Journalism Guidebook is avoidance of conflict of interest, and it addresses exhaustively the ways in which a journalist could be in a real or perceived conflict of interest, and counsels against them, while allowing for certain exceptions (NYT, 2018).

In education and the helping professions the codes focus on exploitation (IUPSIS, 2008; CPA, 2017; NEA, 1975; BACB, 2014; p.6; SFU, 1992; EUI, 2019; etc.). The British Columbia Teachers Federation, for example, states that “a privileged relationship exists between members and students” and stresses the importance of refraining from exploiting that relationship” (BCTF, 2020).

## ***Harm***

The prevention of harm is a theme that arises in numerous codes of ethics. Many codes trace their origins to the written principles for ethical research originating from the Nuremberg trials in 1949 that were used to convict leading Nazi medics for their atrocities during the Second World War (Kay et al., 2012). In general, research should not risk “even remote possibilities of injury, disability, or death,” nor should the harm exceed the potential benefits of the research (USHM, 2020). What counts as harm, however, varies from code to code.

Often, the nature of harm is loosely defined. Accenture’s Universal Principles for Data Ethics (Accenture, 2016; p.5) states that practitioners need to be aware of the harm the data could cause, both directly, and through the “downstream use” of data. The principles also acknowledge that data is not neutral. “There is no such thing as raw data.” The Information Technology Industry Council urges researchers to “Recognize potentials for use and misuse, the implications of such actions, and the responsibility and opportunity to take steps to avoid the reasonably predictable misuse of this technology by committing to ethics by design. (UC Berkeley, 2019)

Discrimination and human rights violations are often cited as sources of harm (IEEE, 2020; p.9.26; NEA, 1975; IFLA, 2012; NUJ, 2011; UC Berkeley, 2019; etc.). For example, the Amnesty International and Access Now “Toronto Declaration” calls on the right to redress human rights violations caused by analytics and AI. “This may include, for example, creating clear, independent, and visible processes for redress following adverse individual or societal effects,” the declaration suggests, “[and making decisions] subject to accessible and effective appeal and judicial review” (Brandom, 2018).

Several codes, by contrast, identify exemptions and cases that will not be considered harm. For example, the U.S. “Common Rule” states that research is exempt from restrictions if it is a “benign behavioral exemption”, that is, it is “brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the interventions offensive or embarrassing” (HHS, 2018; §46.104.2.C.ii).

### **Quality and Standards**

Ethical codes – especially professional ethical codes – also address issues related to quality and standards. Sometimes competence is defined simply as “stewardship and excellence” (TBS, 2011) or professionalism (CFA, 2019; BACB, 2014; p.6). Or a profession may seek to restrict practice to competent practitioners, for example, preventing assistance to a “noneducator in the unauthorized practice of teaching” and preventing “any entry into the profession of a person known to be unqualified in respect to character, education, or other relevant attribute” (NEA, 1975).

The code may also seek to define and reinforce exemplary behaviours such as research integrity, scientific rigor and recognition of sources. The ethical code for behavioural analysts, for example, states that researchers must not fabricate data or falsify results in their publications, must correct errors in their publications, and not omit findings that might alter interpretations of their work (BACB, 2014; p.9.0). Similarly, “The IEEE acknowledges the idea of scientific rigor in its call for creators of AI systems to define metrics, make them accessible, and measure systems” (Feljd et al., 2020; p.59). The major sources of academic misconduct are related to the misuse of intellectual property, for example, through plagiarism, piracy, misrepresentation of authorship (“personation”), and fabrication data or qualifications (EUI, 2019; BACB, 2014; p.9.0).

### **What are the Limits?**

Finally, some ethical codes seek to address the limits of what can be done ethically. It’s not always easy to recognize these limits; it was only after years of effort that IBM announced it would see work in general facial recognition technology, for example (Krishna, 2020). Sometimes the need for limits is stated explicitly. The purpose of the U.K. Government

Data Ethics Framework, for example, to help data scientists identify the limits of what is allowed, to help practitioners consider policy when designing data science initiatives, and to identify core ethical expectations from such projects (Gov.UK, 2018).

Some discussions (e.g. Floridi et al., 2018; note5) omit consideration of the research issues (arguing “they are related specifically to the practicalities of AI development”), however they set an important ethical standard, specifically, “to create not undirected intelligence, but beneficial intelligence” (Asilomar, 2017). In other cases, specific outcomes are undesired, for example, “We should not build a society where humans are overly dependent on AI or where AI is used to control human behavior through the excessive pursuit of efficiency and convenience” (Japan, 2019; p.4). Many “individual” researchers, meanwhile, refuse to work on military or intelligence applications (Shane & Wakabayashi, 2018).

Otherwise, the limits are related to the benefits. For example, the Information and Privacy Commissioner Ontario, Canada. Data-gathering by the state should be restricted to that which is reasonably necessary to meet legitimate social objectives, and subjected to controls over its retention, subsequent use, and disclosure. (Cavoukian, 2013). Similarly, research Ethics Boards (REB) often require that the submissions for ethics approval be accompanied with statements of scientific merit and research need.

## **Core Values and Priorities**

The previous section addressed ethical issues being addressed by codes of conduct. It was, in a sense, addressing the “purpose” of the code “qua” code of ethics, that is, it didn’t look at the social, political or economic need for codes of ethics, but rather, sought to identify the questions for which a “code of ethics” is the answer. No code of those surveyed was designed to meet all of the purposes identified, and none of the purposes identified was specifically addressed by all of the codes surveyed. We use different ethical codes to do different things.

In this section, we will focus on the “values and priorities” that can be found in the codes. These are things that might be found in the ethical “principles” described by the code, if the code is structured that way, or the things that are explicitly described as good or desirable by the code. When people state that there is a “universal” or “general” agreement on values, it is usually with respect to a subset of the items listed here that they refer. Below we have not attempted to create a tab or values mapped to codes, as some researchers (e.g. Fjeld et al., 2020) have done, but rather, to list the values with references to relevant examples where they are asserted.

### ***Pursuit of Knowledge***

The pursuit of knowledge is identified as a core value by many academic and professional codes. For example, the SFU code of ethics, addresses faculty members first as teachers, and then as scholars. “The first responsibility of university teachers is the pursuit and dissemination of knowledge and understanding through teaching and research. They must devote their energies conscientiously to develop their scholarly competence and effectiveness as teachers” (SFU, 1992).

Similarly, the National Education Association statement (NEA, 1975) is based on “recognizes the supreme importance of the pursuit of truth, devotion to excellence, and the nurture of the democratic principles.” Nor is the pursuit of knowledge limited to academics. The Society for Professional Journalists (SPJ) code of ethics, originally derived from Sigma Delta Chi’s “New Code of Ethics” in 1926 (SPJ, 2014), asserts that the primary function of journalism, according to the statements, is to inform the public and to serve the truth.

### ***Autonomy and Individual Value***

Many codes, like National Education Association code (NEA, 1975) are based on “believing in the worth and dignity of each human being. This, though, is expressed in different ways by different codes. For example, in one code, individual development is the objective, to promote “acquisition of autonomous attitudes and behavior.” (Soleil, 1923). The AI4People (Floridi et al., 2018; p.16) adopts a similar stance.

By contrast Tom Beauchamp and James Childress’s “Principles of Biomedical Ethics” contains an extended discussion of autonomy embracing the idea of “informed consent”, which requires disclosure of information, respect for decision-making, and provision of advice where requested. A similar respect for human autonomy is demanded by the High-Level Expert Group on Artificial Intelligence (AI HLEG, 2019).

Similarly, the Belmont Report begins by identifying “respect for persons”, as a core principle which “incorporates at least two basic ethical convictions: first, that individuals should be treated as autonomous agents, and second, that persons with diminished autonomy are entitled to protection.” (DHEW, 1978; p.4).

### ***Consent***

Whether or not based in the principle of autonomy or the inherent worth of people, the principle of consent is itself often cited as a fundamental value by many ethical codes (BACB, 2014; DHEW, 1978; HHS, 2018; Drachsler & Greller, 2016; etc.). However there may be variations in what counts as consent and what consent allows.

For example, the type of consent defined by the Nuremberg Code “requires that before the acceptance of an affirmative decision by the experimental subject there should be made known to him the nature, duration, and purpose of the experiment; the method and means by which it is to be conducted; all inconveniences and hazards reasonably to be expected; and the effects upon his health or person which may possibly come from his participation in the experiment” (USHM, 2020).

Several codes are more explicit about what counts as informed consent. For example, one code requires that “researchers be transparent about the research and give research subjects the choice not to participate. This includes passive data collection, such as collection of data by observing, measuring, or recording a data subject’s actions or behaviour” (IA, 2019). The same code, however, contains provisions that allow data to be collected without consent. If consent is not possible, it states, “Researchers must have legally permissible grounds to collect the data and must remove or obscure any identifying characteristics as soon as operationally possible.” There are also stipulations designed to ensure research quality and to ensure that communications about the research are accurate and not misleading (Ibid).

Meanwhile, that same code of ethics can allow the scope of consent to be extended beyond research. It is the IA Code of Standards and Ethics for Marketing Research and Data Analytics (IA, 2019). Consent is required for research purposes, but in addition “such consent can enable non-research activities to utilize research techniques for certain types of customer satisfaction, user, employee and other experience activities.” The Nuremberg Code and marketing research may stand at opposite poles of an ethical question, however, they are reflective of a society as a whole that holds consent as sacrosanct on one hand and makes legal End User Licensing Agreements (EULA) on the other hand.

### ***Integrity***

Integrity is often required of professionals (CFA, 2019; CSPL, 1995; IA, 2019; etc.), but different codes stress different aspects of integrity. The Canadian Psychological Association section on integrity speaks to accuracy, honesty, objectivity, openness, disclosure, and avoidance of conflict of interest (CPA, 2017). The European University Institute defines integrity as including such values as honesty, trust, fairness and respect. (EUI, 2019). The Ontario College of Teachers focuses on trust, which includes “fairness, openness and honesty” and integrity, which includes honesty and reliability (OCT, 2020). In Guyana, integrity includes “honest representation of one’s own credentials, fulfilment of contracts, and accountability for expenses” (Guyana, 2017). The Nolan Principles state “Holders of public office should act solely in terms of the public interest” (CSPL, 1995) while Raden (2019; p. 9) defines it as “incorruptibility”.

**Confidentiality**

While sometimes breaches of confidentiality are depicted as “harm”, confidentiality is often presented as a virtue in and of itself, perhaps constitutive of integrity. Thus, for example, librarians “protect each library user’s right to privacy and confidentiality with respect to information sought or received and resources consulted, borrowed, acquired or transmitted” (ALA, 2008). Similarly, the Declaration of Helsinki states that “every precaution must be taken to protect the privacy of research subjects and the confidentiality of their personal information” (WMA, 2013).

The need for confidentiality increases with the use of electronic data. The authors of a 1973 report for the U.S. Department of Health, Education and Welfare addressing the then nascent practice of electronic data management noted that “under current law, a person’s privacy is poorly protected against arbitrary or abusive record-keeping practices” (Ware et al., 1973; p.xx). Government policy, they argued, should be designed to limit intrusiveness, to maximize fairness, and to create legitimate and enforceable expectations of confidentiality (Linowes et al., 1977; pp.14-15).

Confidentiality, expressed as privacy, is a core principle for data and information services and codes regulating those. For example, the Federal Trade Commission promotes principles that “are widely accepted as essential to ensuring that the collection, use, and dissemination of personal information are conducted fairly and in a manner consistent with consumer privacy interests.” (Pitofsky et al., 1998; p.ii).

It should be noted that exceptions to confidentiality may be allowed, especially where required by law. For example, the British Columbia Teachers’ Federation code states explicitly that “It shall not be considered a breach of the Code of Ethics for a member to follow the legal requirements for reporting child protection issues” (BCTF, 2020). Similarly, in medical informatics, confidentiality can be compromised “by the legitimate, appropriate and relevant data-needs of a free, responsible and democratic society, and by the equal and competing rights of others” (IMIA, 2015).

**Care**

Care, which includes “compassion, acceptance, interest and insight for developing students’ potential” (OCT, 2020) is found in numerous ethical codes (CNA, 2017; CFA, 2019; IUPSIS, 2008; CPA, 2017; etc.) but is manifest differently in each code in this it appears. Contrasting the OCT definition, for example, is the Canadian Nurses Association discussion of “provision of care” references speech and body language, building relationships, learning from “near misses”, adjusting priorities and minimizing harm, safeguarding care during job actions, and more. It is worth noting that the promotion of

dignity means to “take into account their values, customs and spiritual beliefs, as well as their social and economic circumstances without judgment or bias.” (CAN, 2017; p.12)

The National Council of Educational Research and Training is almost unique in an assertion of care, in the explanatory notes, that states “the demonstration of genuine love and affection by teachers for their students is essential for learning to happen. Treating all children with love and affection irrespective of their school performance and achievement level is the core of the teaching learning process” (NCERT, 2010).

Other codes (e.g. CFA, 2019) adopt a more legalist interpretation of “duty of care”, for example, that researchers must “prioritize data subject privacy above business objectives, be honest, transparent, and straightforward in all interactions (and respect the rights and well-being of data subjects” (IA, 2019). Meanwhile there is a sense of “care” that means “diligence and rigor”; this is the sense intended in the Nuremberg Code (USHM, 2020) and the American Medical Association (Riddick, 2003).

### ***Competence and Authority***

Many of the codes identify competence or authority to practice in the profession as core values or principles (CFA, 2019; IEEE, 2020; p.7.8; IUPSYS, 2008; etc.). This is expressed in several ways: members of the profession may be expected to perform in a competent manner, or they may be required to remain within their domain of competence, or they may be obligated to ensure that unqualified people do not practice the profession (NEA, 1975, as cited above).

For example, behaviour analysts are expected to rely on scientific evidence and remain within the domain of their competence (BACB, 2014; p.6). Similarly, the Nuremberg Code also determines that the researcher should be a qualified scientist and that the research ought to have scientific merit and be based on sound theory and previous testing (USHM, 2020). And the CPA code (2017) requires that the practitioner be competent.

Sometimes what counts as competence is spelled out in the code. For example, the Royal Society data science ethics in government report (Drew, 2016) advises the use of robust data models in data research. Provisions in the Open University code similarly state that the modeling based on the data should be sound and free from bias, and that it requires “development of appropriate skills across the organisation” (OU, 2014; p.4.4).

Codes sometimes require that only authorized professionals perform the work. Accenture’s Universal Principles for Data Ethics (Accenture, 2016; p.5) states “practitioners should accurately represent their qualifications (and limits to their expertise).” This is especially the case where expertise is more difficult to establish or where the stakes are higher. The Guyana code of ethics for teachers, for example, requires “honest

representation of one's own credentials" (Guyana, 2017) while the Ontario Information and Privacy Commissioner Ontario states that "the authority to employ intrusive surveillance powers should generally be restricted to limited classes of individuals such as police officers" (Cavoukian, 2013).

### **Value and Benefit**

While above we represented "the good that can be done" as aspirational, that is, something ethical codes seek to accomplish, in the present case we view the same principle as a limit, and specifically, as the research or practice must produce a benefit in order to be ethical.

In some cases, this benefit may be immediate and practical. For example, the Behavior Analyst Certification Board requires that practitioners provide "effective treatment" (BACB, 2014; p.6). It is arguable, as well, that "health-care professionals, especially, have an obligation to distinguish between remedies that represent the careful consensus of highly trained experts and snake oil" (Kennedy et al., 2002).

In other cases the requirements are more general (and more widely distributed). The Royal Society requires that researchers "show clear user need and public benefit" (Drew, 2016). Similarly, the Asilomar principles state that "AI technologies should benefit and empower as many people as possible" and "the economic prosperity created by AI should be shared broadly, to benefit all of humanity" (Asilomar, 2017). Fjeld (2020) finds a principle of "promotion of human values," and specifically, that "the ends to which AI is devoted and the means by which it is implemented should promote humanity's well being."

In other cases, the requirement that a benefit be shown is limited to requiring that practitioners demonstrate a purpose for their work. The Barcelona Principles (2010) for example require that researchers "specify purposes of data gathering in advance, and seek approval for any new uses," while the DELICATE principles require that universities "Decide on the purpose of learning analytics for your institution" and "E-xplain: Define the scope of data collection and usage" (Drachsler & Greller, 2016).

### **Non-Maleficence**

The principle of non-maleficence is an adaptation of the principle of "do no harm" in the Hippocratic oath. This adaptation is necessary because harm is unavoidable in many circumstances; the surgeon must sometimes harm in order to heal, for example. Harm may occur in other professions as well; a teacher might punish, a researcher might violate privacy, a defence contractor might develop weapons.

So the principle of non-maleficence, as developed for example by Beauchamp and Childress (1992) means "avoiding anything which is unnecessarily or unjustifiably



harmful... (and) whether the level of harm is proportionate to the good it might achieve and whether there are other procedures that might achieve the same result without causing as much harm” (Ethics Centre, 2017). The principle arguably also requires consideration of what the *subject* considers to be harm because as Englehardt (1993) says, we engage one another as moral strangers who need to negotiate moral arrangements (Erlanger, 2002).

The definition of maleficence to be avoided can be variably broad. For example, the AMA (2001) addresses not only the nature and priority of patient care, but also “respect for law, respect of a patient’s rights, including confidences and privacy.” The AMA’s Declaration of Professional Responsibility also advocates “a commitment to respect human life” which includes a provision to “refrain from crimes against humanity (Riddick, 2003).

The principle of non-maleficence is found in numerous ethical codes, and not only medical ethics. For example, the Association for Computing Machinery (2018) states “an essential aim of computing professionals is to minimize negative consequences of computing, including threats to health, safety, personal security, and privacy,” including “examples of harm include unjustified physical or mental injury, unjustified destruction or disclosure of information, and unjustified damage to property, reputation, and the environment” (ACM, 2018).

Non-maleficence in research and data science include being minimally intrusive (Drew, 2016), to keep data secure (ibid; also Raden, 2019; p.9), to promote “resilience to attack and security, fall back plan and general safety, accuracy, reliability and reproducibility... including respect for privacy, quality and integrity of data, and access to data” (AI HLEG, 2019). AI systems, says Fjeld (2020) should perform as intended and be secure from compromise (also Drachslar & Greller, 2016).

### **Beneficence**

Another of the principles defined by Beauchamp and Childress (1992), beneficence should be understood as more than non-maleficence and distinct from value and benefit. A professional demonstrates beneficence toward their client “not only by respecting their decisions and protecting them from harm, but also by making efforts to secure their well-being.” Moreover, “beneficence is understood in a stronger sense, as an obligation.” It’s intended as a combination of “do no harm” and “maximize benefits and minimize harm”, with the recognition that even the determination of what is harmful might create a risk of harm (DHEW, 1978; pp.6-7).

In a number of ethical codes, beneficence can be thought of as “the principle of acting with the best interest of the other in mind” (Aldcroft, 2012). This is more than merely the idea of doing good for someone, it is the idea that the role of the professional is to “prioritize”

the best interest of their client (BACB, 2015; AMA, 2001; CPA, 2017). The principle of beneficence is also raised with respect to AI (Floridi et al, 2018; p.16; Stevens & Silbey, 2014), however, in the precise statement of these principles it is unclear how they should be applied. For example, should “the common good” be included in the principle of beneficence? Should AI promote social justice, or merely be developed consistently with the principles of social justice?

### **Respect**

The principle of respect is cited in numerous ethical codes (AMA, 2001; IUPSY, 2008; CPA, 2017; Dingwell et al., 2017; etc.), for example, acting toward students with respect and dignity (BCTF, 2020), “respect for people” (TBS, 2011), “mutual respect” (Folan, 2020), “respect for the composite culture of India among students” (NCERT, 2010), or “respect for the rights and dignity of learners” (Stevens & Silbey, 2014). Though sometimes paired with autonomy (DHEW, 1978; p.4, cited above) it is often presented quite differently. The Ontario College of Teachers code states that respect includes trust, fairness, social justice, freedom, and democracy (OCT, 2020).

Respect can also be thought of as promoting “human dignity and flourishing”, which AI4All summarizes as “who we can become (autonomous self-realisation); what we can do (human agency); what we can achieve (individual and societal capabilities); and how we can interact with each other and the world (societal cohesion)” (Floridi et al., 2018; p.7). The last two “commandments” of the Computer Ethics Institute’s Ten Commandments of Computer Ethics recommend computer professionals “think about the social consequences” and to “ensure consideration and respect for other humans” (CEI, 1992).

### **Democracy**

Several ethical codes include “respect for democracy” among their values and principles; this can mean, variously, respect for the idea of rule by the people, respect for the “results” of democratic choice (as, say, found in public service ethics; TBS, 2011; pp.1.1-1.2), and respect for democratic values, such as justice and non-discrimination.

Democracy is also identified as both an input and output of ethical codes; the NEA code (1975) is based on “the nurture of the democratic principles,” while the Code of Professional Ethics for School Teachers in India states that “every child has a fundamental right to receive education of good quality,” where this education develops the individual personality, faith in democracy and social justice, cultural heritage and national consciousness (NCERT, 2010).

### ***Justice and Fairness***

Almost all the ethical codes consulted refer to justice in one form or another. Here it is listed alongside “fairness”, as ever since John Rawls’s influential “A Theory of Justice” (Revised, 1999) the two concepts have been linked in popular discourse, according to the principle “justice as fairness”.

As fairness, justice is cited frequently, for example, in academic codes, as fairness to students, including especially refraining from exploiting free academic labour, and ensuring credit is given for any academic work they may have depended on (SFU, 1992) and viewing academics “as role models (who) must follow a professional code of ethics” to ensure “students receive a fair, honest and uncompromising education” from teachers who “demonstrate integrity, impartiality and ethical behavior” (Guyana, 2017).

Even viewed as “fairness”, however, ambiguities remain. As the Belmont Report notes. The idea of justice, “in the sense of ‘fairness in distribution’ or ‘what is deserved’” can be viewed from numerous perspectives, each of which needs to be considered, specifically, “(1) to each person an equal share, (2) to each person according to individual need, (3) to each person according to individual effort, (4) to each person according to societal contribution, and (5) to each person according to merit.” The authors also note that exposing a disadvantaged group to risk is an injustice (DHEW, 1978; pp.6-7).

Fairness is also viewed as impartiality, an avoidance of bias or arbitrary ruling. In journalism, for example, “the primary value is to describe the news impartially – without fear or favour”, as stated by New York Times “patriarch” Adolph Ochs (NYT, 2018). Similarly, the High-Level Expert Group on Artificial Intelligence (AI HLEG, 2019) endorses “diversity, non-discrimination and fairness – including the avoidance of unfair bias, accessibility and universal design, and stakeholder participation.” And the European University Institute opposed acts that are arbitrary, biased or exploitative (EUI, 2019).

Justice, sometimes coined as “natural justice” (CPA, 2017; p.11), can also be depicted in terms of rights (Stevens & Silbey, 2014; Asilomar, 2017; Access Now, 2018). That is how it appears in the Asilomar declaration. The principles themselves reflect a broadly progressive social agenda, “compatible with ideals of human dignity, rights, freedoms, and cultural diversity,” recognizing the need for personal privacy, individual liberty, and also the idea that “AI technologies should benefit and empower as many people as possible” and “the economic prosperity created by AI should be shared broadly, to benefit all of humanity.”

This interpretation of justice is also expressed as an endorsement of diversity and prohibition of discrimination (Sullivan-Marx, 2020; Brandom, 2018; CPA, 2017; p.11;

BACB, 2014; etc.) based on various social, economic, cultural and other factors (this list varies from code to code). The National Union of Journalists code, for example, states explicitly that journalists should produce “no material likely to lead to hatred or discrimination on the grounds of a person’s age, gender, race, colour, creed, legal status, disability, marital status, or sexual orientation” (NUJ, 2011).

Justice, viewed from either the perspective of fairness or rights, can be expanded to include redress for current or past wrongs, or to prevent future wrongs. As early as 1973, U.S. Department of Health, Education and Welfare, on observing abuses in data collection, proposed a “Code of Fair Information Practice”. The intent of the code was to redress this imbalance and provide some leverage for individuals about whom data is being collected. The Toronto Declaration similarly calls for “clear, independent, and visible processes for redress following adverse individual or societal effects” (Brandom, 2018).

Depending on one’s perspective, the principle of justice may be listed together with, or apart from, any number of other principles, including fairness, rights, non-discrimination, and redress. That we have listed them here in one section does not presuppose that we are describing a single coherent core value or principle; rather, what we have here is a family of related and sometimes inconsistent principles that are often listed in the popular discourse as a single word, such as “justice”, as though there is some shared understanding of this.

### ***Accountability and Explicability***

The principles of accountability and explicability arise differently in computing and AI codes than it does in other ethical codes. In the case of academic and medical research, accountability is typically delegated to a process undertaken by a research ethics board (REB). Similarly, the Information and Privacy Commissioner of Ontario asserts that compliance with privacy rules and restrictions should be subject to independent scrutiny and that “the state must remain transparent and accountable for its use of intrusive powers through subsequent, timely, and independent scrutiny of their use” (Cavoukian, 2013).

In other disciplines, a range of additional processes describe practices such as predictability, auditing and review (Raden, 2019; p.9). As the U.S. Department of Health and Welfare argued, data should only be used for the purposes for which it was collected. And this information, however used, should be accurate; there needs to be a way for individuals to correct or amend a record of identifiable information about themselves, and organizations must assure the reliability of the data and prevent misuse of the data. These, write the authors, “define minimum standards of fair information practice” (Ware et al., 1973; p.xxi).

In digital technology, accountability also raises unique challenges. The AI4People code, for example, adds a fifth principle to the four described by Beauchamp and Childress (1992), “explicability, understood as incorporating both intelligibility and accountability” where we should be able to obtain “a factual, direct, and clear explanation of the decision-making process” (Floridi et al. 2018). As (Fjeld, 2020) summarizes, “mechanisms must be in place to ensure AI systems are accountable, and remedies must be in place to fix problems when they’re not.” Also, “AI systems should be designed and implemented to allow oversight.”

Finally, says Fjeld, “important decisions should remain under human review.” Or as Robbins (2019) says, “Meaningful human control is now being used to describe an ideal that all AI should achieve if it is going to operate in morally sensitive contexts.” As Robbins argues, “we must ensure that the decisions are not based on inappropriate considerations. If a predictive policing algorithm labels people as criminals and uses their skin color as an important consideration then we should not be using that algorithm.”

### **Openness**

Many of the codes of ethics, especially those dedicated to research, express openness as a core value, though often with conditions attached. The Sorbonne Declaration, for example, states “research data should, as much as possible be shared openly and reused, without compromising national security, institutional autonomy, privacy, indigenous rights and the protection of intellectual property” (Sorbonne Declaration, 2020). Similarly, the Declaration of Helsinki states “researchers have a duty to make publicly available the results of their research on human subjects and are accountable for the completeness and accuracy of their reports” (WMA, 2013).

Another project, FAIRsFAIR, is based on the the FAIR Guiding Principles (GoFAIR, 2020) for scientific data management and stewardship (Wilkenson et al., 2016). The principles (and the acronym derived from them) are “Findability, Accessibility, Interoperability, and Reusability – that serve to guide data producers and publishers as they navigate around these obstacles, thereby helping to maximize the added-value gained by contemporary, formal scholarly digital publishing.”

In many cases, openness is described in terms of access serving the public good. The Asilomar Convention includes a principle of openness representing learning and scientific inquiry as “public goods essential for wellfunctioning democracies” (Stevens & Silbey, 2014). Citing The Research Data Alliance’s 2014 “The Data Harvest Report” the Concordat Working Group, (2016) authors write “the storing, sharing and re-use of scientific data on a massive scale will stimulate great new sources of wealth” (Genova et al., 2014).

Openness is also described in some principles as openness of access to services. The IFLA (2019), for example, expresses “support for the principles of open access, open source, and open licenses” and “provision of services free of cost to the user.” The Canadian Nurses association code includes “advocating for publicly administered health systems that ensure accessibility, universality, portability and comprehensiveness in necessary health-care services” (CAN, 2017).

Openness is also described in some principles as “transparency” of methods and processes (IA, 2019; Raden, 2019; p.9; Cavoukian, 2013; CSPL, 1995) in a way that often references accountability (as referenced above). The Accenture code, for example, urges professionals to foster transparency and accountability (Accenture, 2016; p.5). The High-Level Expert Group on Artificial Intelligence (AI HLEG) also advocates transparency, which includes traceability, explainability and communication.

Finally, openness can be thought of as the opposite of secrecy, as mentioned in the Department of Health, Education and Welfare report, stating that individuals should have a way to find out what information about them is in a record and how it is used (Ware et al., 1973). It is also the opposite of censorship (IFLA, 2019; ALA, 2008).

### ***Common Cause / Solidarity***

Many codes of ethics also explicitly endorse an advocacy role for professionals to promote the values stated in the code. The AMA Declaration of Professional Responsibility, for example, asserts a commitment to “advocate for social, economic, educational, and political changes that ameliorate suffering and contribute to human well-being” (Riddick, 2003).

The codes vary from advice to “teach what uplifts and unites people and refuse to be, in any way whatsoever, the propagandists of a partisan conception” (Soleil, 1923) to establishing a shared vision of teaching and to “to identify the values, knowledge and skills that are distinctive to the teaching profession” (OCT, 2016) to expressing solidarity with other members of the profession, for example, stating that criticism of other members will be conducted in private (BCTF, 2020).

### **Obligations and Duties**

As Feffer (2017) observes, our duties often conflict. For example, we may read, “As a representative of the company, you have one set of responsibilities. As a concerned private citizen, you have other responsibilities. It’s nice when those converge, but that’s not always the case.”

We might think, for example, that a practitioner always has a primary duty to their client. Thus a doctor, lawyer, or other professional tends to the interests of the client first. A look at practice, however, makes it clear this is not the case. A doctor may (in some countries) refuse to perform a service if a patient cannot pay. An educator may be required to report on a student's substance abuse problem or immigration status.

And often, the locus of duty is not clear. For example, if a company is skewing the data used in order to sway a model toward a particular set of outcomes, does an employee have a duty to disclose this fact to the media? There may be some cases where a company is legally liable for the quality of its analytics, while in other cases (such as marketing and promotion) the requirement is less clear.

If we widen our consideration beyond simple transactions, the scope of our duties widens as well. Our duty to travel to Africa to support a learning program may not conflict with a duty to preserve the environment for people who have not yet been born. (Saugstad, 1994; Wilkinson & Doolabh, 2017) Or our desire to eat meat may conflict with what activists like Peter Singer might consider a duty to animals (Singer, 1979).

This section we look briefly at the different entities to which different codes argue that we owe allegiance, loyalty, or some other sort of obligation or duty.

### ***Self***

Most ethical codes abnegate serving or benefitting oneself, and where the self is concerned, it is typically in the service of the wider ethic, for example, our obligations as role models (Guyana, 2017). The Nolan principles, for example, make clear that the ethics of a member of the public service is selflessness (CSPL, 1995), though there is occasional acknowledgement of a duty to self (AMA, 2001).

And yet, many of the ethical principles described in the code could be construed as the cultivation of a better self, for example, one who is honest, trustworthy, integral, objective and open (this list varies from code to code) (IMIA, 2015; CSPL, 1995; CPA, 2017; IA, 2017; AITP, 2017; etc.) as well as “self-knowledge regarding how their own values, attitudes, experiences, and social contexts influence their actions, interpretations, choices, and recommendations” (IMIA, 2015).

And some principles might be thought of as promoting some desirable attributes of self, even if referring to these in others: autonomous self-realisation, human agency, and individual capabilities, for example (Floridi et al., 2018; p.7), or to “participate in programmes of professional growth like in-service education and training, seminars, symposia workshops, conferences, self study etc.” (Mizoram, 2020).

### ***Less Fortunate***

We included a place-holder for duties or obligations to the less fortunate because of an earlier reference to Peter Singer's (2009) "The Life You Can Save". Statements of any obligation toward the poor or less fortunate are impossible to find in any of the ethical codes, however, with the exception of references to specific clients of a profession, as discussed below).

That is not to say that the less fortunate are completely omitted from ethical codes. As far back as Hammurabi's Code is the edict, "the strong may not oppress the weak" (Gilman, 2005; p.4n3). At the same time, the resistance to considering such matters is telling, as summarized here: "Advocates have urged that considerations for the poor, illegal immigrants, rain forests, tribal rights, circumcision of women, water quality, air quality and the right to sanitary facilities be put into codes for administrators. As important as these issues might be they distort the purpose of ethics codes to the point that they are confusing and put political leadership in the position of quietly undermining them" (Ibid; p.47).

### ***Student***

Ethical codes for teachers or academics often specify obligations or duties to students, though in different ways. For example, "Le code Soleil" assigns a three-fold responsibility to teachers: to train the individual, the worker, and the citizen. Education, according to the code, "is the means to give all children, whatever their diversity, to reach their maximum potential" (Soleil, 1923). The National Education Association code urges teachers to "strive to help each student realize his or her potential as a worthy and effective member of society" (NEA, 1975). Further, the Open University code asserts that "students should be engaged as active agents in the implementation of learning analytics (e.g. informed consent, personalised learning paths, interventions" (OU, 2014; p.4.3.2).

### ***Parent or Guardian, Children***

Parents stand in two roles in codes of ethics. The first is to act as a proxy for children with respect to matters of consent (Kay et al., 2012). The second is as special interests that need to be protected; for example, an Indian code of ethics advises teachers to "refrain from doing any thing which may undermine students confidence in their parents or guardians" (NCERT, 20910; Mizoram, 2020) and with whom teachers need to maintain an open and trusting relationship (OCT, 2020).

Data collection began early in the field of digital media, with the FTC noting that "The practice is widespread and includes the collection of personal information from even very young children without any parental involvement or awareness" (Ibid; p.5) It is worth



noting that the principles are designed specifically to protect consumers, and that they are addressed specifically toward industry (Pitofsky et al., 1998; p.ii).

In the IEEE code there is a detailed section on “working with children” that contains provisions on safety and security, confidentiality, and whistle-blowing, noting specifically that “Adults have a responsibility to ensure that this unequal balance of power is not used for their personal advantage” (IEEE, 2017). Finally, “the Information Technology Industry Council has joined the conversation around children’s rights with a focus on emerging technologies, publishing a list of principles to guide the ethical development of artificial intelligence (AI) systems” (UC Berkeley, 2019).

### ***Client***

In many ethical codes the first and often only duty is to the client. This is especially the case for service professions such as finance and accounting, legal representation, where this is expressed as fiduciary duties, which are “special obligations between one party, often with power or the ability to exercise discretion that impacts on the other party, who may be vulnerable” (Wagner Sidlofsky, 2020).

In health care the needs of the client are often paramount. For example, the Declaration of Helsinki (WMA, 2013) states “The health of my patient will be my first consideration,” and cites the International Code of Medical Ethics in saying, “A physician shall act in the patient’s best interest when providing medical care.” It is thus “the duty of the physician to promote and safeguard the health, well-being and rights of patients, including those who are involved in medical research” (Ibid). In cases where multiple duties are owed, the client may be assigned priority, as in the case of medical research codes. “When research and clinical needs conflict, prioritize the welfare of the client” (BACB, 2014).

There is ambiguity in the concept of client, particularly with respect to the idea that the duty is to the client because the client is the one paying the bills. When care is paid by insurance, or through government programs, or corporate employers, the service recipient and the payer may be two distinct. Similarly, in digital media, costs may be paid by advertisers or publishers, who may then assert moral priority. (Done, 2010). However, as Luban (2018; p.187) argues, “‘who pays the whistler calls the tune’ is not a defensible moral principle.”

### ***Research Subject***

Research ethics codes commonly describe a duty of the researcher to the research subject, beginning with the Nuremberg Principles and established throughout the practice thereafter. The responsibilities to research participants include informed consent,

transparency, right to withdraw, reasonableness of incentives, avoidance and mitigation of harm arising from participation in research, and privacy (BERA, 2018).

In the field of data research and analytics this principle is often retained. Accenture's universal principles for data ethics, for example, state that the highest priority is "the person behind the data" (Accenture, 2016; p.5). Similarly, the Insights Association code (2019) states "respect the data subjects and their rights." In journalism, as well, "ethical journalism treats sources, subjects, colleagues and members of the public as human beings deserving of respect" (SPJ, 2014).

### ***Employer or Funder***

Public service employees are not surprisingly obligated to their employer. "Members of the public service... are tasked with "loyally carrying out the lawful decisions of their leaders and supporting ministers in their accountability to Parliament and Canadians" (TBS, 2011; pp.1.1-1.2)

The same sometimes holds true in the case of ethical codes for teachers. They may be required to "cooperate with the head of the institution and colleagues in and outside the institution in both curricular and co-curricular activities" and that a teacher should "recognize the management as the prime source of his sustainable development" (Mizoram, 2020) or to "abide by the rules and regulations established for the orderly conduct of the affairs of the University" (SFU, 1992).

The same may apply for employees in the private sector. Information technology professionals, for example, may be asked "to guard my employer's interests, and to advise him or her wisely and honestly" (AITP, 2017). Journalists, as well, are subject to obligations to the newspaper (NUJ., 1936). Even funders may make a claim on the duties of the researcher (Dingwell et al., 2017).

### ***Colleagues, Union or Profession***

Professional associations and unions frequently include loyalty to the professional association or union as a part of the code of ethics, either explicitly, or expressed as an obligation owed to colleagues (NUJ, 1936; AITP, 2017; SFL, 1992; NEA, 1975; etc.). This is related to the idea that members are forming a voluntary association. "If a member freely declares (or professes) herself to be part of a profession, she is voluntarily implying that she will follow these special moral codes. If the majority of members of a profession follow the standards, the profession will have a good reputation and members will generally benefit" (Weil, 2008).

**Stakeholders**

The term *stakeholders* is sometimes used without elaboration to indicate the presence of a general duty or obligation (BERA, 2018). Fjeld (2020) asserts for example that “developers of AI systems should make sure to consult all stakeholders in the system and plan for long-term effects.” The Open University policy is based on “significant consultation with key stakeholders and review of existing practice in other higher education institutions and detailed in the literature” (OU, 2014; p.1.2.6). Similarly, one of the DELICATE principles (Drachsler & Greller, 2016) requires researchers “talk to stakeholders and give assurances about the data distribution and use.”

What is a stakeholder? It expands on the concept of “stockholder” and is intended to represent a wider body of interests to which a company’s management ought to be obligated (SRI, 1963). Freeman (1984; p.25) defines it as “any group or individual who can affect, or is affected by, the achievement of a corporation’s... or organization’s purpose... or performance”. He bases it on “the interconnected relationships between a business and its customers, suppliers, employees, investors, communities and others who have a stake in the organization” (Ledecy, 2020). There are many definitions of “takeholder” (Miles, 2017; p.29) and no principled way to choose between them.

**Publishers and Content Producers**

Librarians are subject to special obligations to publishers, according to some codes. For example, “Librarians and other information workers’ interest is to provide the best possible access for library users to information and ideas in any media or format, whilst recognising that they are partners of authors, publishers and other creators of copyright protected works” (IFLA, 2012).

This responsibility is extended in other fields as a prohibition against plagiarism (EUI, 2019; BACB, 2014; SPJ, 2014; NUJ, 2011; NYT, 2017; etc.) and taking credit for the work of others (AITP, 2017; IEEE, 2020; BACB, 2014; etc.).

**Society**

References to a responsibility to society are scarce, but they do exist. BERA (2018) argues for a responsibility to serve the public interest, and in particular, responsibilities for publication and dissemination. The “Nolan principles”, (CSPL, 1995) state “Holders of public office are accountable to the public for their decisions and actions and must submit themselves to the scrutiny necessary to ensure this.”

In the field of data analytics, the last two of the Computer Ethics Institute “Ten Commandments” recommend computer professionals “think about the social consequences” and to “ensure consideration and respect for other humans” (CEI, 1992).

Though as Metcalf (2014) notes, “it appears to be the only computing ethics code that requires members to proactively consider the broad societal consequences of their programming activities” (my italics). Subsequently, the Royal Society (Drew, 2016) recommended data scientists “be alert to public perceptions.”

### ***Law and Country***

Although it has been established that there is not an ethical duty to obey an unethical law, a number of ethical codes nonetheless include respect for the law in one way or another, for example, in reporting child protection issues (BCTF, 2020), compliance with law as an “overarching principle” (IA, 2019), or “operate within the legal frameworks (and) refer to the essential legislation” (Drachsler & Greller, 2016).

Meanwhile, the Association of Information Technology Professionals Code of Ethics asserts “I shall uphold my nation and shall honor the chosen way of life of my fellow citizens,” though it is no longer extant and as Metcalf (2016) comments, “it is decades old and has some anachronisms that clash with globalized ethos of computing today.” Despite this, it was cited (in EDUCAUSE Review) as recently as 2017 (Woo, 2017).

### ***Environment***

The environment is rarely mentioned in ethical codes, though it appears in a statement of obligations to “society, its members, and the environment surrounding them” (ACM, 2018) and as “societal and environmental wellbeing – including sustainability and environmental friendliness, social impact, society and democracy” (AI HLEG, 2019).

### **Bases for Values and Principles**

What grounds these codes of ethics? On what basis do their authors assert that this code of ethics, as opposed to some hypothetical alternative, is the code of ethics to follow? A typical explanation might be that “An individual’s professional obligations are derived from the profession and its code, tradition, society’s expectations, contracts, laws, and rules of ordinary morality” (Weil, 2008), but a closer examination raises as many questions as it answers.

### ***Universality***

Many codes simply assert that the principles embodied in the code are universal principles. Universality may be seen as a justification for moral and ethical principles; if the principle is believed by everyone, then arguably it should be believed here.

For example, the Universal Declaration of Ethical Principles for Psychologists asserts, “The Universal Declaration describes those ethical principles that are based on shared human values” (IUPSIS, 2008). It later asserts “Respect for the dignity of persons is the most

fundamental and universally found ethical principle across geographical and cultural boundaries, and across professional disciplines” (Ibid). So we see here universality being asserted as a foundation underlying a set of ethical principles. Similarly, the Asolomar Convention states that “Virtually all modern societies have strong traditions for protecting individuals in their interactions with large organizations... Norms of individual consent, privacy, and autonomy, for example, must be more vigilantly protected as the environments in which their holders reside are transformed by technology” (Stevens & Silbey, 2014).

Additional studies, such as Fjeld et al. (2020) that suggest that we have reached a consensus on ethics and analytics. We argue that this is far from the case. The appearance of “consensus” is misleading. For example, in the Fjeld et al., survey, though 97% of the studies cite “privacy” as a principle, consensus is much smaller if we look at it in detail (Ibid; p.21), and the same if we look at the others, e.g. Accountability (Ibid; p.28). Assertions of universality made elsewhere (for example: Pitofsky, 1998; p.7; Singer & Vinson, 2002; CPA, 2017; Raden, 2019; p.11) can be subject to similar criticisms.

In their examination of teacher codes of ethics, Maxwell and Schwimmer (2016) found “analysis did not reveal an overlapping consensus on teachers’ ethical obligations.” Nor are they alone in their findings; citing Campbell (2008; p.358) they observe that “despite extensive research on the ethical dimensions of teaching, scholars in the field do not appear to be any closer to agreement on ‘the moral essence of teacher professionalism’.” Similarly, Wilkinson (2007; p.382) “argues that the teaching profession has failed ‘to unite around any agreed set of transcendental values which it might serve’.” And van Nuland and Khandelwal (2006; p.18) report “The model used for the codes varies greatly from country to country.” The selection below is a sample; many more codes may be viewed in the EITCO website (IIEP, 2020).

### ***Fundamental Rights***

The High-Level Expert Group on Artificial Intelligence cites four ethical principles, “rooted in fundamental rights, which must be respected in order to ensure that AI systems are developed, deployed and used in a trustworthy manner” (AI HLEG, 2019).

As noted above, the Access Now report specifically adopts a human rights framework “The use of international human rights law and its well-developed standards and institutions to examine artificial intelligence systems can contribute to the conversations already happening, and provide a universal vocabulary and forums established to address power differentials” (Access Now, 2018; p.6).

The Toronto Declaration “focuses on the obligation to prevent machine learning systems from discriminating, and in some cases violating, existing human rights law. The declaration was announced as part of the RightsCon conference, an annual gathering of digital and human rights groups” (Brandom, 2018).

Nonetheless, it is not clear what these fundamental rights are. Their statement in documents such as the U.S. Bill of Rights, the Canadian Charter of Rights and Freedoms, or the Universal Declaration of Human Rights, is very different. Is the right to bear arms a fundamental right? Is the right to an education a fundamental right?

### **Fact**

Arguments drawing from statements of fact about the world are sometimes used to support ethical principles. For example, the Universal Declaration of Ethical Principles for Psychologists asserts, “All human beings, as well as being individuals, are interdependent social beings that are born into, live in, and are a part of the history and ongoing evolution of their peoples... as such, respect for the dignity of persons includes moral consideration of and respect for the dignity of peoples” (IUPSIS, 2008).

Against such assertions of fact the “is-ought” problem may be raised. As David Hume (1739) argued, moral arguments frequently infer from what “is” the case to what “ought” to be the case, but “as this ought, or ought not, expresses some new relation or affirmation, ‘tis necessary that it should be observed and explained; and at the same time that a reason should be given” (Hume, 1888; p.469). Such “oughts” may be supported with reference to goals or requirements (see below), or with reference to institutional facts, such as laws (Searle, 1964).

### **Balancing Risks and Benefits**

The AI4People declaration states “An ethical framework for AI must be designed to maximise these opportunities and minimise the related risks” (Floridi et al., 2018; p.7). Similarly the Concordat Working Group (2016) document is of open data with the need to manage access “in order to maintain confidentiality, protect individuals’ privacy, respect consent terms, as well as managing security or other risks.” And the AI4People starts from the premise that “an ethical framework for AI must be designed to maximise these opportunities and minimise the related risks” (Floridi et al., 2018; p.7).

The balancing of risks and benefits is a broadly consequentialist approach to ethics and therefore results in a different calculation in each application. For example, the balancing of risk and benefit found in the Common Rule is focused more specifically on biomedical research, and it has to be asked, is biomedicine the ethical baseline? “Not all research has the same risks and norms as biomedicine... there has remained a low-simmering conflict

between social scientists and IRBs. This sets the stage for debates over regulating research involving big data.” (Metcalf, 2016)

It also requires an understanding of what the consequences actually are. Four of the five principles recommended by the House of Lords Select Committee on AI represent a consequentialist approach (Clement-Jones et al, 2018; para417). But what are those consequences? The Committee quotes the Information Commissioner’s Office (ICO) as stating that there was a “need to be realistic about the public’s ability to understand in detail how the technology works”, and it would be better to focus on “the consequences of AI, rather than on the way it works”, in a way that empowers individuals to exercise their rights (Ibid; para51), but this may be unrealistic.

And perhaps ethics isn’t really a case of balancing competing interests. The Information and Privacy Commissioner in Ontario (Cavoukian, 2013) asserts that “a positive-sum approach to designing a regulatory framework governing state surveillance can avoid false dichotomies and unnecessary trade-offs, demonstrating that it is indeed possible to have both public safety and personal privacy. We can and must have both effective law enforcement and rigorous privacy protections.”

### ***Requirements of the Profession***

A requirement is a statement about what a person must believe, be or do in order to accomplish a certain objective or goal. For example, the Universal Declaration of Ethical Principles for Psychologists asserts, “competent caring for the well-being of persons and peoples involves working for their benefit and, above all, doing no harm... (it) requires the application of knowledge and skills that are appropriate for the nature of a situation as well as the social and cultural context” (IUPSIS, 2008). Similarly, the American Library Association sees its role as requiring “a special obligation to ensure the free flow of information and ideas to present and future generations” (ALA, 2008). The IFLA similarly argues that “librarianship is, in its very essence, an ethical activity embodying a value-rich approach to professional work with information” (IFLA, 2012).

The same document also later asserts that “Integrity is vital to the advancement of scientific knowledge and to the maintenance of public confidence in the discipline of psychology,” which is the same type of argument, however, the objectives are much less clearly moral principles: the “advancement of scientific knowledge” and “the maintenance of public confidence.” Such arguments often proceed through a chain of requirements; IUPSIS (2008) continues, for example, to argue that “Integrity is based on honesty, and on truthful, open and accurate communications.”

Such principles may be expressed in two ways: either derived, or conditional. The principle is derived if the antecedent is already an ethical principle. In the first IUPSYs example above, for example, “competent caring for the well-being of persons and peoples” may have been previously established as an ethical principle, from which the derived principle “working for their benefit” is also established. The principle may be expressed as a conditional that describes what is entailed on (say) joining a profession: if one is engaged in competent caring for the wellbeing of persons and peoples then this requires working for their benefit.

Against such assertions of requirements, several objections may be brought forward. The first method is to argue that the requirement does not actually follow from the antecedent; one might argue, for example that competent caring does not entail working for the person’s benefit; it may only involve following proper procedures without regard to the person’s benefit. Additionally, one might argue that the antecedent has not in fact been established; for example, one might argue that being a psychologist doesn’t involve caring at all, and might only involve addressing certain disruptions in human behaviour. A criminal psychologist might take this stance, for example.

### ***Social Good or Social Order***

Social good, however defined, may be the basis of some ethical principles. The preamble to the Society for Professional Journalists (SPJ) code of ethics states that the primary function of journalism, according to the statements, is to inform the public and to serve the truth, because “public enlightenment is the forerunner of justice and the foundation of democracy” (SPJ, 2014).

A basis in social order, however, invites relativism. People’s ethical judgements are relative (Drew, 2016). “People’s support is highly context driven. People consider acceptability on a case-by-case basis, first thinking about the overall policy goals and likely intended outcome, and then weighing up privacy and unintended consequences” (Ibid). This relativism is clear in a statement from a participant: “Better that a few innocent people are a bit cross at being stopped, than a terrorist incident – because lives are at risk.” And this relativism often reflects their own interests: “a direct personal benefit (e.g. giving personalized employment advice), benefit to a local community, or public protection” (Ibid).

“Social order” can be construed to mean national interest. We see this in ethics statements guiding public service agencies and professionals. For example, Russell T. Vought, issued a memo asserting that “Office of Management and Budget (OMB) guidance on these matters seeks to support the U.S. approach to free markets, federalism, and good regulatory practices (GRPs), which has led to a robust innovation ecosystem” (Vought, 2020). The



resulting “Principles for the Stewardship of AI Applications” included such things as public participation, public trust, and scientific integrity, but also included risk assessment and management along with benefits and costs. The document also urged a non-regulatory approach to ethics in AI. A different society might describe ethics in government very differently.

### ***Fairness***

A principle of “fairness” is frequently cited with no additional support or justification.

Often, fairness is defined as essential to the ethics of the profession. The New York Times, for example, “treats its readers as fairly and openly as possible” and also “treats news sources just as fairly and openly as it treats readers” (NYT, 2018).

Fairness may be equated with objectivity. For example, a journalist may say, “it is essential that we preserve a professional detachment, free of any whiff of bias” (NYT, 2018).

While acknowledging that “there is nothing inherently unfair in trading some measure of privacy for a benefit,” the authors of a 1973 report for the U.S. Department of Health, Education and Welfare addressing the then nascent practice of electronic data management noted that “under current law, a person’s privacy is poorly protected against arbitrary or abusive record-keeping practices” (Ware et al., 1973). Hence they proposed what they called a “Code of Fair Information Practice”.

### ***Epistemology***

The advancement of knowledge and learning is often considered to be in and of itself a moral good. For example, it is used in the Universal Declaration of Ethical Principles for Psychologists to justify the principle of integrity: “Integrity is vital to the advancement of scientific knowledge and to the maintenance of public confidence in the discipline of psychology” (IUPSYS, 2008). Epistemological justification is also found in journalistic ethics: “relationships with sources require the utmost in sound judgment and self discipline to prevent the fact or appearance of partiality” (NYT, 2018). And in the case of AI ethics, it may be simply pragmatic: “our ‘decision about who should decide’ must be informed by knowledge of how AI would act instead of us” (Floridi et al., 2018; p.21).

Against this argument, one may simply deny that knowledge and learning are moral goods, and are simply things that people do, and can often be harmful (as in “curiosity killed the cat”). More often, we see such responses couched in specific terms, asserting that seeking some particular knowledge is not inherently good, for example, knowledge related to advanced weapons research, violations of personal confidentiality, and a host of other real

or imagined harms. Seneca, for example, argued “This desire to know more than is sufficient is a sort of intemperance” (Letter 88:36).

### **Trust**

In order to do any number of things, you need trust, or some of the components of trust. As a result, the elements of trust in themselves can be cited as justification for moral principles. For example, the Universal Declaration of Ethical Principles for Psychologists writes “Integrity is vital... to the maintenance of public confidence in the discipline of psychology” (IUPSIS, 2008). Chartered Financial Analysts seek to “promote the integrity and viability of the global capital markets for the ultimate benefit of society” (CFA, 2019).

Similar principles underlie ethics in journalism; “integrity is the cornerstone of a journalist’s credibility” (SPJ, 1996).

Similarly, the New York Times asserts, “The reputation of The Times rests upon such perceptions, and so do the professional reputations of its staff members.” If we here interpret “public confidence” as an aspect of trust, we see how the authors are appealing to the principle of trust to support the assertion that integrity is a moral principle.

Against this it may be argued that trust is neither good nor bad in and of itself, and indeed, that trust may be abused in certain cases, which could make measures that promote trust also bad. Moreover, it could be argued that trust is too fragile a foundation for moral principles, as it may be broken even without ill attempts. Further, it may be argued that trustless systems are in fact morally superior, because they do not create the possibility that trust may be breached, thus preserving the integrity of whatever it was that trust was intended to support.

### **Defensibility**

Another way to define an ethical principle is to say that it is descriptive of “conduct that you (or your organization) would be willing to defend”. For example, the National Union of Journalist code of conduct (NUJ, 2011) offers “guidance and financial support of members who may suffer loss of work for conforming to union principles.”

“Through years of courageous struggle for better wages and working conditions its pioneers and their successors have kept these aims in mind, and have made provision in union rules not only for penalties on offenders, but for the guidance and financial support of members who may suffer loss of work for conforming to union principles” (NUJ, 1936).

Includes burden or onus – responding to U.S. Whitehouse – Guidance for Regulation of Artificial Intelligence Applications – Responding to these guidelines, the American Academy of Nursing argued for a less business focused assessment of the risks and benefits

of AI, saying “federal agencies should broaden the concept around use of AI related social goals when considering fairness and non-discrimination in healthcare.” They also urged that “federal agencies consider patient, provider, and system burden in the evaluation of AI benefits and costs” and “include data accuracy, validity, and reliability” in this assessment (Sullivan-Marx, 2020)

## **Results of the Study**

After having studied a certain number of codes of ethics, in the light of the applications of analytics and arising ethical issues considered above, the following statements can be asserted.

1. None of the statements address all of the issues in learning analytics extant in the literature, and arguably, all of these statements, taken together, still fail to address all these issues.
2. Those issues that they address, they often fail to actually resolve. Often the principles state what should be considered, but leave open what should be the resolution of that consideration.
3. There are legal aspects to analytics, and there are ethical aspects, and there is a distinction between the two, though this distinction is not always clear.
4. Although there is convergence around some topics of interest, there is no consensus with respect to the ethics involved.
5. In fact, there are conflicts, both between the different statements of principles, and often, between the principles themselves (often described as a need to “balance” competing principles).
6. Even were there consensus, it is clear that this would be a minimal consensus, and that important areas of concern addressed in one domain might be entirely overlooked in another domain.
7. Ethical principles and their application vary from discipline to discipline, and from culture to culture.
8. There is no common shared foundation for the ethical principles described. As we will see below, these statements of principles select on an ad hoc basis from different ethical ideas and traditions.
9. Often these principles include elements of monitoring and enforcement, thus begging the question of why or for what reason an individual would adhere to the ethical principle stated.

## Concluding Remarks

It is premature (if it is possible at all) to talk about “the ethics of such and such” as though we have solved ethics. There are multiple perspectives on ethics, and these are represented in the very different ethical codes from various disciplines. Approaches based in simple principles, such as an appeal to consequences, or such as in terms of rights and duties, and as such, as statements of rules or principles, fail to address the complexity of ethics especially as regards learning and analytics. The assertion of a universal nature of ethics doesn’t take into account context and particular situations, and it doesn’t take into account larger interconnected environment in which all this takes place.

Additionally, based in simple principles don’t take into account how analytics themselves work. Analytics systems are not based on rules or principles, they are statistical, using techniques such as clustering and regression. As such, their “input” is going to be complex, and they will produce unexpected consequences in a way that reflects the complexity of humans and human society.

There is an argument, with which we are sympathetic, that when we ask ethical questions, such as “what makes so-and-so think it would be appropriate to post such-and-such?” we are not looking for a single answer, but a complex of factors based on individual identity, society, circumstances and perspective. This suggests an ethics based on different objectives – not “rights” or “fairness” but rather things like a sense of compassion or on a philosophical perspective that uses a relational and context-bound approach toward morality and decision making, for example, as found in work based in conviviality or the ethics of care.

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## **A LITERATURE REVIEW ON THE DEFINITIONS OF DROPOUT IN ONLINE HIGHER EDUCATION**

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### **Abstract**

Online higher education continues to grow, yet its high dropout rates remain a pressing and complex problem. However, there are many different definitions of dropout (and related concepts: attrition, persistence, and retention) in the literature, usually related to a temporal conception, and the issue is controversial. Inconsistent terminology is problematic because the ways dropout is defined determine how it is measured, tackled, and researched. This contribution seeks to remedy such issue by summarizing a scoping review of the recent literature on the theme, focusing on the key issue of online higher education students' dropout conceptualization and definition. A scoping review between 2014 and 2018 yielded 138 articles and dissertations. Findings reveal a complex yet disorganized field, lacking standard definitions. Some concepts (e.g. completion) were defined clearly more often, while others (e.g. attrition and dropout) varied wildly; few papers employed previous definitions from the body of literature. Future research should strive to achieve greater consistency in terminology, so as to compare findings and produce reliable knowledge for intervention in online higher education institutions.

### **Background: Conceptualizing Dropout Research in Online Higher Education**

#### ***The issue with Definitions***

Dropout can be broadly defined as the student's failure to enrol for a definite number of successive semesters. However, there are many different definitions of dropout in the literature, usually related to a temporal conception, and the issue is controversial (Grau-Valldosera & Mingui  n, 2014). A number of related concepts are often employed, some as synonymous –attrition, withdrawal, non-completion– and others as antonymous –retention, persistence, continuance, completion, and success. However, they largely suffer from the same imprecision. Inconsistent terminology is problematic because the ways dropout is defined determine how it is measured, tackled, and researched (Ashby, 2004). The main issue regards who to count as having dropped out (Nichols, 2010); a single course

definition is prevalent, i.e. dropping out of a specific course, yet other authors have proposed a program perspective (Lehan, Hussey, & Shriner, 2018), i.e., not graduating in a program. However, the time frame is also problematic, as students may take a break (of several semesters) but eventually return and re-enrol later in their academic trajectories.

### ***Prevalence and Importance of Dropout***

Over the last 20 years, research on dropout in online higher education (OHE) has gained importance, as official online programs have shown significantly higher student dropout rates than face-to-face (f2f) programs (Grau-Valldosera, Minguillón, & Blasco-Moreno, 2018), which makes dropout rates one of the greatest challenges faced by OHE educators and administrators (Lee & Choi, 2011). Hence, in-depth understanding of the phenomenon, early identification of at-risk students, and efficient prevention measures have become crucial. Nonetheless, there appears to be a tension between conceptions and studies of dropout in traditional, f2f settings (the origin of dropout models), and in online settings. Hence, it is important to review definitions employed in recent years for OHE, and their friction with older f2f models. It is about ordering a field that is clearly ample and somewhat disorganized, in order to better understand it and the phenomena it studies.

### ***A Scoping Review of Dropout in Online Higher Education***

This article summarizes part of a scoping review of dropout in OHE (Xavier & Meneses, 2020), focusing on dropout (and related concepts) definitions. Scoping reviews can be defined as a method of research synthesis that seeks to map the relevant literature on a specific topic or research area, identifying and clarifying key concepts (Peters et al., 2017). The scoping method was chosen because it is best designed for cases in which the body of literature exhibits a large, complex, and heterogeneous nature (Khalil et al., 2016), and when its key concepts are less well defined in advance (Gough & Thomas, 2016).

### **Method**

The scoping review followed the framework proposed by Arksey and O'Malley (2005). Although the complete review aimed at answering a broad research question, here we will focus on a specific question: "How was dropout (and related concepts) defined in recent OHE dropout research?" Studies were searched and selected from two databases (Web of Science and Education Database); hand-searching of eight key journals; Google Scholar; and key papers reference lists, using key search terms related to dropout and OHE. Studies were eligible for inclusion if they were in English and published between 2014 and 2018, having academic dropout or related subjects (persistence, completion, etc.) in OHE as main research subject, and being a scientific publication with full text available. This search generated 3900 records. Applying the inclusion criteria, a total of 138 publications were included in the review (see Xavier & Meneses, 2020, for the complete list of references). To

chart the data, each paper was coded in terms of dropout (or related) concepts or definitions employed.

## Results

### *Definitions and concepts*

Table 1 summarizes the definitions and concepts employed in the dropout literature (see Xavier and Meneses, 2020, for the spreadsheet with the detailed chartered studies, and the definitions employed in each paper). The most salient fact is that the majority of papers did not provide a clear definition of the central concepts employed. In fact, 78% of the studies that used the concept of withdrawal, 70% of the ones that employed dropout, and 63% of those using retention did not define such concepts, taking them for granted. Other concepts such as persistence and completion were defined more often (65% and 56% of the studies that employed them, respectively).

Table 1: Concepts and definitions

Concepts and definitions	n	%	Shared characteristics/Selected references
<b>Attrition</b>			
From author(s)	9	18.37	Attrition as failing (depending on grades) or withdrawing from course or program was prevalent (Dews-Farrar, 2018; Glazier, 2016; Zimmerman & Johnson, 2017). Three papers defined attrition as leaving the university (Figueira, 2015; Hart, 2014; York, 2014). Most papers employed other concepts (dropout, completion, withdrawal, retention) to define attrition (Figueira, 2015; Knestrick et al., 2016; Nadasen, 2016).
From literature	15	30.61	Most common definition was failing to complete, or not continuing, course or program (Burgess, 2017; Huggins, 2017; Lucey, 2018; Wright, 2015). Two papers defined attrition as leaving the institution (Moore, D., 2014; Nuesell, 2016). Only one paper mentioned a specific timeframe (Hannah, 2017). Two papers (Strebe, 2016; Struble, 2014) defined attrition as a synonym of dropout, and one as the antonym of retention (Johnson, C., 2015). Martinez (2003) was the most employed author for definitions (Lucey, 2018; Russo-Gleicher, 2014; Wright, 2015).
Not Provided	25	51.02	Many papers simply did not provide any definition (Ali & Smith, 2015; Bawa, 2016). Two papers did not provide a definition but employed the concept specifically in relation to courses (Cochran, Campbell, Baker, & Leeds, 2014; Greenland & Moore, 2014).



**A Literature Review on the Definitions of Dropout in Online Higher Education**

Completion			
From author(s)	13	48.15	6 articles: completing and obtaining a degree in a time period (usually 6 years) (Allen, 2017; Brock, 2014; Shea & Bidjerano, 2018). 4 articles: completing a course, which depends on grades (Nadasen, 2016; Strebe, 2016).
From literature	2	7.41	The first referred to course completion (pass), the second to graduation in a program (Heald, 2018; Moore, D., 2014).
Not Provided	12	44.44	Three papers did not provide a definition but employed the concept specifically in relation to courses (Gardner, 2016; Murphy & Stewart, 2017). And two papers specifically in relation to a degree (Rashid, Jahan, Islam, & Ratna, 2015; Sweeney, 2017).
Dropout			
From author(s)	11	22.45	Definitions varied wildly; some focused on dropout from an institution or program in a time period (2-4 semesters) (Brock, 2014; Gregori, Martínez, & Moyano-Fernández, 2018). Others focused on dropout from course(s), depending on sitting exams (Deschascht & Goeman, 2015; Tan & Shao, 2015).
From literature	4	8.16	Definitions varied wildly; some focused on graduating or not, voluntarily or involuntarily; others on withdrawing from courses, depending also on grades (Franko, 2015; Gangaram, 2015; Grau-Valldosera & Minguillon, 2014; Seabra, Henriques, Cardoso, Barros, & Goulão, 2018).
Not Provided	34	69.39	Three papers did not provide a definition but employed the concept specifically in relation to courses (Burgos et al., 2018; Croxton, 2014; Mahmodi & Ebrahimzade, 2015). Others mentioned course or program (Yang, Baldwin, & Snelson, 2017; Yukselturk, Ozekes, & Türel, 2014), or course or institution (Sanz, Vírveda, García, & Arias, 2018; Woodley & Simpson, 2014).
Persistence			
From author(s)	16	33.33	Continuous enrolment (in the next course or semester) was the most common definition (Allen, 2017; Bettinger, Doss, Loeb, Rogers, & Taylor, 2017). Some employed a time frame (enrolment for 3-4 consecutive semesters) (Arifin, 2016; Dexter, 2015).
From literature	15	31.25	Martinez (2003) was the most employed author (to remain enrolled or complete a course or program) (Budash, 2015; Nuesell, 2016; Verdinelli & Kutner, 2015). Most studies defined it as completion of degree or program (Duckett, 2014; Johnson, 2015; Struble, 2014). Intention to continue, or continuation itself in HE (Tinto) (Adams, 2017; Mitchell, 2015). Antonym of dropout, indicator of performance (Franko, 2015).
Not Provided	17	35.42	(Banks, 2017; Bornschlegl & Cashman, 2018; Choi & Kim, 2017).

**A Literature Review on the Definitions of Dropout in Online Higher Education**

Retention			
From author(s)	13	18.57	Continuous enrolment (in the next year) was the most common definition (Chiyaka et al., 2016, mentioned "in the same institution") (Allen, 2017; Chiyaka, Sithole, Manyanga, McCarthy, & Bucklein, 2016; James, Swan, & Daston, 2016; Macy, 2015). Graduation or completion of a program/degree (Banks, 2017; Gazza & Hunker, 2014; Knestrick et al., 2016; Wright, 2015). Completion of course and/or degree; opposite of attrition (Dews-Farrar, 2018; Nadasen, 2016). Intention or attempt to complete courses (González, 2015; Harris, 2015).
From literature	13	18.57	Student progress or continuous enrolment from the institution perspective (Adams, 2017; Johnson, C., 2015; Strebe, 2015; Vadell, 2016). Ability of an institution to retain a student through graduation (Duckett, 2014; Giannaris, 2016; Moore, D., 2014). Hannah (2017) mentions a time-period. Number of online students who complete online courses (Heald, 2018; Marshall, 2017; Struble, 2014).
Not Provided	44	62.86	(Armstrong et al., 2018; Sorensen & Donovan, 2017; Stone, 2017).
Success			
From author(s)	7	33.33	Course grades or grade point average (GPA) (Dexter, 2015; Gardner, 2016; Harris, 2015; Levy & Ramim, 2017). Course grades and retention rates (Glazier, 2016). Different definitions - at the institutional level (retention and graduation rates), program level (retention and program completion), and course level (completion of courses) (Nadasen, 2016).
From literature	2	9.52	Students who display persistence throughout courses, measured by grades (Marshall, 2017; Wright, 2015).
Not Provided	12	57.14	(Andrews & Tynan, 2014; Banks, 2017; Winger, 2016).
Withdrawal			
From author(s)	2	22.22	Voluntary or involuntary removal from a course prior to completion (Lim, 2016; McClelland, 2014).
From literature	0	0	
Not Provided	7	77.78	Most papers did not provide a definition but two employed the concept in relation to courses (Greenland & Moore, 2014; Murphy & Stewart, 2017).

Completion seems to be a clearer, less controversial concept in the literature, usually alluding to completion of course or program. However, it must be emphasized that very few authors employed completion definitions from the body of literature. Many papers defined concepts such as attrition, persistence, and success employing other related concepts, sometimes without defining the latter (e.g., retention and persistence as completion; success as retention; etc.). Definitions of dropout varied wildly but centred upon dropping out from either institution, program or course, during a certain time period,

and depending on grades or sitting exams. Perhaps the concept of withdrawal may summarize a general trend in the field. Although one fifth of the articles that centred on studying such concept provided definitions, and they were based on another concept (i.e. completion), the vast majority of papers did not present a clear definition. Comparatively few papers drew definitions from previous literature (with the exception of papers that employed attrition, persistence, and retention, where half of the definitions came from other authors), which seems to point that there is not still a theoretical continuance in the field.

### **Conclusion: A Complex Phenomenon without a Clear Definition**

Dropout-related phenomena are complex and thus require clear definitions. However, the field is almost chaotic in that regard. The vast majority of the papers studied did not provide any definition; when they did, usually they did not employ previous definitions available in the literature. Also, some definitions are narrow, others very broad and vague, and most are used interchangeably. Another problem is that most definitions are designed as institutional indicators (e.g. retention as completion of a course or a program) that do not take into account students' desires and expectations. In OHE, many students do not plan to graduate or even complete their courses (Woodley & Simpson, 2014). Definitions are still "shaped by theories that view student retention through the lens of institutional action and ask what institutions can do to retain their students" (Tinto, 2015; p. 254). Unsurprisingly, they usually do not consider factors such as transfer to another institution (Ashby, 2004), which imply that students continue their HE studies yet are regarded as dropouts. Thus, stakeholders and policy makers have little accurate and reliable information about dropouts (Grau-Valdossera & Minguillón, 2014), which affects monitoring and comparing interventions in practice. Hence, results are often not comparable across courses, programs, institutions, and countries.

Inconsistent terminology is crucial, for dropout definitions determine how it is measured, confronted, and researched (Ashby, 2004). In other words, the whole field depends, first and foremost, on the definitions it employs. Thus, developing common standard definitions and data collection procedures would benefit the field and impact policy and retention strategies. Tinto (1975) stressed that the field suffered from "inadequate attention given to questions of definition", requiring the development of "theoretical models that seek to explain, not simply to describe, the processes" (p.89) that lead to dropout. Given our results, it seems the field has changed little since Tinto (1982), still studying f2f settings, warned that "dropout research is in a state of disarray, in large measure because we have been unable to agree about what behaviours constitute an appropriate definition of dropout" (p.3).

This issue constitutes a major challenge for OHE dropout studies: in theoretical-empirical terms, they need generalizable, ample, and precise definitions; but they also demand context-dependent, flexible definitions that allows addressing situated interventions. Given the variability of contexts (different university systems, countries and OHE models), it seems this impasse is central to the field. The only answer to that question in our sample was given by Grau-Valldosera and Minguillón (2014), who formulated a program- and context-dependent definition based on learning analytics.

Therefore, many efforts are still needed to develop the field, and it seems the most crucial one should focus on establishing common and shared definitions. Its main research gaps include theorization and precise definitions, which would impact measurement, new models, and the need for stronger evidence on the effectiveness of strategies and early interventions (which is only achievable through comparison between different interventions in different contexts). However, possibly the field will remain as varied and complex as the phenomena it studies: after all, “[t]here is no simple formula that ensures student persistence” (Rovai, 2003; p.12), nor its understanding or definition.

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## ESSENTIAL INPUTS TO EVALUATION THE B-LEARNING UNDERGRADUATE PROGRAMME IN ENVIRONMENTAL SCIENCES

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### Abstract

The undergraduate programme in Environmental Sciences (UPES) have a higher contribution to sustainability and produce better-educated graduates in sustainability areas. To evaluate the UPES, two questionnaires were applied: (a) to the students who dropout; and (b) to the graduates. Also, a student satisfaction questionnaire was used that obtained very positive answers about the experience with online teaching, the coordination team and have very positive general satisfaction of UPES. It was found that most students dropped without doing any course, which may indicate that they have not adapted to this type of Online Education. The positive and negative aspects presented by the dropouts were very dispersed, which reveals that they did not know UPES deeply. Mostly graduates work in the environmental and related areas and have move up their professional careers. The positive and negative aspects among graduates revealed greater knowledge and involvement in UPES, showing, in addition to a good study plan, proximity and collaboration between students and teachers.

### Introduction

Programme courses that deliver an education to sustainability are needed, and also more and better-educated graduates who understand and implement holistic and trans-disciplinary approaches that address the four dimensions of sustainability (economic, environmental, social, and time) and their inter-relations. Programmes with higher contribution to sustainability are, among others, the undergraduate of Environmental Sciences (Lozano & Young, 2013).

While conducting program evaluations, it is important to clearly identify the types of stakeholders among the people surrounding the program, as they are likely the main informants who can tell about the quality and value of the program (Chyung, 2015). The evaluation processes in educational institutions can be undertaken via a survey of students who withdraw from the online courses and students who continue to study using e-

learning systems (Alsabawy, Cater-Steel, & Soar, 2016). The premise for reducing dropout rates is to understand the various factors associated with dropping out. The key to reducing dropout rates is to make use of these factors to screen out potential dropout students and take targeted retention measures before the dropout behaviour happens (Tan & Shao, 2015).

The Undergraduate Programme in Environmental Sciences (UPES) at Universidade Aberta (UAb) is a b-learning programme, directed to an adult public (>21 years old), who are mostly working-students seeking professional development. This 1<sup>st</sup> cycle degree UPES is already in its 12<sup>th</sup> edition and is the only programme being offered mostly in an e-learning context in Portugal. The UPES follows the UAb pedagogical model in its virtual class regime (Pereira et al., 2008), excepting for two curricular units (Fieldwork I and Fieldwork II) which include a face-to-face component (Martinho et al., 2016). In this learner centred pedagogical model, based on the flexibility of access, without temporal or spatial constraints, the students are responsible for knowledge building.

The main goals of this study is to characterize the integration of the graduates in the labour market after finished the UPES, the degree of satisfaction with the UPES, and we are interested to know what are the graduate's opinions about weaknesses and strengths of UPES. We also wanted to know the reasons that led Environmental Science students to drop out and to identify their opinions about weaknesses and strengths of UPES.

## **Methods**

Some questions from the satisfaction surveys applied in the 2018/19 academic year by the Universidade Aberta, Portugal, to students were select. These surveys are applied at the end of each semester and have as main objective the continuous improvement of all evaluated parameters. The average response rate to the Environmental Sciences student surveys in 2018/2019 was 16.9%. The complete results of these surveys can be found at: <https://portal.uab.pt/sgq/inqueritos/>.

An additional online questionnaire was delivered to 104 students who dropped out of UPES between 2014 and 2019. Thirty dropout students answered this survey corresponding to a 29% response rate. It consisted of 14 questions divided into the following areas: socio-demographic characterization; reasons to give up UPES; and positive, negative aspects of UPES. Another survey was also applied, but now to graduates who finished UPES between 2014 and 2019. It consisted of 21 questions divided into the following areas: socio-demographic characterization; employability of graduates; and positive, negative aspects of UPES. An online questionnaire was delivered to 90 graduates and 43 submitted their answers corresponding to a response rate of 47.8%.

## Results and Discussion

In this section are presented the results of the three applied questionnaires: (a) to undergraduate student's satisfaction survey – Academic Year 2018/2019; (b) to dropout's students of UPES (2014 – 2019); and (c) graduates of UPES (2014-2019). These three questionnaires were used to cross information and have as much information as possible in order to implement future improvements in UPES.

### ***Undergraduate Student's Satisfaction Survey – Academic Year 2018/2019***

Regarding student's satisfaction (Table 1), results shows that 91.4% have positive general satisfaction (58.4% *totally agree* and 33% *partially agree*), satisfaction with the experience with online education have 87.65% of agreement (50.6% *totally agree* and 37.05% *partially agree*). Students revealed around 11% of a non-compromising position in relation to the experience with the online education and 1.35% of disagreement. Another important parameter evaluated in this UAb survey is the opinion about the coordination team. Results shows 98.65% of positive experience (57.85% of *totally agree* and 40.8% of *partially agree*) and no negative opinions were found.

Table 1: UPES Student's Satisfaction Survey – Academic Year 2018/2019.

	Totally agree	Partially Agree	Not agree or disagree	Partially Disagree
General satisfaction	58.4%	33%	5.4%	3.2%
Satisfaction with the experience of online education	50.6%	37.05%	10.95%	1.35%
Satisfaction with the performance of coordination team	57.85 %	40.80%	1.35%	0

### ***Dropouts of undergraduate program survey in Environmental Sciences (2014 – 2019)***

UPES students are characterized by having more men (63.2%) than women (36.8%) according to the information from academic services of UAb. Regarding the graduates who answered the questionnaires, this proportion remains almost unchanged (Table 2). Regarding the dropout rate between women and men, this proportionality is no longer verified. It reveals that women abandon more the university (50% vs 37.2%) than men (50% vs 62.8%). One must try to understand the reasons for this difference found. One possible explanation is that our female students give up university in order to support the family and some future concrete solutions should be considered to reduce these dropouts.

Table 2: Gender of dropouts, students and graduate students of UPES -Survey (2014 – 2019).

Gender	Female	Male
Dropouts	50%	50%
Graduates	37.2%	62.8%



Among the dropout students, 73.3% have not completed any course, 10% only have completed 1-5 courses, 6.7% 6-10 courses and 10% completed more than 16 courses (Table 3). Considering that there is such a large number of students with zero completed courses, it should be more deeply studied. It is curious to note that when dropout students were asked if they had the intention to recommence their UPES studies at UAb, 73% answered that, yes, they have that intention and 27% said they did not.

Table 3: Number of completed courses between dropouts' students

Number of completed courses	0	1-5	6-10	16-20	26-29
Dropouts	73.3%	10%	6.7%	6.7%	3.3%

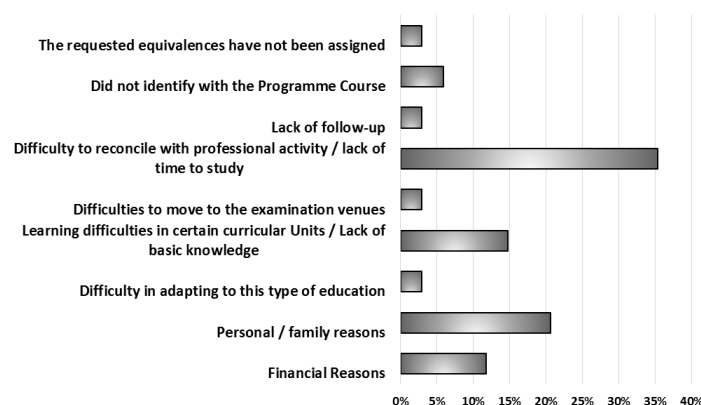


Figure 1. Reasons for giving up the b-learning UPES (34 answers)

The four main withdrawal reasons found were difficulty to reconcile with professional activity / lack of time to study, Personal / family reasons, Learning difficulties in certain curricular Units / Lack of basic knowledge and Financial Reasons (Figure 1). These results are similar to other studies (Aydin et al., 2019; Lee, Choi, & Kim, 2013; Park & Choi, 2009; Street, 2010).

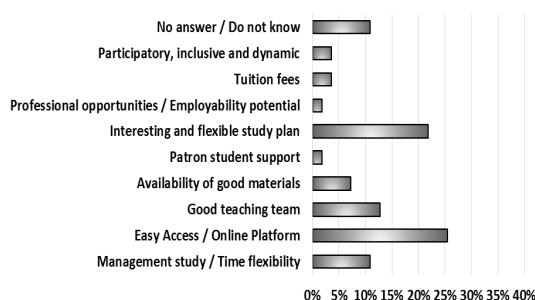


Figure 2. Positive aspects of the UPES (dropouts) (55 answers)

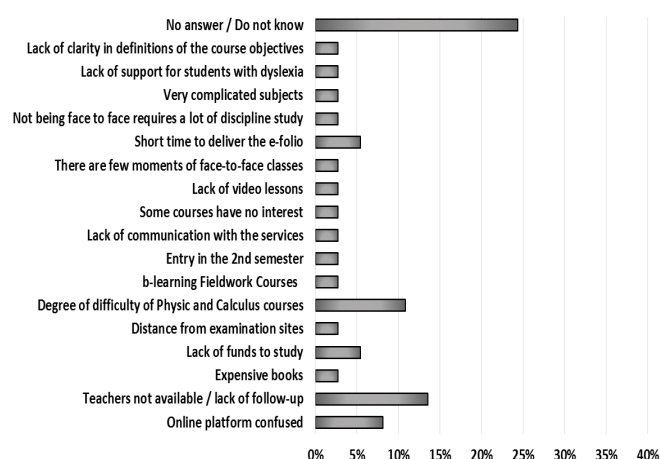


Figure 3. Negative aspects of the UPES (dropouts) (37 answers)

Regarding the positive aspects of UPES between the dropout students, this study found that the four most frequent responses (in 9 different answers) were “Easy Access/Online Platform”, followed by the “interesting and flexible study plan”, “good teaching team” and “management study/time flexibility” (Figure 2). In relation to the negative aspects, the results show more widespread replies (Figure 3). Around 25% of the dropout students mentioned “didn’t answer / didn’t know”, followed by “teachers not available / lack of follow-up”, “Degree of difficulty of Physics and Calculus courses” and “Online platform confused”.

### ***Graduates of undergraduate program survey in Environmental Sciences (2014-2019)***

Table 4 shows the employment situation of the graduates in Environmental Sciences between 2014 and 2019. It allowed 37.2% of the graduates to be able to move up the professional career, thus constituting the achievement of an important objective when students enrol in the course. Of these graduates, more than half (56.3%) achieved it in less than a year, which leads us to believe that this is a positive point that should be emphasized, especially when students assume that there is no recognition of the course by the entities. Regarding the high employability rate of students before and after finishing the course (95.3%), this is in line with the general characterization of this type of audience, since distance learning students are adults inserted in the labour market (Chao, DeRocco, & Flynn, 2007). More than half of the graduates (51.2%) currently work in the area of Environment Sciences or related areas.

Table 4: Employment situation of graduates in UPES (2014 – 2019)

Situation	%
Unemployed before and after UPES	4.7
Employed before and after UPES	95.3
Currently employed in Environmental Sciences and related areas	51.2
Climbed the professional category after UPES	37.2
Climbed professional category until 1 year	56.3
Climbed professional category after > 1 year	43.8

Regarding the expectations of the graduates about UPES, Figure 4 shows that maximum scores (8, 9 and 10) were found in 89% of the responses. Barth and Burandt (2013) concluded that substantial benefits can be derived in higher education from the use of e-learning as a facilitator of on-going innovation in education for sustainability.

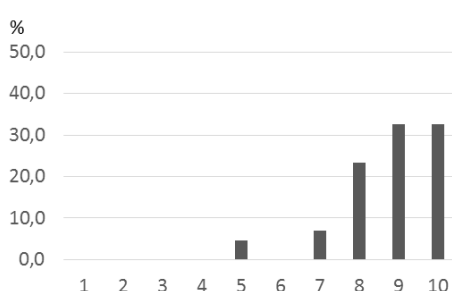


Figure 4. Expectations of graduates related to UPES.

The scale ranges from 1 – *did not correspond* to 10 – *fully corresponded to expectations*

Among the graduates, there was a list of 15 positive aspects, in 101 answers (Figure 5) and in relation to the negative aspects there was a list of 26 different classes enunciated in 61 answers (Figure 6). Regarding positive aspects, the “interesting and flexible study plan” was the most nominated, followed by the “good teaching team”, “easy access/Online platform” and “face-to-face fieldwork courses”, “management of study/time flexibility”, “mutual aid between students and teachers” and “Rigor/ Scientific requirements”. Baker and Moyer (2019) suggest that students who perceive a sense of community in an online course will have more favourable online course impressions. Students who felt they established a connection with others had higher levels of engagement, perceived value to career, overall evaluation and preference for online courses, and lower levels of anxiety/frustration. This fact may explain the maximum scores (8, 9 and 10) found in the expectations of graduates related to UPES in the Figure 4 above.

Regarding negative aspects, “the absence of videos/absence of synchronous moments” was the most enunciated aspect, followed by the “lack of recognition by the entities” and “teachers not available/lack of follow-up/slow responses” and followed by “outdated study materials/some shallow subjects/maladjusted subjects”. The 5<sup>th</sup> score response of graduates was that there are “no negative aspects”. Regarding negative aspects, “the absence of videos/absence of synchronous moments” was the most enunciated aspect,

followed by the “lack of recognition by the entities” and “teachers not available/lack of follow-up/slow responses” and followed by “outdated study materials/some shallow subjects/maladjusted subjects”. The 5th score response of graduates was that there are “no negative aspects”. According to Violant and Vezzetti (2015), an interactive multimedia module (which includes video, animations, simulations, audios, and films) can visually stimulate a student and transform learning into an active engaging process. Also, the feedback given by teachers help students to clarifying things and help students to improve the ways of learning and studying (Palmer & Holt, 2009; Vaz-Fernandes & Caeiro, 2019). Those negative aspects ate an important alert in order to improve some modifications in the UPES.

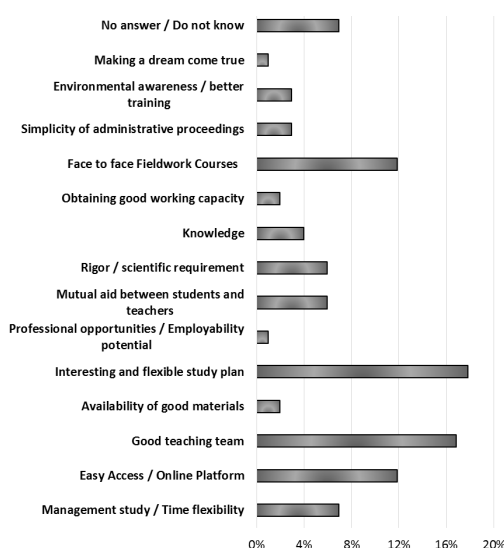


Figure 5. Positive aspects of the UPES (Graduates) (101 answers)

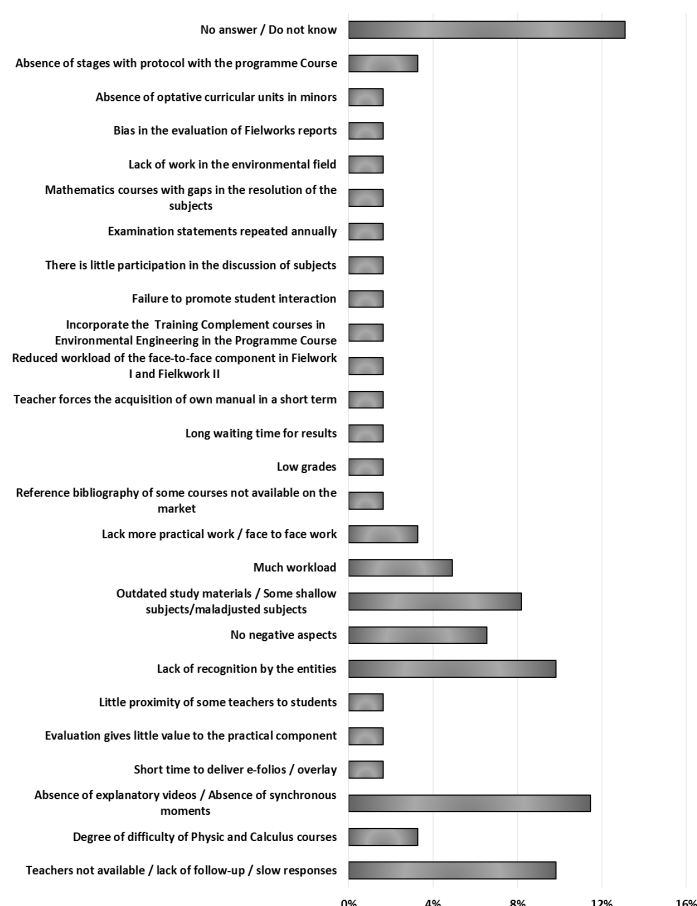


Figure 6. Negative aspects of the UPES (Graduates) (61 answers)

## Conclusions

We can conclude that the choice of stakeholders for the evaluation of the programme course is a very important measure because only the participation of students is not enough. For this reason, we extended the assessment to students who dropped out and to the graduates in Environmental Sciences. Therefore, it was possible to deepen the positive and negative aspects of the UPES and have information for future improvements. This study also allowed better understand the current situation of employment of graduates.

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## **DIGITAL BADGES FOR STUDENTS' ASSESSMENT AND RECOGNITION – A UNIVERSITY CASE**

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### **Abstract**

The main goal of the paper is to describe current practice and experience of one university in application of digital badges with particular attention to two research questions: What are the purposes of issuing digital badges to students? How digital badges are used in fully online or blended learning studies referring to student's assessment and recognition? A case study design has been selected in order to analyse real-life issues and practices. Virtual learning environment and characteristics of meta data of digital badges have been analysed. The results of the analysis indicate that majority of digital badges were issued in order to assess students' knowledge, skills, and competencies while the rest of the digital badges were issued to acknowledge personal features and to motivate. However, recognition using digital badges does not take place at the University. Findings indicate that teachers need trainings on the development and application on digital badges in order to offer transparent procedures when the system itself gives digital badges to students after their fulfilment of predefined criteria to make assessment process more objective.

### **Introduction**

The word and the concept of “badges” have been used for many centuries (Araújo, Santos, Pedro, & Batista, 2017; Halavais, 2012), by different civilizations and with different meanings. However, one can start with the definition given by Mozilla, 2014 (referred by Araújo et al., 2017; p.27): badge is a “symbol or indicator of an accomplishment, skill or interest” as it applies to several contexts where they had been used, primarily as a physical artefact (e.g. used on cloths by the armies with a wider circulation during the fourteenth century), and nowadays in learning environments and on online spaces. In what education is concerned this concept has gained a worldwide interest only since 2010 (Gibson, Ostashevski, Flintoff, Grant, & Knight, 2013).

Given the scope of our study, digital badges in Higher Education (HE), one will discuss now this context by exploring, based on recent literature, DB meanings, potential, the



variety of ways they have been used, as well challenges they are still experiencing. One should notice, since now, that there are a considerable number of studies which already refer the use of DB in HE. A search of “Digital Badges + Higher Education” on Scholar google, done on 13<sup>th</sup> of January 2019, and since 2016, shown 18 600 results in 0.08 s. This may be an indicator that justifies what Stefaniak and Carey (2019) affirms, that “badges are growing in popularity” in HE (p.5). Researchers and practitioners have offered solutions how to introduce DB, what information has to be embedded in metadata of DB, how the learner can earn DB, what technical standards allow sharing digital badges with others. Nonetheless, each university implements DBs differently and solves emerging problems in its own way.

The main research questions of the paper are:

- What are the purposes of issuing digital badges to students?
- How digital badges are used during fully online or blended learning studies referring to student's assessment and recognition?

## **Background**

Digital badges potential can be seen as having an effect in increasing (a) students' achievement (Mah, 2016), (b) students' motivation (Iwata, Telloyan, Murphy, Wang, & Clayton, 2017), and (c) opportunities to peer review and feedback (Stefaniak & Carey, 2019).

Stefaniak and Carey (2019) refers three main ways of implementing digital badges, namely at an individual course-level, program-level and at a university-level, respectively: when a digital badge is introduced in a given course and any student may choose to earn a digital badge; when a given program adopts digital badges and teachers of different courses may choose to use them in theirs courses; and when a digital badge is adopted by the university thus incorporating digital badges in its learning management system.

The traditional university setting is trusting more paradigms of academic credentialing and educational assessment and is not particularly keen on including a new type of credentials in the form of digital badges that are transforming education and learning (Casilli & Hickey, 2016). Nevertheless, the use of digital badges in HE have been studied with different purposes (Abramovich, Schunn, & Higashi, 2013), namely (a) to influence students' engagement and learning (e.g. the earning of a DB may motivate a student to learn), (b) to asses learning (e.g. in classroom) in formal and less formal (autonomous work) contexts (Abramovich, Schunn, & Higashi, 2013), (c) to certify by giving a micro-credential to a students' achievement and (d) to value academic and professional development in particular to enhance employability.

Given the focus of our study – the use of digital badges for students' learning assessment and recognition, one will develop further the topic of using digital badges for assessment and recognition.

Digital badges have been successfully tested in university graduate research programs to assess acquisition of necessary research skills and serve as a certain roadmap to skills necessary to attain during research studies that are not too structured in terms of constant course work (Mewburn, Freund, & Rutherford, 2014). Besides, introduction of digital badges in education bring transparency to teaching, learning and assessment, reveal identifiable and detailed learning aspects for all stakeholders and provide a new mechanism to recognize skills, experience and knowledge through an open, transferable and stackable technology framework (Gibson, Coleman, & Irving, 2016).

Theoretical findings demonstrate that DB at Universities are issued for different purposes and on different levels as shown in table 1

Table 2: Digital badges at Universities are issued for different purposes and on different levels

Level	Purpose
University	To award teachers and/or students for activities in Learning Management system.
Programme	1. Encouragement of motivation 2. Assessment of learning achievements 3. Certification through micro-credentials
Course	4. Recognition of skills, experiences and knowledge gained outside academia.

At university level teachers could be awarded for different purposes as for example for development of online learning courses, students – for their volunteering in different events or mentoring other students during their studies or taking care for foreign students' integration into the university community. On program or course level students could be awarded digital badges with the purpose of motivation and engagement in learning. The feature of digital badges to provide evidence in the form of digital credentials (usually on the course level) could be attractive for higher education students, who are willing to demonstrate specific skills to the employers that are not otherwise visible in the official university transcripts. And finally, badges have a potential to measure students' learning assessment and recognition of skills, experiences and knowledge gained outside academia.

## **Methodology**

Considering the research questions of the study, a case study design has been selected. Case study allows researchers to analyse real-life issues and practices by employing and combining various data collection and analysis techniques and providing holistic understanding of the phenomenon analysed.

The unit of the case study is comprised of 13 different study courses and datasheets, generated by virtual learning environment analytical tools, where digital badges were created, activated, and issued to students. The courses for analysis have been selected with the assistance of a Moodle administrator. All of the analysed study courses belong to either humanities or social sciences. Besides, the analysed courses are designed for blended or fully online learning mode.

Digital badges are created and used in virtual learning platform, i.e. Moodle, and, once they are issued, they can be seen by all Moodle users. Teachers and administrative bodies are responsible for creating digital badges that are given to students, whereas, administrative bodies establish digital badges for teachers. In order to create and activate a digital badge, a teacher has to fill out a template that is provided within the virtual learning environment: they have to name the digital badge, add its description, image, and, finally, select its expiration date. This description later serves as the metadata for a digital badge.

Once the criteria are set and the digital badge is created and activated, it can be categorized in terms of its purpose, i.e. to motivate, to assess, or to recognize certain features, skills, or competencies. A note should be made that the institution that is being examined provides a training course for teachers who are willing to create digital badges in their study courses. However, the participation in the training course is voluntary.

The data collection method is analysis of the database of a virtual learning environment. There the digital badges were established and used in the teaching and learning process. Virtual learning environment was used as the database to collect evidence of digital badge design and application for students' motivation and recognition. A careful examination of the metadata of digital badges was performed in order to find out information on their type and purpose. This allowed exploration of the main reasons for what purposes digital badges are being issued to students. The data sheets that were used for the analysis were generated by the analytics tools of the virtual learning environment in order to find out how digital badges are used during fully online or blended learning mode referring to student's assessment and recognition. To get clear data on how digital badges are used content analyses of meta data of digital badges were used.

Considering the fact that the vast majority of digital badges have been created and issued in social sciences and humanities, the research is only going to focus on these two study fields. The sample for the document analysis is 13 different study courses, taught starting fall semester of 2015 up to fall semester of 2019, in two different study fields.

## **Findings**

At the university where investigations are made, both students and teachers are being awarded with digital badges. Digital badges can only be seen by users (e.g. students, teachers, administrators, staff members) of the University's Moodle platform. Unless the Moodle platform user decides to transfer one's earned digital badges to any of the open digital badges collection systems, there is no possibility for outsiders to observe one's achievements that have been listed through digital badges. As a result, a remark can be made that here the Moodle system is closed and recognition of digital badges is still only within institution. Besides, it is very important to stress the fact that digital badges are only valid for a definite period of time.

Teachers can create and reward students with digital badges. Students usually receive digital badges for course activities or fulfilment of particular requirements. Digital badges that students were awarded can be seen by all users on University Moodle platform. It should be noted that teachers not only create digital badges by composing the description, choosing image, setting the criteria that have to be fulfilled in order to receive it, but also they often are the ones deciding on who are going to be awarded with digital badges. Thus, it might be rather subjective, in comparison to a more objective assessment procedure when the system itself gives digital badges to students after they fulfil predefined criteria.

The content analysis of metadata descriptions of digital badges revealed the fact that digital badges are usually awarded to students for the following reasons: for acknowledgement of soft skills, personal features, such as thoroughness, punctuality, activeness, then for motivation/encouragement, and, finally, for assessment. Thus, different categories of digital badges for students have been determined. The representation of these categories of digital badges in our case was: 200 digital badges for assessment, 77 digital badges for motivation and soft skills.

The purpose of the majority of digital badges that were issued to students was to help to assess students' knowledge, skills, and competencies. For example, in most cases, a student who was awarded a badge belonging to the category assessment, received it for participation and offering insight within the class online forums, may get his/her final or midterm grade raised by a significant amount, as much as up to ten percent in some cases. Then, digital badges are used to acknowledge students' features, skills, and qualities. The content analysis has suggested that digital badges, belonging to the category of acknowledgement, refer to a particular feature, skill, or competence that is being acknowledged. For example, a teacher awarded a student with a digital badge for punctuality in order to show that the student always submits assignments on time. And, finally, through establishment of categories, it has become obvious that digital badges can

be used as tools to motivate/encourage students in their study process. There was a large group of digital badges with the title and/or metadata descriptions suggesting that the main purpose of these badges is to motivate/encourage students to continue with their course work, to try harder, and to encourage if the student (i.e. digital badges for active participation, involvement, thoroughness).

It worth to stress that analysis of virtual learning environment confirms that not a single student transfer any digital badge from other virtual environments. And this allows us to state that recognition using digital badges does not take place at the University study courses nor programs level.

The analysis of metadata descriptions of digital badges have indicated that students can be awarded with digital badges that serve as admitting their particular features such as active involvement in course activities, punctuality in completing tasks, creativity overall and creativity in preparing presentations, and thoroughness in doing homework assignments. 40 digital badges that have been used to indicate qualities in students have been issued. Besides, the document analysis has shown that some digital badges to admit features such as collaboration, leadership have been created; however, none of the students have been awarded with them. Finally, in order to receive such digital badge, student has to demonstrate the skills and abilities and then the teacher decides whether to give the award or not. Thus, even though the digital badge itself has been established, it does not mean that the students will be awarded with them; certain criteria that are indicated in the metadata description of digital badge have to be fulfilled.

Analysis of digital badges on virtual learning platform has demonstrated that most of these badges are created using non-official pictures, and in many cases the title of theses badges sounds rather informal. Thus, a note should be made that a vast majority of these digital badges seem to be rather unprofessional and informal. Besides, often the title of the digital badge and its description are the same and metadata descriptions are also rather poor and lacking details when and why this kind of digital badges are being issued. In some cases no explanations or criteria for earning badges are provided at all.

## **Conclusions**

The case analyses of existing application and practices of DB at university reveal the purposes of issuing digital badges to students. The vast majority of digital badges that have been issued to students is to help to assess students' knowledge, skills, and competencies the minority of DB demonstrate willingness of teachers to admit soft skills, personal features of students, to motivate them to study. Unfortunately, recognition of knowledge, skills, and competencies gained in other environments that do not belong to the university using DB do not take place at the University.

Virtual learning environment analysis proves that digital badges are used in fully online or blended learning studies. In most cases not the system but teachers decide whether to give the award or not while this might be rather subjective. As a contrast a more objective procedure could be suggested when the system itself gives digital badges to students after they fulfil predefined criteria. Digital badge metadata analysis confirms a rather poor and detail lacking descriptions about when and why digital badges are being issued.

All those findings indicate that teachers desperately need training in preparing data, describing results, and employing virtual learning platform to create digital badge based on evidences.

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## TEACHER PRACTICES IN USING LEARNING ANALYTICS TO ENHANCE LEARNING IN BLENDED ONLINE STUDIES

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### Abstract

While higher education institutions (HEIs) are exploring innovative ways to enhance and facilitate learning experience of students and so to improve the overall quality of studies, technology enhanced learning (TEL, henceforth) becomes inevitable. Having explored the possibilities and benefits of TEL, HEIs encourage teachers to develop blended online courses in virtual learning environments, to use new tools and solutions available for student learning monitoring and enhancement and to research how these practices are successful and what are the factors that make impact to teaching and learning success. This paper aims to identify teacher practices how the use of learning analytics in virtual learning environment may enhance learners' engagement in blended online studies in HE.

### Introduction

Higher education institutions (HEI) are constantly searching for ways of improving the quality of studies, enhancing learning experience for students through engaging them into studies and increasing flexibility, mobility, and accessibility, though at the same time trying to meet all organizational and institutional guidelines (De George-Walker & Keeffe, 2010; Bonk, Kim, & Zeng, 2006; De George-Walker, Hafeez-Baig, Gururajan, & Danaher, 2010; Graham, 2006). The adoption and integration of technological advancements and the promotion of technology enhanced learning, which is the usage of information and communication technologies to further the learning/teaching processes, has become rather common practice among HEIs (George-Walker & Keeffe, 2010; Kirkwood & Price, 2014). This paper aims at describing teacher practices at Vytautas Magnus University (Lithuania) in adopting technology enhanced learning through the development of blended online studies, and using virtual learning environment tools such as learning analytics (LA) to increase learners' engagement and enhance the learning/teaching processes.



## **The Benefits of Blended Online Learning**

TEL includes different forms of learning using technological advancements; however, it should be noted that the most commonly used type at HEIs is blended learning. Blended learning has a variety of modes, and each university may decide which definition is mostly meeting the forms adopted by university teachers. Vytautas Magnus University has institutional regulations that define the application of technologies in teaching and learning following the intensity of the use of technologies, that is measured using specific quality assurance tools. There are online courses and programs available for students, but the majority of the courses in university correspond to blended online learning courses, which means that all curriculum is online, but following the needs of the students some classes may take place in face to face mode, if needed and if agreed with the students and the teacher. As this is the most popular mode at this particular university, the paper will address this mode and will refer to it as blended online studies further on.

There are many advantages for HEIs to use blended online learning. It should be stated that blended online learning has changed the traditional teacher-centred approach, with a more learner-centred practices, with more learner engaged activities in teaching and learning (Bonk, Kim, & Zeng, 2006). As a result, teaching/learning processes have become more personalized and flexible. A note should be made that digital tools, integrated in virtual learning environments, i.e. learning analytics, may assist teachers while adopting a more learner-oriented approach, designing curriculum that satisfies learners' needs, and increasing students' engagement (Van Harmele & Workman, 2012; Siemens, 2015). In addition, blended online learning can contribute to enhancing learning/teaching processes, and at the same time, addressing organizational requirements (Bonk, Kim, & Zeng, 2006; Garrison & Kanuka 2004; Laurillard, 2002; Graham, 2006; Macdonald, 2008). Finally, a note should be made that integration of technologies in teaching and learning can grant access to massive amounts of study materials at any given time (Teresevičienė et al., 2015). In a similar manner, virtual learning environments, with the help of learning analytics, can produce a lot of data about learners and the contexts where learning occurs (Siemens & Long, 2011). Such data may be useful for teachers who are working on improving curriculum that would address real-time learner's needs and promote personalized learning. Thus, it should be stated that courses developed for blended online studies in a virtual learning environment benefit from the learning analytics as tools integrated in the environment, allowing much greater potential for student monitoring and activity completion tracking, as well as student behaviour analysis for study purposes. The data of student behaviour in one particular blended online course may enhance study experience, increase students' engagement, and address learning and teaching quality issues.

## **Description of VMU Experience Using Virtual Learning Environment**

To begin with, it should be noted that the university offers a huge selection of different courses in different fields of study such as humanities, social sciences, natural sciences, arts, computer sciences, as well as different types of instruction, including traditional face-to-face classrooms, blended, and online learning. The university actively promotes technology enhanced learning and encourages teachers to be innovative and to adopt new types of instruction, including blended and online, in order to enhance the learning experience, to increase availability of education, and to raise the overall quality of studies.

In fact, it should be noted that the university has integrated a virtual learning environment (Moodle) in 2009 and been using it since. Even though, the virtual learning environment was not popular among teachers at the very beginning, later, the situation changed as more teachers have opted for registering their courses in Moodle and exploring new ways of instruction (see Figure 1 below).

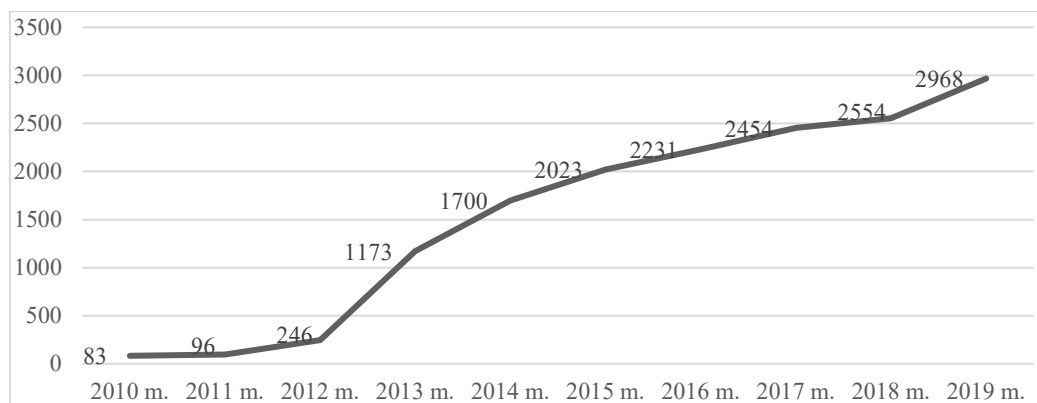


Figure 1. Numbers of blended online courses available in Moodle, 2010 – 2019.

As demonstrated above, for the first three years the growth of study courses in the Moodle platform has been rather slow. Prior to adoption, there were several competing systems for student-teacher communication, including Moodle, First Class, various websites or blogs of the teachers, individual email, and the fledgling Facebook interfaces. Thus there was a need to centralize and manage the learning/teaching, communication, and collaboration processes. As a result, administrative regulations and guidelines have been established which set obligations for teachers to start using the Moodle platform for teaching by developing blended or online courses for the virtual learning environment. Besides, it should be stated that these guidelines have provided organizational, content, and structural criteria for blended online learning course quality criteria. Thus, it can be stated that the university supports integration of blended online learning on the institutional level.

Another fact should be noted that three levels of study course preparation for the online learning platform have been described. In order to fulfil the requirements for the first level,

study course preparation and adaptation for Moodle platform, a teacher has to register the course in the online platform and upload approximately 20-49% of the curriculum. With the second level, blended learning has been promoted because the teacher would have to upload approximately 50-90% of the study content and choose such study activities that would not always require face-to-face interaction. Finally, the third level has defined the parameters for completely online learning offered by the institution, meaning 91 through 100% of the study content to be uploaded and the whole course curriculum has to be designed for fully online learning and teaching (interactions, learning assignments, mid-term and exams).

Again, since establishment of these administrative guidelines, a significant increase in study courses registered in Moodle can be observed. To illustrate this, before the announcement of guidelines, only 246 study courses existed in the Moodle environment, however, once the guidelines were announced, the number of study subjects increased dramatically, to a total of 1173 (see Figure 1). Moreover, it should be stated that the number of study courses in Moodle is constantly growing due to academic staff turnover and establishment and accreditation of new study programs. For instance, by the fall semester of 2019, a total number of 2968 study courses exist on the Moodle platform, out of which 729 courses have been newly created and 293 courses have been erased in order to eliminate courses that have not been used in that way of optimizing study programs. Besides, it should be stated that the vast majority of study courses registered in Moodle belongs to the Agriculture Academy (i.e. 568 study courses), followed by the Faculty of Humanities with 476 courses registered in Moodle in second place, while Music Academy holds the smallest number of subjects in Moodle (54 courses). However, overall a rather small number of study courses are prepared for blended or online mode. For example, last semester 264 study courses were taught in blended learning mode, while only 104 study courses have been accredited for the fully online mode. The reason why such a small number of study courses have been accredited for fully online mode is that there is a relatively long list of criteria (that are described in documentation) that have to be met in order to gain said accreditation.

Another important thing that needs to be mentioned is that the university has not only implemented and promoted the usage of the virtual learning environment, but also purchased licenses for the Adobe Connect tool, which enables video conferences. This tool is supposed to ease communication between teachers and students when face-to-face interactions are not possible, eliminate any physical restrictions, and increase accessibility of study materials (lectures can be recorded and students can participate in the lecture at convenient time for them by simply listening to the recording). Besides, it should be noted that every year, the university invests both financial and human resources into

maintenance and renewal of the learning platform, Adobe Connect tool, and operating systems. In addition, the university is even offering to buy licenses for additional external tools, i.e. collaborative tools that are compatible or can be integrated within the learning platform if the existing Moodle tools cannot meet the needs of teachers while trying to ensure efficient teaching/learning processes.

A note should be made that integration of the Moodle platform and various tools, including Adobe Connect, and active promotion of blended and online learning, have enabled mobility and flexibility of teachers and students. For example, in 2019, students and teachers have logged in to Moodle, using IP addresses from 97 different countries. In Figure 2, a pie chart with the list of countries from which more than 100 unique logins have been registered is provided.

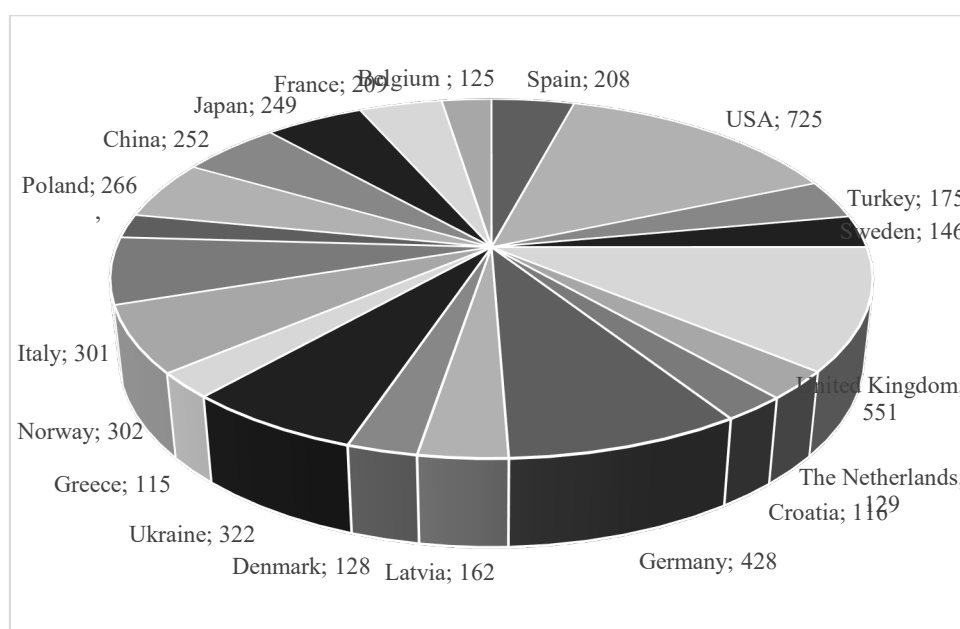


Figure 2. Logins to VMU Moodle from different foreign countries

As seen above, the vast majority of logins to the VMU Moodle platform (i.e. 725) has been noted from the USA, whereas, the lowest number of logins (i.e. 115) has been observed from Greece. Nonetheless, it should be stated that 9176 students have been using the online learning platform on a daily basis. Thus, it can be stated that the Moodle platform is used actively, frequently, and even internationally. As a result, it becomes rather obvious that integration of the Moodle platform and other related tools increased accessibility of education, allowed flexibility, and contributed to internationalization.

Besides, the university has introduced digital badges for both students and teachers as a means to raise motivation, to acknowledge a variety of soft skills or professional competencies, and to assist in digital assessment. At VMU, teachers can be awarded with digital badges on four different occasions. For instance, teachers can get a digital badge if

they have fulfilled the requirements and prepared or adapted their courses for the Moodle platform. Additionally, teachers can get a badge that is given for experts in online learning to acknowledge skills, experience, and certain competencies, too. They can also receive a digital badge if they attended courses or seminars. Finally, they can be awarded with digital badges when they receive positive evaluations from students. In the meantime, students at VMU can receive digital badges that are issued by their teachers at course level. The most typical reasons for earning digital badges for students are the following: assessment, motivation/encouragement, and finally, recognition of so-called soft-skills such as leadership, collaboration, etc. In short, it can be stated that the university is trying to integrate and popularize digital tools such as digital badges in order to encourage the academic community to use and explore the virtual learning environment possibilities for recognition of skills, competences, and assessment.

Finally, it should be stated that the university actively invests in support systems and trainings for teachers who are integrating and using Moodle and other digital tools in the teaching process. There is a technical support team who can answer any questions regarding Moodle and the Adobe Connect tool. Teachers and students can either fill out online request forms, where they describe their issue, or contact support directly and arrange individual meetings in order to solve their problem regarding the usage of Moodle. For instance, in 2019, teachers have created 1337 online requests, whereas, students have filled out 1609 request forms for the VMU Moodle technical support team regarding various technical or organizational questions. Additionally, user manuals are available in both English and Lithuanian. The university is constantly organizing trainings for teachers that cover such topics as usage of Moodle, Adobe Connect tool, design and development of technology enhanced curriculum, content licensing, and arrangement of teaching in a virtual learning environment.

## **Methodology**

The empirical part of the research aims at describing teachers' experiences of using LA in order to engage students into the blended online courses. This research is part of a wider scope of research on the needs of digital and networked society for open and online learning. This research aims to contribute to the research field of LA by revealing existing practices and disclosing pedagogical LA data-driven decisions.

### ***Research participants***

A qualitative approach was used to take 25 interviews from university teachers, delivering blended and/or online courses in Moodle. Research participants covered 10 study fields: economics, natural sciences, education, agriculture, philology, law, mathematics,

informatics, communication, and psychology. The age of interviewees varied from 29 to 63, with the online teaching experience varying from 2 to 15 years.

### **Data collection**

Semi-structured interviews were used to collect data, following the set of topics as interview guidelines.

### **Data analysis**

Qualitative content analysis was chosen to analyse interviews and present research findings.

### **Results**

A note should be made that data analysis was driven by the research question – “What are teachers’ practices of using LA to engage students into blended and/or online courses?” The research question has been analysed and results are being discussed in a category which summarises teachers decisions about changes in course curriculum based on LA data.

The interviewers emphasized the fact that it is very significant for a teacher to be open to changes. These changes can be induced by the urge to improve course curriculum based on the data from LA in response to one or the other activity. Despite being aware that in most cases the course does not go on the way they have planned in advance, some of the research participants feel rather confused when the discussion comes to the timely changes of the course curriculum. Therefore, it is important not to be afraid to experiment with the learning activities and reflect with students on them.

Trying different learning activities uncovers the teaching presence. Analysis of this experience demonstrates that designing of the curriculum is not a static process; instead, it should be seen as going through continuous changes that are related with the improvement and designing of learning activities or tasks. Research participants confirm that next to the grades, data given by learning analytics helps them grasp challenging moments related to students’ task implementation or engagement. Sometimes, from the teacher’s perspective, the task may seem much more engaging and interesting than it is for students:

*“I created a blog, where I asked students to upload their analysis of different articles in the media, discussing the same topics from the perspective of state, the resident, or the business. But this blog failed, as it got absolutely formal and did not evolve into some format that could stay by itself. As my initial*

*idea was that we could have a place to upload news. <...> but they did what I asked them to do and that's it." (I01)*

As analysis reveals, formally, the task that was given by the teacher was delivered by the students. But despite the fulfilment of formal requirements, students showed no interest in getting involved in the suggested blog any deeper. It could have happened because of the lack of students' motivation or because the teacher did not explain expectations s/he had and how it was supposed to help everyone for the further learning process. In this case there was a lack of social and teaching presence in the course.

Research participants demonstrate different practices and experiences related to the application of new approaches towards the development of learning activities. Some teachers tend to make timely changes related to the improvement of activities:

*"if I feel that there are some difficulties in my course, that tasks are too difficult, there's too many of them and so bigger part of students do not deliver them, <...> that there's a significant delays <...>, I make a decision to make changes, either by shifting individual activities into group work, or by simply ignoring them." (I22)*

Others tend to revise their curriculum each semester by observing learners' level of knowledge and preparation:

*"it is impossible to teach the same material each semester, this is not English language, history, or philosophy. I always observe if we are in time with the themes, if there is any delay, what students understand and what not" (I13).*

Nevertheless, they all share a unanimous understanding that having the possibility to observe learners' activities and engagement, provide them with at least basic directions on what changes should be made. As it was observed, in most cases, when the tasks were not working well with the students, teachers tended to change tasks only the next year, when new students would join the course. This kind of decision may not seem very reasonable when thinking that all groups of students are different and so, if the task does not work well with one group, it might be a success with the other.

## **Conclusions**

In conclusion, it should be stated that the university is trying to ensure transition from traditional face-to-face teaching/learning organization to a more modern and flexible teaching/learning in a virtual learning environment. The university has taken administrative measures to promote technology enhanced learning and to accelerate usage of the Moodle platform. Besides, it should be stated that the university invests both

financial and human capital in development of support mechanisms for teachers and students who are using Moodle. Training is offered where teachers can find out about the possibilities of the virtual learning environment and its tools, to learn how to use these online tools, to understand the different pedagogic approach that dominates in blended or online learning, and, finally, to get some skills in creating curriculum for online or blended studies. The university's efforts seem to have paid off because Moodle is being actively used on daily basis. Moreover, it should be mentioned that the integration of Moodle has increased the accessibility of education and mobility of teachers and students.

The application of LA tools to monitor learners' engagement has facilitated teaching and learning processes and enabled teachers to quickly interact and intervene into learning processes whenever needed. Teachers report that they make changes in curriculum design and pedagogical approaches that would correspond to actual learners' needs and to make learning more personalized.

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## ASSESSING CRITICAL THINKING IN OPEN-ENDED ANSWERS: AN AUTOMATIC APPROACH

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### Abstract

The role of Higher Education (HE) is growingly acknowledged for the promotion of Critical Thinking (CT). Constructed-response tasks (CRT) are recognized to be necessary for the CT assessment, though they present problems related to scoring quality and cost (Ku, 2009). Researchers (Liu, Frankel, & Roohr, 2014) have proposed using automated scoring to address the above concerns. The present work is aimed at comparing the features of different Natural Language Processing (NLP) techniques adopted to improve the reliability of a prototype designed to automatically assess six sub-skills of CT in CRT: use of language, argumentation, relevance, importance, critical evaluation and novelty (Poce, 2017). We will present the first (1.0) and the second (2.0) version of the CT prototype and their respective reliability results. Our research question is the following: Which level of reliability are shown respectively by the 1.0 and 2.0 automatic CT assessment prototype compared to expert human evaluation? Data collection is realized in two moments, to measure respectively the CT prototype 1.0 and 2.0 reliability from a total of 264 participants and 592 open-ended answers. Two human assessors rated all of these responses on each of the subskills on a scale of 1-5. Similarly, NLP approaches are adopted to compute a feature on each dimension. Quadratic Weighted Kappa and Pearson product-moment correlation were used to evaluate the between-human agreement and human-NLP agreement. Preliminary findings based on the first data set suggest adequate level of between-human rating agreement and a lower level human-NLP agreement ( $r > .43$  for the subscales of Relevance and Importance). We are continuing the analysis of the data collected in the 2<sup>nd</sup> step and expect to complete them in June 2020.

### Introduction

Despite the scepticism toward the possibility to objectively assess Critical Thinking (CT), CT skills are considered a desirable learning outcome in all the level of education, included Higher Education (HE), according to economic (OECD, 2012) cultural (UNESCO, 2015)

and educational research-oriented organizations (IEA, 2018). In response to the Bologna Declaration of 1999 aimed at developing a comparable degree system among European countries, the Tuning Projects identified different general and subject specific skills to develop in HE students, included CT (Gilpin & Wagenaar, 2008). The AHELO project carried out by OECD (2012) also included CT as one of the general skills that should be assessed at an international level. Thus, reflecting upon CT assessment choices is necessary at least for two reasons: firstly, CT is considered a desirable learning outcome for European HE students and should be assessed and recognized in a comparable way, according the Bologna Strategy; secondly, research is necessary to understand which teaching strategy can foster CT skills in HE. As asserted by Rear in a recent review (2019), the assessment of CT has become a significant enterprise with a number of standardized test available. Assessment tests could be classified in different ways. Hyytinen, Nissinen, Ursin, Toom, and Lindblom-Ylänne, (2015) differentiated self-report from performance-based measurements. Moreover, the performance-based measurements can be classified into multiple choice tests (MCT) / questionnaires and constructed response tasks (CRT). Although there is evidence that by applying a well-designed MCT it is possible to measure higher order skills, MCT cannot assess student's skill to synthesise or generate own answers, necessary components of CT (Ennis, 1987; Facione, 1990). To address this limitation, new CT assessment incorporates both CRT and MCT. CRT are often open-ended tasks in which students need to analyse, evaluate and synthesise complex information as well as provide reasoned explanation. Although CRT are recognized to be necessary for the CT assessment, they present problems related to inter-rater reliability and high-cost of scoring (Ku, 2009). Automated scoring could be a viable solution to the above concerns (Liu, Frankel, & Roohr, 2014). Recent research describe the development and the validation of automatic tools for the assessment of CT sub-skills, such as reasoning (Mao et al., 2018) or argumentation (Song, Heilman, Klebanov, & Deane, 2014). Having said that, there are still open-challenges in terms of validity and reliability of the measures.

The present work is aimed at comparing the features of different NLP techniques adopted to improve the reliability of a prototype designed to automatically assess CT in CRT. In the present work, we will present the first (1.0) and the second (2.0) version of the prototype and their respective reliability results. Our research questions is the following:

- Which level of reliability are shown respectively by the 1.0 and 2.0 automatic CT assessment prototype compared to expert human evaluation?

This research is aimed at developing a prototype which can assess six indicators in open-ended answers: use of language, argumentation, relevance, importance, critical evaluation and novelty (Newmann, Webb, & Cochrane, 1997; Poce, 2017).

The first macro-indicator, namely *use of the language*, is useful to assess the language form of the text. The macro-indicator called *justification* evaluates students' ability to elaborate on their thesis and support their arguments throughout a discourse. *Relevance* is a macro-indicator that analyses consistency in the texts produced. For instance, it refers to the correct use of outlines and to the capability to accurately use given stimuli. The macro-indicator called *importance* evaluates the knowledge used in discourses. *Critical evaluation* assess personal and critical elaboration of the sources, data and background knowledge. Finally, *novelty* concerns the development of new ideas and solutions based on the initial hypothesis and personal thesis. Even though different tools have been developed to automatically assess one or more of these sub-skills, this prototype has been developed to assess them together, based on different NLP techniques and Open Source tools and databases.

### **The CT assessment prototype 1.0**

The CT prototype 1.0 was designed to assess four areas out of six: use of the language, relevance, importance and novelty. This version of the prototype at the moment works only with English Language.

The system is composed by four main modules:

- **A security module:** the module has been implemented by using the Spring Framework (<https://spring.io/projects/spring-framework>), an open source application adopted to automatically configure security processes, such as authentication and authorization.
- **Question / answer manager:** through this module it is possible to insert the questions and the answers to assess. For each question, in addition to the title and the text of the question, users are also asked to include words representing the *concepts* and the *successors*. Concepts could be defined as the topics that should be covered in a correct and exhaustive answer. Successors represent, instead, deepening or related topics of the given concepts.
- **Human evaluation input module:** Through this module, expert assessors can manually evaluate the answers. For each answer, it is possible to associate one or more anonymous evaluation; these evaluations will be compared with the automatic evaluations to verify the reliability of the proposed approach.
- **CT automatic evaluator.** The last module is at the heart of the system. To evaluate the *Use of language*, the prototype calculates the number of misspellings and obtains the correct version of the text, using an external service, the JLanguageTool. The *Importance* is assessed by extracting the concepts contained in the text of the question and in the answer using the Tagme service and after that execute the

intersection between those sets of word. The *Relevance* and the *Novelty* are obtained by crossing the concepts extracted from the answers in the previous calculation and crossing respectively with the concepts and successors defined in the creation of the question. To improve the precision of the calculations, the prototype applies the n-gram calculation to the sets and recalculates the intersections.

## **The CT assessment prototype 2.0**

The CT assessment prototype presents the same general infrastructure of the previous version. However, two main innovations have been introduced: (a) the attempt to include the automatic assessment of the *argumentation* and *critical evaluation* indicators, (b) the adaptation of the prototype to the Italian language.

To assess *Use of language*, the prototype calculates: (a) misspelling and grammatical errors, (b) frequency of words and (c) lexical diversity. *Argumentation* is assessed training the prototype at distinguishing discourse categories, checking: tense verbs; polarity, and arguing lexicon. Human judges could also annotate hundreds of essays, so that the machine is facilitated at recognizing the discourse structure typical of persuasive writing. *Relevance* is evaluated using Latent Semantic Analysis (LSA), a statistical model of language learning and representation, based on the idea that the semantic similarity of words is reflected by the way they co-occur in a text. *Importance* is obtained by means of Intelligent Essay Assessor (Landauer, Laham, & Foltz, 1999). IEA is based on LSA; it makes a comparison between the semantic content of previously scored essays to esteem the score which the essay under analysis is nearer to. Since we hypothesize that the better the *Critical evaluation* of the writer, the deeper the parse tree of his sentences and the larger his use of persuasive syntactic patterns (e.g. ADV + ADJ + CONJ + ADJ), the prototype uses The Italian NLP Tool to analyse the syntactic trees of the essays' sentences under study. *Novelty* is assessed through LSA and TF-IDF (Term Frequency-Inverse Document Frequency). LSA checks words which co-occur in a context in which they usually do not. TF-IDF calculates the weight of a word assigning the importance to that word based on the number of times it appears in a document and in similar documents of the same corpus: the smaller the weight, the more common the term; the higher the numerical weight value, the rarer the term.

## **Data collection and analysis**

Data collection is realized in two moments, to measure respectively the CT prototype 1.0 and 2.0 reliability.

The first experimentation was aimed at collecting evidence on CT prototype 1.0 reliability. Data were collected with a group of 64 university international teachers after workshops carried out in the USA and Belgium. Participants were required to answer to different

kinds of CRT. Since the context of the workshop was international, participants were required to write their answers in English. The task requires to read an extract from the Galilei's book "Dialogue on the Two Chief World Systems" and then to write a paraphrase, a comment and a critical analysis (Paul & Elder, 2006). The second experimentation was aimed at collecting evidence on CT prototype 2.0 reliability. Data were collected with a group of 200 Italian university students at the beginning and at the end of an annual university course in Experimental Education. Participants were required to read an extract from the Galilei's book "Dialogue on the Two Chief World Systems" and then write a short essay (Poce, 2017). Thus, they produce a total of 400 hundred essays.

In both the experimentation, two human assessors rated all of these responses on each of the on a scale of 1-5. Similarly, one of the two versions of the CT prototype was adopted to compute a feature on each dimension. Quadratic Weighted Kappa and Pearson product-moment correlation is adopted to evaluate the agreement between the human raters' scores and between human raters and the two versions of the CT prototype, as a measure of reliability.

## Preliminary results

The rubric for CT assessment shows good properties, with satisfactory reliability between two human raters (see Table 1)

Table 1: The agreement among human raters regarding the indicators use of language, relevance and importance respectively in the paraphrase and in the commentary.

Macro-indicator	H-H Correlation	H-H Quadratic Weighted Kappa
Paraphrase_Use of Language	0.911*	0.83*
Commentary_Use of Language	0.745*	0.618*
Paraphrase_Relevance	0.75*	0.682*
Commentary_Relevance	0.881**	0.811*
Paraphrase_Importance	1.000**	1.000*
Commentary_Importance	0.642	0.571

\*sign. <0.05 \*\*sign<0.001

The best correlation among human raters and CT prototype 1.0 were obtained for the macro-indicators *Relevance* ( $r = 0.47$ ) in the commentary and *Importance*, both in the paraphrase ( $r = 0.45$ ) and commentary (0.45). However, the overall reliability could be not considered satisfactory yet (Poce, Amenduni, De Medio & Re, 2019).

In Figure 1, it is shown that in paraphrase the prototype provides higher score than human raters for the macro-indicators *Use of Language* and *Relevance*. On the other hand, the average score for the indicator *Importance* is slightly higher for human raters than in the prototype. In the commentary, there is a general trend of the prototype to provide lower scores comparing to the human raters. However, it is possible to see that the differences

between the average scores for the *Use of Language* scores and *Novelty* in the commentary is quite low.

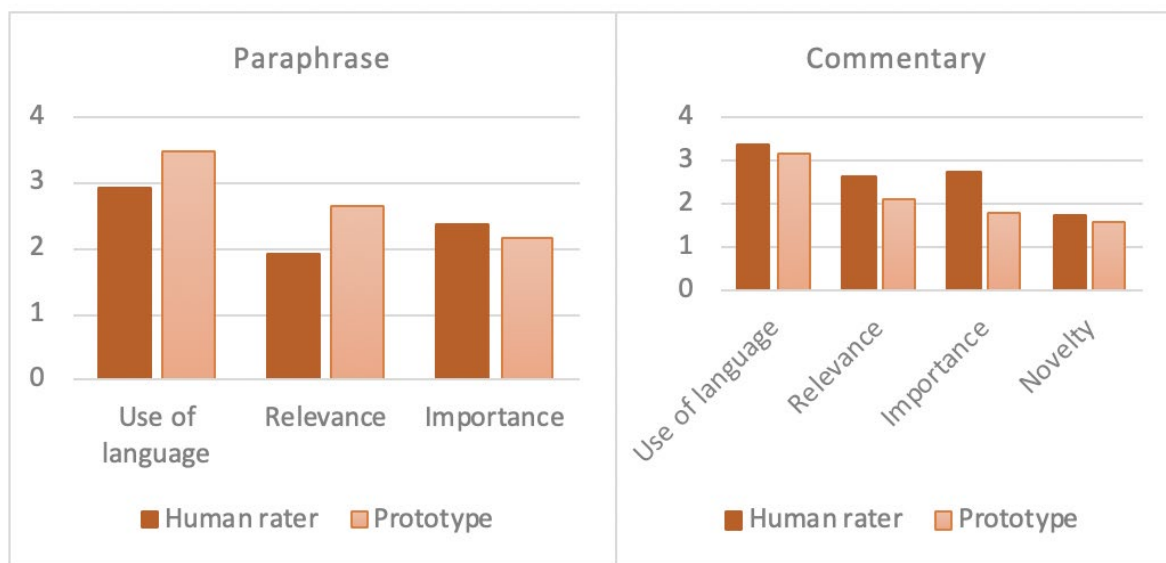


Figure 1. A comparison of CT scores calculated by a human rater and the prototype in paraphrase and commentary

## Discussion and conclusive remarks

In line with previous research (Liu et al., 2014), human raters tended to assign higher scores than our CT assessment prototype 1.0 in the commentary. On the other hand, in the paraphrase the prototype assigned higher scores than human raters on the macro-indicators *Relevance* and *Importance*. This result could be explained because the prototype is designed to infer concepts from the questions and answers texts. In the paraphrase, the participants are required to report all the text's topics. In this condition, the prototype easily identifies all the concepts, without the need of further analysis. For these reasons, in paraphrase exercise the macro-indicators *Relevance* and *Importance* could obtain higher scores than the other macro-indicators and, more in general, than commentary or argumentation texts. This data leads us to think that it may be necessary to apply changes to the evaluation of the macro-indicators based on the type of stimulus given to the participants (paraphrase, argumentation, commentary, poetry).

We are continuing the analysis of the data collected in the 2<sup>nd</sup> step and expect to complete in June. Though early findings of this study suggest that the NLP approach appears to have a lower level of rating quality than human raters, more research seems necessary to explore features and possibilities to improve such rating quality in the future.

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## About the Authors

A. Poce coordinated the research presented in this paper. Research group is composed by the authors of the contribution that was edited in the following order: A. Poce (Introduction, Discussion and Conclusive Remarks) F. Amenduni (Data collection and analysis; primary results) C. De Medio (The CT assessment prototype 1.0). A. Norgini (The CT assessment prototype 2.0)

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## **INTEGRATING AN AI-DRIVEN DISCUSSION PLATFORM: THE IMPACT OF PLATFORM ON ENGAGEMENT AND QUALITY**

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### **Abstract**

Online educators rely on asynchronous discussions to satisfy the bulk of student-student engagement that is lost when transferring from a face-to-face to an online format. However, not all discussion platforms are created equal and some specialized tools may offer advantages over standard tools embedded in more comprehensive learning management systems (LMS). In this study, we compare two online discussion platforms – one is the native discussion tool embedded within the Canvas LMS and the other is a specialized discussion platform, Packback, which supports students and instructors with gamified elements and artificial intelligence. Specifically, we assess whether post quality differs across these platforms, as measured by average word count, cited sources and weekly participation rate. The initial results are mixed and differ by course, leading us to conclude that the impact of platform on engagement and quality likely depends on the course content, instructor and protocol.

### **Introduction: Artificial Intelligence in Asynchronous Discussions**

The decision to adopt a new tool should be based on, at a minimum, two elements: the impact this tool will have on students and the ease of adoption by instructors. In this article, we discuss our preliminary findings after piloting a discussion platform (Packback) with artificial intelligence (AI) features designed to support instructors in monitoring and grading discussions while encouraging student engagement through quick feedback and gamified elements. Specifically, Packback prevents students from submitting posts that do not meet minimum requirements, such as word count and non-plagiarized content, and assigns each post a “Curiosity Score” using a proprietary algorithm that includes weighted measures for three different quality factors: depth, credibility and presentation, as determined by word count, sentence structure, citations and formatting. Furthermore, posts that appear to contain inflammatory material are automatically flagged and subject to human review to determine whether the content should be removed. Posts of sufficient quality are counted toward a minimum determined by the instructor, enabling them to

generate custom participation reports which can be input manually into their institutions' LMS.

While no formal consensus on what constitutes artificial intelligence has been reached (Pedro, Subosa, Rivas, & Valverde, 2019), there are some common themes in research on AI in higher education. Perhaps most prominently is the fact that the use of AI-driven tools, such as Packback, is commonplace at institutions of higher learning, but users often do not recognize these products as "AI" (Baker & Smith, 2019). Given that such resources are already in use by instructors, formal research into how these tools are related to successful enhancements of course goals are imperative. Furthermore, the use of AI fundamentally involves the pursuit of tangible rewards balanced against the risks of assigning, for lack of a better word, computers to complete tasks that were once accomplished by a human (ITU, 2018). In case of the present study, one sought reward for instructors is enhanced discussion quality and engagement by automating (i.e. trusting to an AI) tasks that were once the responsibility of the instructor, allowing for a greater portion of instructor time to be devoted to providing quality feedback.

### **Measuring Engagement in Asynchronous Discussions**

Students engage in online discussions in different ways, some of which are seemingly "invisible", like reading and browsing. Researchers have spent two decades classifying these behaviours, with the earliest attempt being Hewitt's (2003) analysis of how users in an online discussion environment decide which posts to read. Hewitt (2003) concluded that users were biased toward creating elongated thread structures by responding to the most recent post in a thread. In other words, after the response to the initial post in a thread, subsequent posts were made to replies (and then later replies were replies to earlier replies) – or, in Hewitt's (2003; p.36) words, "recent notes are more likely to inspire responses than older notes". Using session logs, Hewitt (2003) determined that the first action most people took in the discussion forum was reading a post (97.6%), most of which were previously unread (82%). Then students would compose a response, 80% of which were to posts written within the last 48 hours.

On the surface, this does not appear to constrain the growth of the discussion; however, if the most recent response (the post on the "outer edge") does not inspire further conversation, then the thread is likely to die off, regardless of how stimulating older posts in the response chain were. Furthermore, there may be unintentional changes in topic (Hewitt, 2001; 2003). When only the most recent post is taken into account, ignoring the context provided by previous posts, subsequent posts may veer off topic, leaving behind topics that may be more relevant to the course. Fundamentally, Hewitt (2003; p.41) argues that discussants in online platforms are prevented from creating a shared direction because

the participants “do not recognize when topic changes occur, fail to notice when the discourse falters, and generally do not monitor how particular lines of inquiry are evolving.” He suggests including a student or instructor moderator to breathe life into faltering discussion threads and a careful examination of “how individuals interact with the user interface”. To investigate how user-interface influences participation patterns, we conducted an experiment to assess post quality across two discussion platforms. There are four ways in which interface changes across Canvas and Packback could influence engagement and quality: prompt (or “protocol”), gamified elements and discussion structure.

The prompt is a significant difference between Packback and other discussion platforms – Packback has a well-defined, inflexible discussion prompt whereas the native discussion tool in Canvas does not lend itself to a specific style of questioning. Students in Packback are expected to pose a question to their peers about course-related material and other students respond to these questions with supporting points or counterpoints. Prompt can have a significant impact on interactions in online discussions (Zydney et al., 2012), though the specific prompt used in Packback has not been assessed. In order to minimize the impact of prompt, we attempted to replicate this style of discussion using the native discussion tool in Canvas.

A second key difference between Packback and Canvas discussions are the gamified elements embedded within the Packback platform. Packback uses the students’ total Curiosity Points to rank each student on a Learner Leaderboard. From the Learner Leaderboard, students can view their own ranking in the class and quickly navigate to Learner Profiles of other students that show a breakdown of this students’ participation and each of their contributions to the discussion throughout the semester. The Learner Leaderboard is supported by the AI features we discussed earlier – posts are automatically assigned a Curiosity Score, which facilitates this ranking.

Finally, the structure of the discussion platform, including presentation of posts, feed and feedback differ extensively across both environments. For example, Packback shows the discussion as a continuous feed throughout the semester while offering students multiple ways to filter and view the discussion occurring within their course, such as viewing new posts, posts with the most responses and high-quality posts. Instead, the native discussion tool in Canvas is fixed, with the most recent posts at the bottom of the feed. It is possible that alternative platform configurations could impact overall engagement and participation in online discussions, as discussed above by Hewitt (2003). Additionally, methods of establishing instructor presence differ across both platforms. In Canvas, direct feedback to students is always private and must be accessed outside of the discussion forum itself through the students’ grade view. In Packback, graders have the option of publicly

praising a student, featuring their posts or providing private coaching. This enables instructors to highlight the elements of posts students should mimic in a highly visible way, facilitating the feeling of teaching presence, a core component of the Community of Inquiry model (COI) (Anderson et al., 2001; Garrison et al., 2001; Zydney et al., 2012) associated with improved cognitive presence (Park et al., 2015) and students' perceived learning and satisfaction (Arbaugh, 2010). According to this model, Packback's practice of publicizing instructor praise in a highly visible way could enable instructor's to more easily act out the role of a "facilitator and co-creator of a social environment conducive to active and successful learning" (Anderson et al., 2001; p.2). The combination of prompt, AI-supported feedback and highly visible public praise provides "participants with the directions to facilitate themselves" ultimately "reducing the burden on the instructor" (Zydney et al., 2012). Interaction on the part of the instructor that is both highly visible but infrequent may allow students space to engage in behaviours typically associated with high teaching presence (Park et al., 2015) while coaching could lead to an increase in the frequency of higher-order thinking (Stein et al., 2013).

In our initial assessment of post quality, we compared platforms in terms of three indicators of engagement and post quality: posts per week, word count and citing sources. We predicted that students using the Packback platform would do the following:

- H1. When using Packback, students will average a higher word count per post, compared to Canvas.
- H2. When using Packback, a higher proportion of student posts will reference external sources, compared to Canvas.
- H3. When using Packback, students will average a higher number of posts per week, compared to Canvas.

## **Methods**

The findings we will present in this presentation are part of a larger, ongoing study at the University of North Texas about the impact of using Packback on instructor workflow and student learning. The data that we will use to convey these preliminary findings are based on the discussion posts from students enrolled in two different courses. The two courses followed a similar discussion protocol, but the student population varied significantly. One course was an upper-level Political Science course, while the second was a graduate course in Learning Technologies. The Political Science course was face-to-face, while the Learning Technologies course had both a face-to-face and online section. All data is from the fall 2019 semester and data collection is ongoing for the spring 2020 semester.

### ***Post Quality and Engagement***

For both courses, students used the native discussion platform in Canvas for the first half of the semester and, during the second half of the semester, students used Packback. In all, students in the Political Science course engaged in discussions in Canvas for seven weeks and six weeks in Packback. Students in the Learning Technologies course engaged in discussions for eight weeks in both Packback and Canvas. There were 41 unique discussion participants in the Political Science course and 16 unique participants in the Learning Technologies course. In order to be included in the analysis, participants must have posted at least once in both Packback and Canvas. Altogether, these students authored 1,027 posts in Political Science and 456 posts in Learning Technologies, but these posts are aggregated to the student level for all further analysis.

We compare the effect of both platform and course on post quality and student participation using a Two-Way Mixed ANOVA in IBM SPSS 25, as measured by: (a) the proportion of student posts with cited sources, (b) students' average word count per posts and 3) students' average number of posts per week.

## **Results**

### ***Post Quality and Engagement***

The impact of platform and course varied depending on the outcome measure (word count, proportion of sources cited, or average posts per week). Specifically, results suggest that there is a main effect for both platform ( $F(1,55) = 23.99, p < .001, \eta^2 = .30$ ) and course ( $F(1,55) = 15.93, p < .001, \eta^2 = .23$ ) on word count. When using Canvas ( $M = 180.16$ ), on average students wrote longer posts than when using Packback ( $M = 148.11$ ), and students in the Learning Technologies class ( $M = 193.06$ ) wrote longer posts than those in the Political Science course ( $M = 135.21$ ). However, a significant interaction was present between platform and course ( $F(1,55) = 13.64, p = .001, \eta^2 = .20$ ), suggesting straight interpretation of the main effects is not a full representation of test results. Initial inspections of group descriptive suggest that the main effect of platform was driven by the especially large difference across platforms for the Learning Technologies course (Canvas  $M = 221.17$ , Packback  $M = 164.94$ ), while the differences for the Political Science course were much less pronounced (Canvas  $M = 139.15$ , Packback  $M = 131.27$ ). However, in both courses, posts were longer when students used Packback, indicating that there is no support for H1: "When using Packback, students will average a higher word count per post, compared to Canvas". In fact, especially for the Learning Technologies course, posts were significantly longer in Canvas. Figure 1 shows the average word count per post for both courses in both conditions.

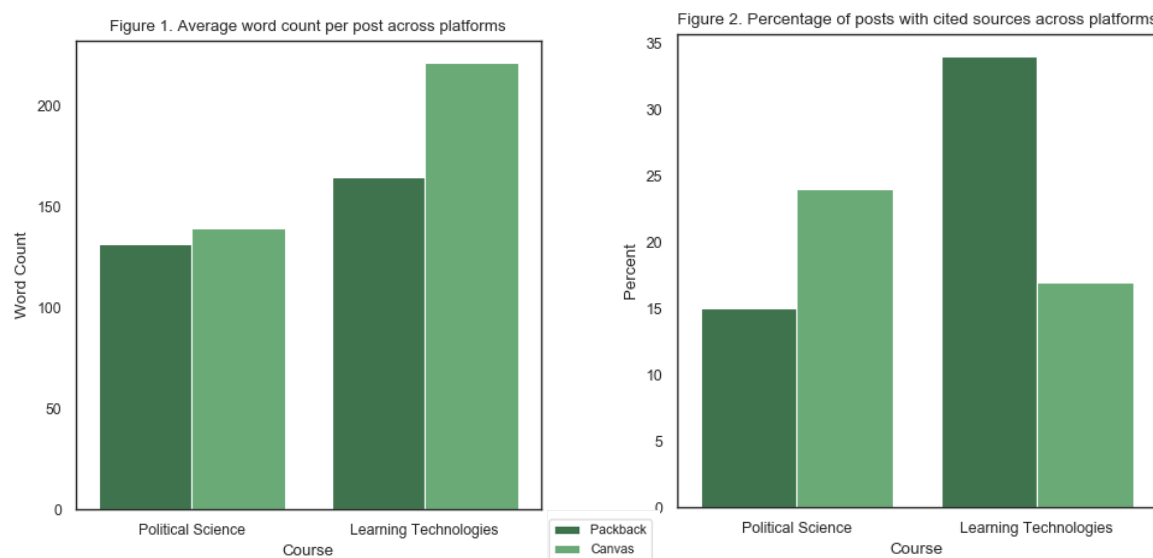


Figure 1. (right) This figure shows the average word count per post across platforms. Students in the Learning Technologies course wrote longer posts overall, but this difference was most striking for posts made in Canvas.

Figure 2. (left) shows the percentage of sources cited across both courses and platforms. The trend is opposite for both courses.

For the next measure of post quality, proportion of sources cited, results suggest that neither a main effect for platform ( $F(1,55) = 6.39$ ,  $p = .014$ ,  $\eta^2 = .10$ ) or course ( $F(1,55) = 8.63$ ,  $p = .005$ ,  $\eta^2 = .14$ ) is present. More specifically, there did not appear to be a difference in how often students using Canvas ( $M = .20$ ) or Packback ( $M = .25$ ) cited sources. Furthermore, overall results suggest students in the Learning Technologies class ( $M = .26$ ) cited sources at similar rates to the Political Science course ( $M = .19$ ).

However, there was significant interaction between platform and course ( $F(1,55) = 12.04$ ,  $p = .001$ ,  $\eta^2 = .18$ ), suggesting straight interpretation of the main effects is not a full representation of test results. Initial inspections of group descriptives suggest that the impact of platform depending on the course students were enrolled in. As shown in Figure 2, Learning Technologies students (Canvas  $M = .17$ , Packback  $M = .34$ ) cited more sources in Packback, while students in the Political Science course (Canvas  $M = .24$ , Packback  $M = .15$ ) cited more sources in Canvas. These findings indicate that there is partial support for H2: “When using Packback, a higher proportion of student posts will reference external sources, compared to Canvas”.

Finally, we measured engagement by the students’ average number of posts per week. Results suggest that there was a main effect for both platform ( $F(1,55) = 6.39$ ,  $p = .014$ ,  $\eta^2 = .10$ ) and course ( $F(1,55) = 8.63$ ,  $p = .005$ ,  $\eta^2 = .14$ ). More specifically, when students used Canvas ( $M = 1.86$ ), they appeared to post more often than when using Packback ( $M = 1.66$ ), and students in the Learning Technologies class ( $M = 1.60$ ) posted fewer times

per week than students in the Political Science course ( $M = 1.91$ ). However, a significant interaction was present between platform and course ( $F(1,55) = 24.15, p < .001, \eta^2 = .31$ ), suggesting straight interpretation of the main effects is not a full representation of test results. Initial inspections of group descriptives suggest that inverse effects of platform exist depending on what course the students were in. Learning Technologies students (Canvas  $M = 1.91$ , Packback  $M = 1.30$ ) posted less often in Packback, while students in the Political Science course (Canvas  $M = 1.82$ , Packback  $M = 2.01$ ) posted less often when using Canvas. These findings indicate that there is partial support for H3: “When using Packback, students will average a higher number of posts per week, compared to Canvas”.

It is clear that, when comparing these two discussion platforms, the question of engagement and quality is complex. In the following section, we will discuss some possible explanations for these findings and next steps for this research.

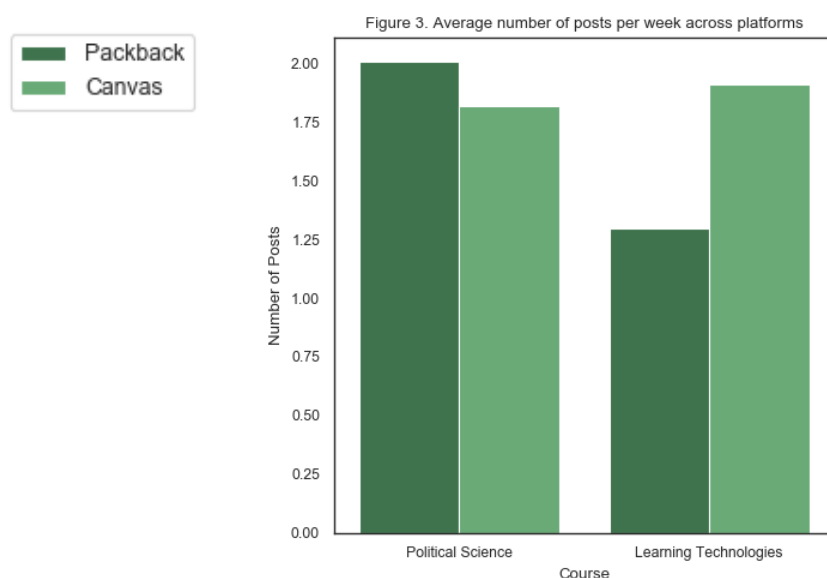


Figure 3. This figure shows the average number of posts per week for both courses across platforms.

## Discussion

It is difficult to say conclusively whether the impact of using Packback was positive or negative – in fact, it is difficult to say whether it was positive or negative even for a specific course. In the Political Science course, students wrote posts of approximately the same length, but cited sources about 1.6 times as often in Canvas. In other words, their posts were of comparable length, but, when posting in Canvas, students more often provided evidence for their claims. Even so, the participation rate was higher in Packback than in Canvas for these students – indicating that they posted more often. In fact, given that the instructor required a minimum number of two posts per week, it appears that students met this minimum more often in Packback than in Canvas. This could be due to the fact that participation guidelines become more clear by the end of the semester, but it also could be



related to Packback's ease of use or the gamified elements incentivizing participation. We are currently interviewing students about their usage of these platforms in order to ascertain which is more likely. We will also plot participation rates over time to verify whether participation rates in Canvas are lower at the beginning of the semester, suggesting a period of adjustment that artificially lowers the overall participation rate. Interestingly, the fact that participation in Packback (at the end of the semester) is both higher and in line with course requirements is notable in of itself, as previous research suggests that participation in asynchronous discussions declines during times of increased workload (such as final exams) (Ding et al., 2018; Xie & Durrington, 2011; Xie & Fengfeng, 2011).

The trends in the Learning Technologies course suggest an entirely different story, however. Overall, posts were shorter, but they provided supporting evidence at nearly twice the rate in Packback compared to Canvas, and their participation rate was also lower in Packback – there were fewer, shorter posts, with more supporting evidence. There are two potential confounding factors worth mentioning in this case. First, the instructor of the Political Science course was a veteran user of Packback; her prompt in Canvas mirrored that in Packback as closely as possible and she assisted her students in the transition from one platform to the other more easily, given her experience using the tool. Meanwhile, the instructor of the “Learning Technologies” course was not familiar with the tool, leading to a more difficult transition and a prompt that was not aligned. The Canvas prompt was more instructor-driven, requesting that students respond to instructor-derived questions, while the Packback prompt requested that students pose questions to one another and respond to the student-derived questions. Responding to instructor-derived questions is likely to result in longer, reflective posts, rather than sustained dialogue or debate between students, which would be characterized by shorter posts with more corroborating evidence (cited sources). Generally, we would expect higher participation with this style of dialogue, as well, but the undoubtedly difficult transition between Canvas and Packback for this course could artificially lower participation rates. Because of this, we will track rates over time to assess when during the semester participation was lowest.

There are many unanswered questions here – is it the tool or the prompt that is driving differences in student behaviour? Are instructors utilizing the AI features of this tool in order to bolster instructor presence? Do students even notice the gamified elements designed to extrinsically motivate them to participate? Does transitioning from one platform to another cause participation rates to drop? In order to address these questions, we are conducting focus groups with both instructors and students. We are also carefully reviewing participation over time and have designed an experiment to assess the impact of transitioning on student participation rates. Ultimately, data from different disciplines, use

cases from instructors and student perspectives will be invaluable in determining whether this gamified, AI-driven tool positively impacts the asynchronous discussion experience.

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## INVESTIGATING THE IMPACT OF AN AI-DRIVEN DISCUSSION PLATFORM ON EDUCATOR PERCEPTIONS AND FEEDBACK

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### Abstract

Asynchronous discussions are a popular element in online education, often used to replace the student-student and educator-student interactions that occur in physical classrooms. Most Learning Management Systems (LMSs), such as Canvas and Moodle, include native discussion tools that offer students and instructors the ability to interact and communicate at their own time and pace. Some specialized products offer a wider variety of discussion features that standard LMS tools may not have. In this study, we discuss the impact of an online discussion platform powered by artificial intelligence (AI) and gamified features. We conducted a qualitative study examining how AI elements affect the workflow, grading, and feedback experience of educators. Preliminary findings offer insights into the impact of the AI elements on graders' perceptions, in particular on their perception of giving feedback and the perceived ambiguity of the way the AI assesses students' post quality.

### Perspectives of Artificial Intelligence in Education

Educators are in the driving seat when it comes to determining which technology to use to facilitate a learning experience. When the learning experience is online discussions, there is a wealth of options to choose from. The purpose of this study is to document the educators' experience using an artificial intelligence (AI) driven discussion tool, as opposed to a native discussion tool in Learning Management Systems (LMS) like Canvas or Blackboard. In this section, we are discussing what we know about applications of AI in education and its benefits and challenges to students and educators.

We can define AI broadly as "computing system that are able to engage in human-like processes such as learning, adapting, synthesizing, self-correction and use of data for complex processing tasks" (Popenici & Kerr, 2017; p.2). This is an inclusive definition, which allows less complex AI-driven tools to be classified as "artificial intelligence". AI is not a new concept, having been first coined and defined by John McCarthy in 1956 (Russell

& Norvig, 2003), but AI-driven applications have become more popular in education only in the latter part of the last decade. Several companies offering AI-driven learning applications were established in the last decade (e.g., Duolingo in 2012, Packback in 2014) and they have been refining their products as more and more data becomes available about usage and learning analytics.

Despite the growth in popularity, there is still a dearth of empirical studies on AI in education (AIEd) applications, particularly in higher education and in high-enrolment classes, and on their impact on student learning and educator workflow.

The successful integration of educational technology in courses is wholly dependent on the educators of these courses who choose when and how to integrate tools into a course. AI-driven tools, such as Packback, are no exception. Despite this, the educator perspective of AIEd is understudied—to the point where the title of a recent article by Zawacki-Richter et al. (2019; p.1) asks “...where are the educators?” while lamenting the “lack of critical reflection of challenges and risks” of AIEd. According to the authors, this oversight is likely due to the lack of research conducted by education faculty – of 146 articles reviewed, only nine had first-authors from Education departments. The result is that the vast majority of study designs are quasi-experimental, testing the impact of an intervention on students, with little to no exploration of the challenges of adoption, implementation, or impact on educators. More in-depth research in this area would likely illuminate some of the concerns associated with the implementation of AIEd, such as the educator’s fear of replacement, bias, privacy concerns and data protection, each of which could contribute toward a resistance to adopt an AI-driven technology by both educators and students.

There is also a general ignorance of what constitutes AI in general and AIEd in particular. This causes some to recoil at the term, despite using both simple (e.g., spell checkers) and complex (e.g., virtual assistants) AI tools on a day-to-day basis. An alternative is viewing AI as an enhancement of human intervention. A January 2020 report by McKinsey & Co., focused on the impact of AI in K12 education, claims that AIEd saves teachers’ time. According to the report, only half of the teachers’ workload is actually spent interacting with students, while the rest is spent on repetitive administrative tasks, lesson preparation, and grading. Their research suggests that 20 to 40 percent of current teacher workload could be automatized, enabling teachers to focus more on activities that are more creative and socially engaging for them and their students.

Human intervention still occurs in AIEd but may just shift in type and timing. Educators may have to learn how to integrate and use the tool in their course, either independently or with support from vendors or support staff. In the long-term, an AI tool may save time, but instructors must invest time up front to use the tool successfully.

## **Using AIEd in Online Discussions**

Our research investigates the impact of an AI-driven discussion platform, Packback, on student learning and educator workflow in online courses. Packback approaches online discussions using a protocol based on the Socratic method of questioning, assigning students a “curiosity score”, and creating a newsletter of featured posts. It includes automated moderation of inappropriate posts. The AI, based on length of posts, sentence structure, and presence of a source citation, amongst other variables, calculates grading and curiosity scores.

The platform has other features that mimic a social networking site and gamify the experience. Students can “spark” other students’ post, mimicking a “like” and they are ranked on a Learner Leaderboard, which relies on the curiosity score. Students can view their own ranking in the class on the Learner Leaderboard and can access the profiles of other students, which show a breakdown of this students’ participation and each of their contributions to the discussion throughout the semester.

With AI taking away the time spent grading and moderating posts, educators can focus on more meaningful interactions with students, like providing public praise or private coaching. This helps establish a sense of teaching presence, a core element of the Community of Inquiry model (COI) (Garrison & Anderson, 2003) associated with improved cognitive presence (Park et al., 2015) and students’ perceived learning and satisfaction (Arbaugh, 2010).

Fundamentally, asynchronous discussions derive meaning as a cognitive constructivist tool to promote learning. Cognitive constructivism emphasizes both the impact of the environment and cultural context in shaping knowledge, as well as valuing the learner’s individual characteristics. Using social media tools and learning technologies, including online discussions, knowledge is individually generated but socially mediated (Felix, 2005; Whitelock, 2010). With Packback, students formulate their own questions, moving a step beyond traditional discussion protocols, enabling students to discuss personally meaningful topics with one another under the guidance of an educator (Garrison & Anderson, 2003).

Though Packback provides just-in-time feedback and rapid assessment, the benefits of the tool are largely purported to be for educators, rather than students despite the fact that Packback is a learner-facing tool (Baker & Smith, 2019). This trend of developing AI tools to support educators, rather than to improve student learning, is a recent shift according to Barshay (2020) who reflects on the aforementioned 2020 McKinsey & Co. report about the impact of AI on K-12 teachers. Barshay (2020; p.1) claims that the evidence that AI tools (like virtual tutors) improve student learning is “not strong” and that “technology use

at school sometimes hurts student learning”, citing the recent reports on the final impacts of Columbia University Teach to One program (Consortium for Policy Research in Education, 2019). While this evidence is from the K-12 sector, these studies are a glimpse into what is possible in higher education and set the tone for beliefs about the impact of AI on education generally.

There are some potential concerns with automatic grading, as well, which tends to be simplistic and runs the risk of students learning to “trick” the autograder. As Popenici and Kerr (2017; p.2) claim, while the possibilities of AIED are vast, “we have reasons to stay aware of the real limits of AI algorithmic solutions in complex endeavours of learning in higher education.”

In this paper, we will discuss how educators used Packback in their courses and their impression of both human and AI-initiated feedback. The research questions that this study aimed to address are:

- RQ1: What are the graders’ perception of an AI-driven discussion platform?
- RQ2: How does an AI-driven discussion platform influence grading and feedback?
- RQ3: How does an AI-driven discussion platform impact graders’ workflow?

## **Methods**

This paper forms part of a broader research project at the University of North Texas (UNT) that uses mixed-methods and is investigating the impact of an AI-driven discussion platform on students’ learning and educators’ workflow. The focus in this presentation is on the qualitative portion of the study, which focused on researching the impact of the platform on the graders’ workflow. The research team is still collecting data from more participants. All data is from the Fall 2019 semester and data collection is ongoing for the Spring 2020 semester.

### ***Recruitment and artifacts collected***

We conducted focus groups with three teaching assistants (TA) facilitating a large online first-year undergraduate course in Biology and Environmental Sciences. The TAs taught the online course using Packback in Summer 2019 for eight weeks and in Fall 2019 for 16 weeks. The TAs served as the primary individuals responsible for grading and providing feedback to students. In Fall 2019, the course was divided into five online sections of 50 students each and one TA managed each section. Three out of five TAs consented to participate in this study. All participants had experience using both Packback and Canvas for online discussions.

Data was collected in the form of focus groups during the Fall 2019 teaching semester. The focus groups were administered three times during the teaching semester: one at the beginning of the semester, during the first week of class, to examine participants' prior experience with and perceptions of online discussions; one half-way through teaching using Packback; and one at the end of the semester. The focus groups were audio-recorded and transcribed using the NVivo Transcription service.

### ***Data analysis techniques***

The research team analysed the data from the focus groups using a combination of thematic and saliency analysis. Thematic analysis helps identify themes or patterns in data by using a coding scheme. It helps to derive the patterns most relevant to the research questions and the most recurrent in the participant sample (Braun & Clarke, 2006). Saliency analysis focuses on the saliency of the themes: some themes may not be as recurrent but of high importance and relevance in answering a research question or furthering understanding of the overall research goals (Buetow, 2010).

Our primary goal was to assess TAs' perceptions of online discussions generally, their perception of Packback as a tool for online discussion, and any changes to their perception that may have occurred because of using this tool. While there are many facets of these focus groups that we could discuss, for this presentation we will focus on two dimensions of an overarching theme related to artificial intelligence: perceived impact of feedback and ambiguity. The research team, through an inductive process, collaboratively determined the artificial intelligence theme and others, after a close reading of all focus group transcripts, using the three research questions as the lens through which data was interpreted.

After agreeing on the primary themes and dimensions, two members of the research team coded the transcripts using NVivo 12, allowing for the possibility of additional recurring and salient themes. After completing the coding process, we reviewed all new recurring and salient themes and any inconsistent themes and dimensions highlighted by NVivo's Coding Comparison feature, until we achieved a Cohen's Kappa for all dimensions of above 0.80 through negotiated agreement (Lavrakas, 2008).

## **Results**

As mentioned toward the end of Methods, in this section we are focusing only on two dimensions from the overall artificial intelligence theme: TAs' perceived impact of feedback to students, and ambiguity. We include quotations from focus group interviews to illustrate the themes emerged. The three participants are referred to as PA, PB and PC.



### ***Perceived Impact of Feedback: human-initiated vs. AI-powered***

A recurring and salient pattern emerging from the data on all three TAs was the importance they placed on feedback in online discussions and its impact on student learning, both human TA-initiated feedback delivered via the platform and AI-powered feedback. In TA-initiated feedback, TAs used platform features such as private coaching and public praising, and “featuring” or “pinning” posts to recognize good work, which they perceive as aiding both student engagement and writing quality:

*PA: “I think [giving feedback] helps [students] to umm make an effort and do better job. And when you tell them for example you did a great job, they try to participate more in the discussion.”*

*PA: “I prefer to guide them to umm, for example, elaborate their idea or umm I tell them you mention a great idea, but you need to explain more. Or sometimes, for example if they umm they didn’t write umm details or something or examples as I told...but if they write a good, I mean discussion I just tell them it’s a great idea, you did a great job or something like that.”*

*PC: “...the student’s name was being put out there, they’re like “ooh, I’m being publicly recognized in the class now.” So that is a positive good thing that the student would want.”*

*PA: “...sometimes I tell them, you did a great job and your post is a very good post and something like that, or sometimes I tell them, you have to elaborate your response. It’s better to write a better question or something like that. So both of these feedbacks can be helpful for our students in my opinion.”*

The TAs also discussed the impact of feedback calculated by the AI itself, in the form of grading and curiosity points. TAs appear to be intrigued by the curiosity scores but are not always in agreement with how the AI algorithm grades or assigns curiosity points, leaving the TAs wondering what criteria are used for assessment, if these criteria are available to students or not, and whether grades are informed by curiosity points or not:

*PB: “I want to see the criteria, like, I want to be able to click on the curiosity points and be able to see why they were assigned or why they weren’t assigned (...) If [students] could click on the curiosity points and see why they got what they got, I think that would be phenomenal.”*

*PB: “...some posts get really good curiosity points and some post get just a few. But those students still get full credit for those posts, which obviously isn’t fair to the other students that put in the work to get the full amount.”*

As they try to make sense of how the scores are calculated by the AI, TAs are also concerned that their own feedback, delivered using their praising or coaching feature, may not be taken into account into the scores:

*PC: "...so, is the praises and coaches that we as TAs give, is that also taken into consideration while it is being graded? (...) Does that give them extra points? Or is it just that...because, if it has to be graded properly, I would say that if a particular student has a praise from us that should give them some extra points. Because that means that there is no repetition of ideas and this is something that we actually liked."*

The TAs' comments on their perceived uncertainty as to how grades and curiosity scores are calculated by the algorithm is one element of ambiguity, a theme discussed in more detail in the next subsection.

### **Ambiguity**

TAs know that the AI grades and assigns scores based on length of post, sentence structure, and source citation, to name a few criteria. However, their experience interacting with the platform, reading students' posts and observing how these are scored by the AI, left them wondering to what extent each criterion weighs into the score, or if the AI places more emphasis on simple participation or engagement with the tool itself:

*PC: "I'm not really sure, so in assessment, who exactly is grading it? I think right now it is just like the presence and absence thing and if the words are correct, but is anybody actually reading it?"*

The TAs noted another ambiguous element. This stems from the structure of the platform, which differs from discussion boards in traditional LMSs. With discussions presented in one feed, TAs feel it may not make the posting instructions stand up:

*PA: "Packback is awesome, but it is a little confusing for students because it has lots of...umm. The students can see the previous questions and they don't know if they should answer that question or the new one."*

*PC: "It's all going to be on one feed. So, the post – the student would argue with us that they did post – and they must have posted (...) but maybe they posted in a section that was already done and graded. So, they need to know where exactly they have to be posted."*

Ambiguity can also be a consequence of students and TAs familiarizing with online discussions via a tool that is novel to them, because of the gamified and social media-like elements:

*PC: “Even I don’t remember any of my students having missed a discussion when it was on Canvas. (...) but in Packback, I think maybe first, navigation issues, understanding what exactly they’re supposed to do.”*

*PC: “Canvas is just doing a better job, it is very easy for us also take a look. It would hardly take one hour for us to completely finish the entire discussion because we know that everyone is going to take part in the discussion only at the deadline. (...) In Packback, you’re not getting that. So it’s too much of a back and forth happening over there”*

*PB: “I think I can’t see the full potential of Packback and all of its functions, and if I did, maybe I would have a better idea of what really did or didn’t work.”*

## **Preliminary Reflections and Next Steps**

The feelings of uncertainty but also curiosity that TAs have been experiencing using Packback could be a result of participating in a Community of Inquiry (Garrison & Anderson, 2003) where a novel element, previously unknown to the TAs, is introduced. The AI is designed to partly replace some aspects of human intervention such as grading (Teaching Presence) and moderating (Social Presence), which in turn plays a role in influencing student learning and writing skills (Cognitive Presence). In this novel COI dynamic, TAs were faced with the challenge of learning a new technology, understanding how the AI worked, and figuring out how to best complement it with human intervention, with minimal disruption to student learning.

These preliminary findings come from a small sample of graders, three TAs facilitating one large, first-year undergraduate online course in Biology. Further research is ongoing and the research team is interviewing more graders and educators, including full-time professors and educators teaching other subjects, such as political science and learning technologies, to increase the validity of these trends or identify other emerging patterns across subject disciplines and academic ranks. Focus groups are also being conducted with students, to investigate the impact of using AI in online discussions from the learners’ perspective. We are also collaborating with other academic partners to identify cross-institutional trends in the next iteration of the analysis.

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## SCIENCE EDUCATION AND ARTIFICIAL INTELLIGENCE – A CHATBOT ON MAGIC AND QUANTUM COMPUTING AS AN EDUCATIONAL TOOL

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### Abstract

Artificial Intelligence (AI) has entered the realm of higher education and has become an impressive emerging field. Since AI is starting also to be applied to Science Education, here an essay is provided while the opportunities of AI in a particular case of Science Education are reviewed and assessed, namely a chatbot on Quantum Computing, another awesome emerging field. Indeed, Quantum Computing is based on a set of principles that are difficult to understand by the general population, so the ultimate goal of such a chatbot is to learn a few complex concepts in this field and to increase public understanding and awareness of Science. Actually, AI is starting also to be applied to Science Communication, even though progress is not so advanced as in learning.

Magic tricks based on mathematical principles are especially well suited to teach difficult concepts, like those related to Quantum Science. They are used to explain entanglement, quantum cryptography, the superposition principle, and other quantum-related concepts – along with other physical and chemical core elements like Entropy.

Developing a chatbot is not especially difficult (e.g., with Botpress, Watson, Dialogflow, Manybot, etc.). One may build either scripted, intelligent, or application bots. Indeed, the first ones are those that are easiest to create, and correspond to the first phase of the current project. Intelligent bots understand natural spoken language and correspond to a second phase in this project. In general, Bots are connected to a real-world messaging service, like Facebook Messenger, Twitter, Telegram, Slack, etc.

### Introduction

Machine learning, chatbots, learning personalization, and other artificial intelligence (AI)-related concepts have entered the realm of higher education. AI may be used to enhance

and power education, and augmented human intelligence (rather than taking decisions on its own) is an emerging field. AI is starting also to be applied to Science Communication, even though progress is not so advanced as in learning.

EU's Horizon 2020 initiative has pointed out that there are fewer students interested in STEM areas. Since magic is deeply related with the latest technological and scientific discoveries, it is a good vehicle for getting more interest into science and technology from young students. In fact, technical issues like turning up a lamp were already presented as a magic trick in the 19th century as a magical fact: the illusionist (Robert Houdin) claimed he turned up a candle. At that time people did not have electricity at their homes, so they were not used to lamps and it seemed to be something magical (i.e., impossible within natural behaviour). It is also part from the popular culture that magicians use mirrors to get surprising effects – another use of Science for conjuring.

### **On Magic, Science, and AI**

Magic, the Science of Deception and Illusion, is much related to Psychology and Behavioural Sciences, and is actually a field of interest for consciousness studies. For that reason, Artificial Intelligence may be a useful tool to build up new magic tricks – and the opposite too: magic may be used to create artificial intelligence agents. Here a few, relevant sources on the use of AI in the field of intersection of Magic and Science are pinpointed.

A recent paper (Zaghi-Lara et al., 2019) by a team of neuroscientists and a magician showed how magic tricks played to deep neural networks untangles human deception. In such a paper, it was shown that humans and machine often behave oppositely regarding a particular magic trick.

Moreover, a few years ago, a leading Science of Magic research group (McOwan, Queen Mary Univ. London) developed new magic tricks using AI techniques (McMillan, 2014), thus creating new card magic apps for smartphones that are slightly different, more “intelligent”, than commonplace tricks performed by conjurors. The same group published another paper (Williams & McOwan, 2017) involving intelligent search of the Internet to create new magic tricks.

Literature on magic, illusion and AI is scarce, but nice examples may be found every now and then, for instance, blurring the line between human tasks and automation (Primlani, 2019). A nice paper (Sharkey & Sharkey, 2006) also deals with this issue: deception as an integral part of AI and robotics (on automata and their relationship with conjuring).

AI has been compared (probably in an unjustified way) negatively (Doctorow, 2019), where AI itself is perceived like a magic trick: “amazing until it goes wrong, then revealed as a cheap and brittle effect”.

Indeed, the current wealth of AI apps for pattern recognition, mimicking creativity (e.g., emulating someone’s paintings, songs, or literature) may yield to new forms of impossibility in magic performances. Moreover, AI may be used as an (obscure) excuse to justify the illusion of impossibility: for instance, in the trick entitled “Instant Personality Test” (Messina, 2020), AI is seemingly used for guessing someone’s personality, which makes the trick stronger than ever.

Even cheap new tricks are sold involving use of the two “magical” words “Artificial Intelligence” (Smiffys, 2016). And one must not forget magic performed by robots (an updated version of automata playing magic tricks in the 19<sup>th</sup> century) (Rosenbluth, 2018).

## **On Quantum Mechanics and Quantum Computing**

Quantum Mechanics is based on a set of principles that are difficult to understand by the general population. Several games based on mathematical tricks have been created to pinpoint the key aspects of Quantum Science. Currently, their online versions are being created – that result into a scripted chatbot, later to become an intelligent one.

Playing cards are quite useful because black and red cards may represent values 0 and 1 for qubits (and bits, of course). This allows to present the Superposition Principle in Quantum Mechanics, leading to a metaphoric Schrödinger’s Card. Further, entanglement has also been tackled, using card magic Gilbreath’s First Principle. Card magic may thus be used to provide a learning path to quantum gates used in quantum computing. Similar games are used to explain in a plain way quantum cryptography, using hints about the use of De Bruijn’s extension to Gilbreath’s Principle as applied to Quasicrystals in order to understand it.

Those techniques have been used to explain Quantum concepts in Science workshops, talks, and fairs for a few years, and have verified their usefulness in formal and informal educational environments. This has led to use of Magic in University teaching and Public Understanding of Science. Moreover, Magic has been used as a tool for professional development, because Magic improves communication, theatrical and rationale skills, which are of utmost importance in Higher Education.

Magic has been successfully used in Higher Education, especially to enhance experiments related to key areas of chemistry, but also in physics and biomedicine. Not only does Magic



provide the illusion of impossibility, but it does also enhance the reality of teaching and learning.

## **On Science Communication and AI**

Dealing with the area of intersection of Magic, Science and Education follows the main purpose to use Magic and Illusionism to increase public awareness and understanding of Science. Use is made also of scientific concepts and rationale to explain either superficially or in depth magical effects. Moreover, Magic is dealt with to improve teachers' professional skills and to develop new developments in university education.

Such an innovative and research effort in this field has allowed to enter the realm of formal and non-formal education at all levels, from children education to high school students, up to higher education. Experience shows that magic provides increased learning opportunities and leads to a more inclusive education, because of learning being made more attractive.

Experience with workshops and shows at schools, universities, street level and stage theatres has led to consider magic as a very relevant tool to cohesionate communities, especially suitable for underprivileged environments. Moreover, the public is far more engaged with science if it is presented in an attractive way.

Magic is also used in mentally handicapped people through a therapeutic activity. Moreover, magic is currently used with hospital patients along with other entertainer volunteers.

Finally, there is another social impact of magic: as a very relevant tool for communication skills and for personal development – namely that of shy individuals.

Artificial Intelligence plays a relevant role in Science communication (yet less important than in personalized and online learning): it may allow researchers to digest the enormous amount of scientific information created by scholarly journals. One does not longer have the time needed to keep with publications and bibliographic references of likely interest, so probably a bot may do much better to curate content. Moreover, artificial intelligence may help in science communication in a way similar it will do in general communication and publishing.

For instance, a recent paper (Zandan, 2017) has tackled the way people will communicate in the future, by considering “hybrid thinking” and an interplay between human and cyber intelligence. AI writing bots have been proposed to revolutionize science journalism, even substituting the very journalists, and AI may lead to bots writing real news stories about

science discoveries. Actually, AI algorithms are already summarizing scientific research papers and automatically turning them into simple press releases and news stories. Indeed, one the main drawbacks (or advantages) of AI is that it will have no emotional or heated responses.

Mundane tasks are likely to be carried out by machines letting scientists focus on bigger questions of research and development and contribute to supporting science journalism. Moreover, there are already examples of AI taking care of routinely tasks of creating movie trailers or science videos, thus helping scientists to become better communicators (and fulfilling the new challenges of disseminating original research). Finally, AI can expedite scientific communication and eradicate bias from the publishing process: the current publishing models has created an opportunity for predatory journals and publishers that should be solved – AI may help in the reviewing process and the assessment of quality and high standards.

## **Conclusions**

As far as higher education is concerned, magic has been successfully use to enhance experiments related to key areas of chemistry. Classical magic tricks have been also adapted to teach and enhance learning of complex concepts related to physics, chemistry and biomedicine.

Besides the aforementioned game on Quantum Computing, a modified version of a classical card trick has been developed to explain entropy – as a measure of disorder and as a non-observable thermodynamical property in Nature, since entropy is linked to the arrow of time. Indeed both games carry a large amount of deception and surprise.

Mystery brings about a strong impact on participants, while causing them to know about awesome science and difficult concepts. And indeed, secrecy provides a continued anchor with Science – and an extrapolation of the learning process. Artificial Intelligence fosters interaction and impact with students and citizens, so a Chatbot is very convenient and justified – thus being developed to further enhance the user experience towards Science.

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## THE IMPACT OF EMOTIONS ON STUDENT PARTICIPATION IN AN ASSESSED, ONLINE, COLLABORATIVE ACTIVITY

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### Summary

There is growing recognition of the importance of emotions in academic online learning contexts. However, there is still little known about the role of emotions in social and collaborative online learning settings, especially the relationship between emotions and student participation. To explore this relationship, this study used a prospective longitudinal research design to follow 46 distance learning students throughout a 3-week assessed, online, collaborative activity. This approach allowed the fluctuating and dynamic aspects of emotions to be explored as well as the relationship between emotions and student participation in the collaborative activity. Self-report data were gathered using a semi-structured online diary at five time points throughout the task (once at the start of the collaborative activity, three times during the activity, and the final entry after the activity had finished). Findings revealed that learners generally perceived pleasant emotions (such as *relief*, *satisfaction* and *enjoyment*) to have positive impacts, or no impact, on participation, whereas unpleasant emotions (such as *anxiety*, *frustration*, and *disappointment*) were generally perceived to have negative impacts, or no impact, on participation. Interestingly, however, *anxiety*, and to a smaller extent *frustration*, were perceived by a number of students to have positive impacts during the activity. To conclude this paper, implications for educators are highlighted.

### Introduction

Research is increasingly highlighting the profound effects that emotions have in academic contexts (Pekrun et al., 2018; Pekrun & Linnenbrink-Garcia, 2012). It has been found that there are inextricable links between a learners' emotions and their cognitive processes (such as memory, attention and perception) (Tyng et al., 2017). Although support is growing for acknowledging the importance of emotions in online learning settings (e.g. Graesser, 2019; Artino, 2012), there is currently scarce research regarding the role of emotions in social and collaborative online learning environments, with a particular lack of research exploring the impact of emotions on student participation.

Providing a clear definition for the terms *emotion* and *student participation* is a not an easy task. Previous research has noted that both concepts are loosely defined and difficult to operationalise (Azevedo, 2015; Mulligan & Scherer, 2012). In this study, emotion will be viewed as a relatively short-lived intense reaction in response to a particular object or event (Artino et al., 2012). Emotions are thought to be multifaceted, consisting of affective, cognitive, physiological, motivational, and expressive components (Pekrun et al., 2018). The term *student participation* can be viewed as describing active engagement in academic tasks (Rocca, 2010). In the online collaborative activity, participation was defined to students as their: contribution to discussions; effort levels to complete the task and work with others; and overall involvement in the activity. Student participation is very much related to the concept of *student engagement*. There have been many conceptualisations of this concept; one commonality is that this it is viewed as being a multidimensional meta-construct consisting of several components (such as cognitive, behavioural, and emotional dimensions; Fredricks et al., 2004). In this study, we considered emotional engagement as an antecedent to the other dimensions of this construct (such as behavioural and cognitive engagement). This is a view that has been advocated previously. For instance, Pekrun and Linnenbrink-Garcia (2012) suggest that student engagement acts as a mediator between emotions and their academic learning and achievement. Whilst Boekaerts (2016) believes that discovering the effect of different types of emotions on other aspects of engagement (e.g. the quality of students' attention, participation, strategy use, interaction with peers, compliance, effort, and persistence) could be missed without separating emotional engagement from the overall conceptualisation of student engagement.

Although not specifically examining collaborative online learning, when exploring the links between emotions and student engagement in a distance learning environment, Kahu et al. (2015) found emotions to have differing effects on engagement. More specifically, pleasant emotions of *enjoyment* and *interest* were viewed as central to student engagement whilst *anxiety* and *frustration* were often found to inhibit engagement. The researchers also highlighted that such pleasant and unpleasant emotions often led to positive and negative outcome emotions (such as *pride* or *disappointment*) which could have powerful reciprocal effects on engagement, often by increasing or decreasing motivation and self-efficacy. Work by Linnenbrink-Garcia et al. (2011) provides support for the notion that pleasant emotions lead to positive impacts and unpleasant emotions lead to negative impacts on student engagement. In a face-to-face group work environment, these researchers found that increased levels of negative emotions were associated with social loafing whilst higher levels of positive affect were related to positive group interactions. Viewing the relationship between emotions and student engagement in this way may, however, be over simplistic. In accordance with Barrett and Russell's (1998) conceptualisation of emotion, not only are emotions distinguished by their valence

(i.e. pleasant or unpleasant) but also their activation (i.e. physiologically activating or deactivating). The activation of an emotion may dramatically impact its effects on student engagement (Linnenbrink, 2007). For instance, an unpleasant activating emotion such as *anxiety* can energise and motivate a student whereas an unpleasant deactivating emotion such as *hopelessness* may reduce and undermine engagement (Pekrun & Linnenbrink-Garcia, 2012). We have also observed the facilitative effects of unpleasant emotions in our own research (Hilliard et al., 2020). When exploring students' experiences of anxiety in an assessed, online, collaborative project, we found that more learners perceived anxiety to have had a facilitative effect on their individual participation and performance than a debilitating one. Such findings highlight the importance of gaining a greater understanding of the role of emotions in social and collaborative online learning.

## **Purpose and Research Questions**

The main purpose of the study was to explore the impact of emotions on undergraduate distance students' participation in an assessed, online, collaborative activity. The following research questions were addressed:

- To what extent do students perceive pleasant and unpleasant emotions to impact participation in an assessed, online, collaborative activity?
- How do students perceive pleasant and unpleasant emotions to impact participation in an assessed, online, collaborative activity?

## **Study Context**

The study was undertaken with UK Open University students who were studying a second-year undergraduate module in cell biology. As part of the module, students were required to work in small groups (between 3-6) to undertake a 3-week assessed, online, collaborative activity. This predominantly involved students working together to explore a neurodegenerative disease (Parkinson's, Huntington's or Alzheimer's). Each group was required to research their chosen disease and contribute information to a wiki. After this research had been carried out, each group had to collectively generate a summary of information about the disease (no more than 1000 words). To carry out the activity, groups were provided with a forum to discuss and interact with other group members. A student's overall grade for the activity was made up of both individual and group marks.

## **Research Methods**

### ***Sample and Procedures***

After gaining ethical approval from the Open University's Human Research Ethics Committee (HREC) and the Student Research Project Panel (SRPP), invitation emails stating the purpose of the study were sent to 245 out of the 729 students that studied the

module that year (some could not be included because of rules observed by SRPP). Students who agreed to take part in the study filled out a short online consent form. A total of 48 students volunteered to take part in this study (19.6% response rate). Two students withdrew one week into the collaborative activity and their data has not been included in this paper. The remaining 46 students were aged between 21 years and 56 years ( $M = 32.72$  years;  $SD = 8.78$  years) and the majority were female (82.6%; 38 females and 8 males). When compared to the student cohort, women were slightly over-represented as the proportion studying the module was 72%. This study adopted a prospective longitudinal research design (Menard, 2008) and students were sent links to five online diary entries (created using JISC Online Surveys) over a 6-week period. The first diary entry planned to be completed before the start of the collaborative activity, the next three during the activity and the final entry after the activity had been completed. Students were briefly instructed on how to fill out the diary entries after agreeing to take part in the study. Students had 48 hours to complete each diary entry; after this time, they were unable to access the online form. In total, 227 diary entries were completed out of a possible 230 (98.7% completion rate). For participating in the study, participants received a financial incentive (£20 Amazon voucher).

## **Measures**

The online diaries were semi-structured and included a mix of closed-ended and short open-ended questions. In this paper, a specific sub-set of the data were reported which related to the impact of emotions on student participation in the assessed, online, collaborative activity. Diary entry 1 is not discussed as it did not ask students about how emotions impacted their participation (this entry was intended to be completed before the collaborative activity began).

### *Diary entries 2-4*

These entries were aimed at exploring emotional experiences throughout the activity and asked students to self-report how specific emotions impacted their participation. Students were asked to select one pleasant and one unpleasant emotion they had experienced in relation to the collaborative activity for the specific time period stated in each diary entry (e.g. the time since the previous diary entry). Students could select from nine pleasant emotions (*hope, curiosity, enjoyment, relief, satisfaction, excitement, happiness, pride, surprise*) and nine unpleasant emotions (*anger, disappointment, confusion, frustration, anxiety, dissatisfaction, insecurity, guilt, boredom*). These emotions were chosen based on previous research which has investigated emotions in online collaborative activities (e.g. Hilliard et al., 2019; Webster, 2019). Students also had the option to select *other* if they felt that the predefined lists did not capture the feelings they experienced. If a student had not experienced any pleasant or unpleasant emotions, they could select “No

pleasant/unpleasant emotions experienced”. For instances when students selected a pleasant and/ or unpleasant emotion, they were asked to report the extent to which they felt the emotion had impacted their participation (1 – *Not at all* to 5 – *A great deal*). Where students perceived that emotions had impacted participation (i.e. a score greater than 1), they were asked to identify the ways in which this had occurred by selecting one or more statements from a pre-defined list. This consisted of 17 statements which aimed to reflect how emotions could impact participation in both positive and negative ways and was based on previous literature and research undertaken by the authors of this paper (e.g. Hilliard et al., 2020; Linnenbrink-Garcia et al., 2011). For example: “I increased my effort and tried harder in the collaborative activity” and “I didn’t contribute to the tasks as much”. An “other” was also available for students to describe any other ways emotions had impacted their participation.

#### *Diary entry 5*

This entry was intended to be completed after the activity had been completed and aimed to gain a reflective assessment of how emotions impacted participation throughout the whole activity. Students were asked to respond to four statements about whether they thought pleasant and unpleasant emotions had positively or negatively affected their participation (using a 4 point-scale from 1 – *None at all* to 4 – *To a great extent*). For instance, students were asked: “Overall, in relation to the S294 collaborative activity, to what extent did pleasant emotions (e.g. enjoyment, curiosity, relief, excitement, hope) have a positive impact on your participation in the activity?”. They were also asked to indicate how six pleasant emotions (*hope, curiosity, enjoyment, relief, satisfaction, excitement*) and six unpleasant emotions (*anger, disappointment, confusion, frustration, anxiety, dissatisfaction*) had impacted on their participation in the collaborative activity. Students responded by selecting one or more of the following response options: *Positive impact*, *Negative impact*, or *No impact*.

#### **Analysis**

Quantitative data were analysed using descriptive statistics. Frequencies (n) and percentages (%) were calculated and transformed into tables in Microsoft Excel 2013.

#### **Results**

Findings from diary entry 5 are presented first, as they provide an overall assessment of how students perceived emotions to impact their participation throughout the activity. In total, 45 students responded to this diary entry. Findings are presented in Table 1 and Table 2. When asked if pleasant emotions positively impacted their participation (Table 1), a large majority of respondents (84%) said that they did. When asked if pleasant emotions negatively impacted their participation, the majority of students (71%) said they did not.



# The Impact of Emotions on Student Participation in an Assessed, Online, Collaborative Activity

When asked whether unpleasant emotions positively impacted their participation, slightly over half the respondents (56%) said that they did. When asked whether unpleasant emotions negatively impacted their participation, about two thirds (66%) of the respondents said they did.

Table 1: Students perceptions of the extent to which pleasant and unpleasant emotions impacted participation.

	None at all	To a small extent	To a moderate extent	To a great extent
Did pleasant emotions positively impact participation?	7 (16%)	11 (24%)	13 (29%)	14 (31%)
Did pleasant emotions negatively impact participation?	32 (71%)	7 (16%)	5 (11%)	1 (2%)
Did unpleasant emotions positively impact participation?	20 (44%)	10 (22%)	12 (27%)	3 (7%)
Did unpleasant emotions negatively impact participation?	15 (33%)	19 (42%)	5 (11%)	6 (13%)

In diary entry 5, students were also asked how specific pleasant and unpleasant emotions had impacted on their participation in the collaborative activity (see Table 2). Overall, substantially more students reported pleasant emotions to have a positive impact on participation than a negative impact. A large proportion of students also reported pleasant emotions to have no impact on their participation in the collaborative activity. For the specific pleasant emotions, the three most reported to have a positive impact were: *relief* (reported by 69% of students), *satisfaction* (reported by 58% of students), and *enjoyment* (reported by 56% of students). Although *curiosity*, *hope* and *excitement* were reported by many students to have a positive impact (reported by 49%, 44% and 44% of students, respectively), the same number of students, or more, reported these emotions to have no impact on their participation in the collaborative activity (reported by 49%, 56% and 53% of students, respectively).

Overall, substantially more students reported unpleasant emotions to have a negative impact on participation than a positive impact. A large proportion of students also reported unpleasant emotions to have no impact on their participation in the collaborative activity. This was higher than that reported for pleasant emotions. The most reported emotion to have a negative impact on participation was *anxiety* (reported by 64% of students). This emotion, however, was also the most reported unpleasant emotion to have a positive impact of participation (reported by 29% of students). The second most reported unpleasant emotion to have a negative impact was *frustration* (reported by 42% of students) and this was also selected by a few students to have a positive impact on participation (reported by 13% of students). Although *dissatisfaction*, *disappointment*, *confusion* and *anger* were reported by a number of students to have a negative impact (reported by 31%, 26%, 33%

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and 24% of students, respectively), considerably more students reported these emotions to have no impact on their participation in the collaborative activity (reported by 67%, 69%, 62% and 76% of students, respectively).

Table 2: Students' perceptions of the general impact of pleasant and unpleasant emotions on student participation (Darker red = higher frequency; White = lower frequency).

	Positive impact	Negative impact	No impact	Overall
Pleasant	144	9	122	275
Relief	31	1	15	47
Satisfaction	26	2	17	45
Enjoyment	25	2	19	46
Curiosity	22	2	22	46
Hope	20	1	25	46
Excitement	20	1	24	45
Unpleasant	27	100	155	282
Anxiety	13	29	9	51
Frustration	6	19	23	48
Disappointment	2	14	30	46
Dissatisfaction	3	12	31	46
Confusion	3	15	28	46
Anger	0	11	34	45
Total	171	109	277	557

Table 3: Students' perceptions of the specific impact of pleasant and unpleasant emotions on student participation.

Emotion	I posted more in the forums	I didn't post as much in the forums	I tended to initiate discussions	I mostly responded to messages sent from others but did not initiate discussions	I felt confident in expressing my thoughts and opinions to the group	I didn't feel I could express my thoughts and opinions to the group	I increased my effort and tried harder in the collaborative activity	I reduced my effort and didn't try as hard in the collaborative activity	I made more effort to support other group members	I made less effort to support other group member	I took more of a leadership role	I left others to take the lead	I did more of the work by myself	I didn't contribute to the tasks as much	I took on some tasks that were outside of my comfort zone	I only took on tasks that I was fully confident with	Other	Overall
Pleasant	34	2	18	6	32	0	32	0	26	0	11	6	9	3	15	2	5	201
Relief	11	0	8	2	12	0	11	0	13	0	5	2	4	1	6	0	2	77
Satisfaction	9	0	6	1	10	0	8	0	6	0	5	2	3	0	4	0	1	55
Curiosity	3	1	0	1	2	0	3	0	1	0	0	2	0	1	1	1	1	17
Pride	2	1	1	0	4	0	3	0	1	0	1	0	0	1	1	0	0	14
Enjoyment	3	0	1	1	3	0	2	0	2	0	0	0	1	0	1	0	0	14
Surprise	2	0	1	0	1	0	3	0	1	0	0	0	0	0	2	0	0	10
Hope	2	0	1	1	0	0	1	0	0	0	0	0	1	1	0	1	1	9
Happiness	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	3
Excitement	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Unpleasant	18	18	12	8	5	7	19	6	15	5	11	9	12	3	4	5	6	163
Anxiety	7	4	4	4	2	0	7	0	4	1	4	3	4	1	1	2	3	51
Frustration	4	4	4	0	1	2	4	2	2	1	2	3	3	2	1	1	1	37
Disappointment	3	2	3	0	1	2	3	2	3	1	2	0	4	0	1	0	1	28
Insecurity	3	1	1	2	1	1	3	1	4	0	1	2	1	0	1	0	0	22
Anger	1	2	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	11
Dissatisfaction	0	2	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	5
Confusion	0	1	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0	5
Boredom	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	3
Guilt	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	52	20	30	14	37	7	51	6	41	5	22	15	21	6	19	7	11	364

In diary entries 2-4, students were asked to select one pleasant and one unpleasant emotion they had experienced in relation to the collaborative activity and indicate whether this had impacted their participation. In total, 101 pleasant emotions were selected by students and from these 70 were reported to impact participation in the activity. From the 89 unpleasant

emotions selected by students, 68 were reported to impact participation. Frequencies of specific ways emotions affected participation are reported in Table 3. In general, pleasant emotions led to more positive impacts on participation. The four most frequently reported ways pleasant emotions impacted participation were as follows: “I posted more in the forums”; “I felt confident in expressing my thoughts and opinions to the group”; “I increased my effort and tried harder in the collaborative activity”; and “I made more effort to support other group members”. For the specific pleasant emotions, students reported *relief* and *satisfaction* to have the most impact on participation overall. Students reported that unpleasant emotions had both positive and negative impacts on participation. The four most frequently reported ways unpleasant emotions impacted participation were as follows: “I increased my effort and tried harder in the collaborative activity”; “I posted more in the forums”; “I didn’t post as much in the forums” and “I made more effort to support other group members”. For the specific unpleasant emotions, students reported *anxiety* and *frustration* to have the most impact on participation overall.

## **Conclusion**

This study aimed to explore the impact of emotions on undergraduate distance students’ participation in an assessed, online, collaborative activity. Findings highlighted that students perceived emotions to have varying effects on participation, with pleasant emotions largely having positive impacts, or no impact, and unpleasant emotions generally having negative impacts, or no impact. The pleasant emotions of *relief* and *satisfaction* were found to be of particular importance in relation to student participation in this study. Both of these retrospective outcome emotions have been found to be prevalent in similar learning activities in previous research (Hilliard et al., 2019). In accordance to Barrett and Russell’s (1998) taxonomy of emotions, both *relief* and *satisfaction* would be classified as pleasant deactivating emotions. These are thought to have potentially debilitating effects on student engagement, such as reduced attention and motivation. However, both emotions were found to be central to engagement in this collaborative activity. These findings highlight the need to explore the relationships between specific discrete emotions and student engagement further in this learning context, as emotions may act differently than in other academic learning environments. The unpleasant emotions of *anxiety* and *frustration* were also found to be of significance in relation to student participation. These emotions have also been found to be frequently reported by students in previous research in similar settings (Hilliard et al., 2019). Findings revealed *anxiety*, and to a lesser extent *frustration*, were perceived by students to have both negative and positive impacts on student participation. Both emotions would be classified as unpleasant activating emotions, which are thought to be able to facilitate engagement (e.g. by enhancing motivation to avoid failure). The dual effect of such unpleasant emotions in online collaborative activities is an interesting area of study, which needs to be explored further

to fully understand the role and function of these emotions when learning in social online learning contexts.

This study has contributed towards understanding how emotions impact student participation in an assessed, online, collaborative activity and there are a number of important implications for educators and learning designers from these findings. Firstly, we believe that a greater focus should be placed on student emotions when designing and teaching online collaborative activities. Research has highlighted that emotions can have profound effects in academic contexts and placing a strong emphasis on students' emotions in online collaborative activities may not only have a substantial impact on student experience but also on learning and achievement. Secondly, it is important to understand that unpleasant emotions do not have negative effects for all students. As highlighted in this study, numerous students reported beneficial impacts from *anxiety* and *frustration* on their participation. Further research is, however, needed to understand the functions of different emotions in this learning context. Third, support should always be provided to students when unpleasant emotions are strong and persistent. These experiences can lead to reduced student satisfaction, academic achievement, and student retention. Exploring ways to best support students in distance learning environments is essential and more research needs to be undertaken in this area. For instance, we are currently exploring incorporating an emotion awareness and regulation tool throughout an online collaborative project at the UK Open University.

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## IMPACT OF AI APPLICATION ON DIGITAL EDUCATION FOCUSED ON STE(A)M

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### Abstract

Digitization is omnipresent and digital transformations are thus constantly taking place in all areas of society. Of course, education is also subject to these changes. Since it is an absolute prerequisite for both the future security of society and the development of the individual, it must be innovated continuously in order to guarantee the future opportunities of future generations. To ensure that these developments can be planned and shaped systematically, there are varieties of initiatives by education stakeholders. Current studies emphasize that the further digitisation of education is a very complex and demanding process, although successful theories, concepts and models already exist.

Although the key role of the digitisation of education is taken into account, the new challenge of the interplay between human and artificial intelligence is emerging. Artificial intelligence has been researched and taught for many years, especially in the context of knowledge-based systems], but with digitisation it is gaining a completely new status and an exploding range of applications. The individual field of artificial intelligence is increasingly linked with other scientific fields in an interdisciplinary way, resulting in new methodological, technological, social and ethical challenges.

Existing target systems in research and teaching are not to be replaced completely, but should rather be questioned and further developed in a very comprehensive way. For this reason, the proven problem-solving processes are being made more dynamic and agile. They will be optimised with the methods and means of digitisation as well as artificial intelligence. Due to the omnipresence of digitization and artificial intelligence, all processes, structures and functions must also be reviewed and adapted in education.

A prerequisite for this is a renaissance of the interaction of science, technology, engineering, mathematics, and their combination with areas of humanities,

economics and social sciences. Applications of artificial intelligence are finding their way into all the above-mentioned scientific fields and promote their networking. These developments are already becoming visible in complex research and education projects, making it possible to demonstrate the sustainability of the new approaches in an exemplary manner.

However, the rapid development of digitalisation in general and of artificial intelligence in particular is generating distortions in the systems. Seeking solutions for them is also on the agenda of research and teaching. This paper contributes to this debate by applying a systemic approach to develop a new understanding of the relationships between digitalisation and artificial intelligence.

First, an overview of digitalisation in education as well as of smart systems based on human and artificial intelligence will be presented. The next section of this paper explains the theoretical basis of this research before discussing a specific example of STEAM influence on education. Finally, ethical borders of digitalisation and AI in education are highlighted.

## **Digitalisation in Education**

Digitisation is the basis for the transformation and presentation of information and communication as well as for the more complex design of objects and services and thus for the digital transformation of complex systems of the entire society. Therefore, digitisation is not sufficient for education as a complex application. It is rather simply the basis for their digitalisation. For the users and thus also for the developers, it is much more relevant how digitalisation can generate innovations, improve processes and optimise operations. Digitalisation takes place within the framework of digital transformations.

In order to ensure the success of digital transformations, they should always be related to the processes of society, living, professional and working environments, because, on the one hand, they are initiated in this context and, on the other hand, they lead to fundamental changes in these areas. Education should therefore not only be subject to general digitization, but rather be education for digital transformations. First, this includes raising awareness of social acceptance and change. If this is given, then education for digital transformation includes new forms of teaching and learning as well as new teaching content. Digitalised teaching will therefore have a growing share in all educational processes.

Digitalised teaching and learning in a globalised world promote open education, lead to greater individualisation of education and life planning, require better coordination of all interfaces of initial and further education in lifelong learning and demand new skills in areas such as social networking, connected learning, knowledge and information literacy.

The daily interaction of the digital natives with digital information and communication media does not necessarily lead to the development of a deeper understanding of digital transformations. In addition to technical-informal skills, an understanding of, for example, new digital models, data security and protection as well as other social implications must be present in order to be sufficiently educated for digital transformations. (Gallenkämper et al., 2018)

A study of the Association of German Engineers (VDI) on engineering education for digital transformation in 2019 determined the current state of education in Germany and served to identify supportive and inhibitory framework conditions. It led to a comprehensive and constructively critical discussion in educationally oriented areas of society. Due to the change in the fields of life, learning and activity, inter- and transdisciplinary approaches, soft skills, the combination of theory and practice, and ethical aspects are becoming increasingly important. The accelerated change through digital transformations requires agile models for curriculum development. Digital transformations become a strategic goal for educational institutions. Across all groups surveyed, the willingness to undergo digital transformation was rated higher than their own ability to do so.

Students would like more interdisciplinarity in teaching content according digital subject. Largely, they are in favour of adapting their own study foci in the course of digital transformations. Teachers who are hostile to new content and formats are also seen as an obstacle to the digitalisation of education. In contrast, cooperation with partners in practice and particularly active teachers were highlighted as drivers of digitalisation in education.

Overall, several fields of action were identified that are relevant for remedying the deficits in digitalised education between the content and quality of studies and the actual and future requirements of the professional and living worlds. They are supported by concrete recommendations for activities. It is demanded that strategic goals be set, drivers and obstacles identified, target systems operationalised, ethically responsible action generated, competence profiles further developed and academic continuing education systematically expanded (Wernz et al., 2019).

## **Smart Systems Based on Human and Artificial Intelligence**

Smartness is a characteristic that is posited positively in many ways. It expresses that intelligence exists or an appearance acts intelligently. In the face of the overwhelming flood of information, the barely controllable explosion of data, the omnipresent streams of communication and the constant influence of the media, the question arises, how smart can respond to these influences and challenges by appropriate education. Digital transformations intensify these scenarios, but they also offer the opportunity to design



education systems and processes in such a way that the new conditions are not only a burden but also an opportunity for better education and thus better living conditions.

However, smart education also means that data, information, communication and media in all social, professional and personal areas are used intelligently, in order to generate more quality of life, better career opportunities and personal happiness. (Schumann & Kauper, 2018) Smart systems are therefore at the same time intelligent systems, which can also form a framework for the symbiosis of human and artificial intelligence. Holistic recognition and understanding of complex interrelationships as an essential part of human intelligence is combined with the possibility of artificial supplements.

As soon as all areas of society, including education, is permeated by digitalisation, all facets of digitalised education will be influenced by artificial intelligence. The formation of collective intelligence requires that natural and artificial intelligence influence each other in their development without making each other obsolete. Through artificial intelligence, problems can be solved holistically and human consciousness can be expanded. (Pagel, Portmann, & Vey, 2018)

That is why; artificial intelligence is an indispensable component of the methodology and content of digitalised education and offers a wide range of methods and numerous areas of application to support human intelligence, expansion of consciousness, support of awareness and creativity (Figure 1).

Methods	Neural Networks	
	Machine Learning	
	Deep Learning	
	Cognitive Computing	
	Natural Language Processing	
Applications	"Frugal" Artificial Intelligence	Image Recognition
		Speech Recognition
		Navigation Systems
	"Complex" Artificial Intelligence	Autonomous Systems
		Self-training Systems
		?

Figure 1. Essential methods and application areas of AI

Artificial intelligence is the ability of artificial systems or objects to plan and execute tasks independently and efficiently in an analogous way to humans by means of creative and intellectual activities and by learning to adapt to new conditions. Since methods of AI are in different, partly still very early stages of development and complex systems of AI still show a rather low degree of maturity, they can of course only be part of educational content and drivers of educational methodology according to the current state of knowledge.

## **Problem Orientation, STE(A)M and Digitalised Education**

According to activity theory (Leontjew, 1987), a human as a social being is motivated to perform activities that lead to purposeful actions based on operations. This statement is also valid for mental actions based on mental operations and is not relativized by artificial intelligence. Therefore, the activity theory has a direct relation to the action theory (Parsons, 1937) and, due to the knowledge gain associated with it, to the learning theory (Harasim, 2017). Because, however, in all goal-oriented activities that are the subject of the theories mentioned, it is assumed that people recognize, describe, discuss and, if they have the necessary knowledge, partially or completely solve problems. Therefore, problem orientation as well as the actions and operations associated with it remain the central task of human activities and the associated learning processes from the human point of view. Artificial intelligence will only promote or inhibit this sphere of human existence, since its processes are relatively independent and can at least temporarily run independently of human activities, actions and operations.

In an increasingly digitalised world, science, technology, engineering and mathematics (STEM) are particularly relevant and useful disciplines for recognising, describing and, if necessary, solving complex problems by means of complex actions and operations. They are seen as the key to structured, systematic, constructive-critical thinking and systematic understanding of the human environment and thus serve to shape meaningful approaches in school and university education. It is interesting to look at the STEM-bearing disciplines in comparison to those that are characteristic of the AI (Figure 2).

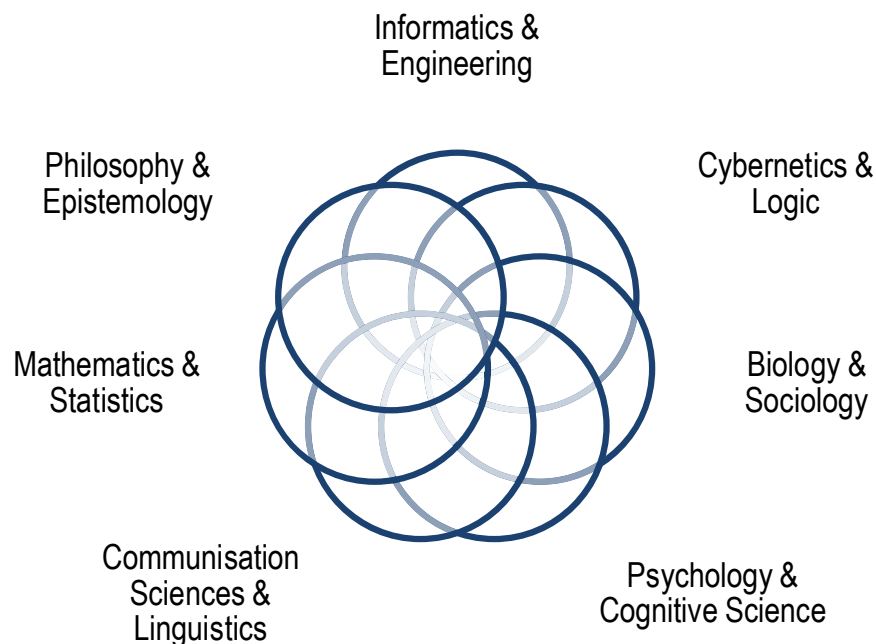


Figure 2. AI-supporting disciplines

With the increased spread and growing influence of AI, a renaissance of STEM will therefore inevitably have to occur. It will have a decisive influence on educational potentials and outcomes and thus on the development capacity of society (Figure 3).

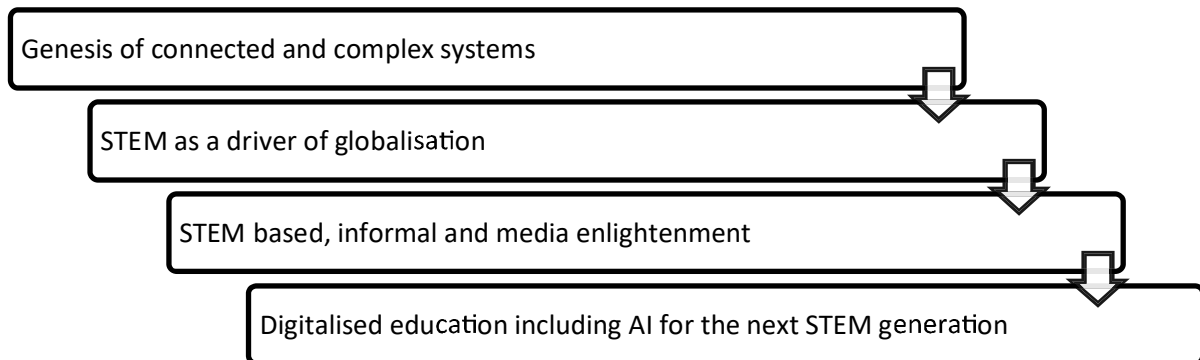


Figure 3. Educational change through globalisation, digitization and AI

Since creativity and innovative ability beyond STEM are essential for the development of individuals, it is expanded by arts to STEAM. This process is duplicated in the transition from classical computing to cognitive computing in the field of artificial intelligence, which in turn promotes STEAM.

### **Problem Orientation, STE(A)M and Digitalised Education**

Proven educational formats should be further developed in the application and teaching of digitised education. Therefore, a complex project in an interdisciplinary field with a high degree of digitization and selective application possibilities for AI was selected to exemplify the associated challenges and opportunities. The selected project takes place within the framework of a so-called junior research group and serves the further education of young researchers and students.

The goal of the research project is the development of a digital assistance system for measuring and evaluating individual work demands. Therefore, empirical studies are conducted based on systemic developments. This project is highly suitable to demonstrate how digitization and artificial intelligence massively influence digitized education in the high technology sector, both methodically and in terms of content, and why STEAM is the basis for successful teamwork. The interdisciplinary team went through several project phases in an agile manner, which were structured in work packages as demonstrated in Table 1.

Table 1: Impact of digitalisation, AI and STEAM in work packages of a training project

Work Package	Degree of Digitalisation	Possible AI Impact	Existing STEAM Reference
Capture of work content and processes and their digitization	High	Low	High
Selection of vital data for the individual assessment of workloads	Low	Medium	High
Creation and design of the measuring systems close to the body for data acquisition	High	High	Very high
Generation of a data acquisition tool and data analysis	Very high	Very high	Very high
Development of a digital assistance and evaluation system	Very high	High	Very high
Investigation of stress curves for selected applications	High	Very high	Very high
Optimization of specific, digitally supported work content and processes	High	High	High
Evaluation and generalisation of the work results obtained	Medium	Medium	Very high

If young researchers are trained in digitalised research development and application environments by means of interdisciplinary project work, special demands on knowledge and competence development arise with regard to digitisation, AI and STEAM. Through the permanent transfer of knowledge during the joint concept development, implementation and evaluation, those involved in the project are excellently prepared for the requirements of future research and working environments in the age of digitalisation. The project contents are both a direct component of the current training of the team members and the basis for scaling the results by means of digitalised training formats. Due to the excellent results in terms of learning worlds, this form of interdisciplinary project work in digitalised worlds is considered particularly suitable for digital education and training, which is why this form of knowledge and competence development is being rolled out.

## **Ethical Borders of Digitalisation and AI in Education**

Digital transformations and the further spread of artificial intelligence create new challenges for society in general and ethics in particular. Since ethics is related to human action, the connection to the theory of action is immediately apparent. Young people have to be educated in order to be able to recognise the new constraints and act accordingly. STEM has to be expanded to include this view of applied philosophy. Principles and fundamental values of ethics, such as the inviolability of human dignity, are preserved. They have to be supplemented by new demands of moral action, which inevitably arise

from the mass application of digital, autonomous and smart systems and artificial intelligence.

The new values will be incorporated into education, but people's fields of action and decision-making are becoming even more complex and are increasingly influenced by artificial intelligence and systems. In new approaches to ethical rules, it is proclaimed across the board that transparency and human control of machine decisions and, above all, the traceability of decision paths should be given in order to be able to act morally at all. At present, however, the dilemma, and thus the limits of ethics in education and application, is that intelligent systems sometimes make decisions without the required transparency and traceability being completely given. These ethical limits of education and action must be identified and clarified.

Thus, in order to be able to act morally, ethical considerations are needed on how to ensure transparency, influence and traceability in the interaction of natural and artificial intelligence in system control and decision-making. The solution is that, in addition to the necessary STEAM-based professional knowledge and general education, they should be a prerequisite for the use of digitization and artificial intelligence. It is precisely this idea that is being pursued in new concepts for ethical rules in order to give those acting the opportunity for moral behaviour at all. With regard to the design and handling of autonomous AI-based systems, the following specific values are of particular importance with regard to the design of the essential interfaces (man-machine, machine-machine, man-cloud, machine-cloud) in addition to the traditional values: explainability, transparency, accountability, reliability, safety, data privacy, cybersecurity, fairness. A necessary prerequisite for the fulfilment of these values is the traceability of the decision-making processes. (Hubig et al., 2020)

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## METHODOLOGY FOR THE DEVELOPMENT OF A COMPETENCE FRAMEWORK FOR STE(A)M EDUCATORS

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### Abstract

The STE(A)MonEdu Project aims to increase the adoption and impact of STE(A)M education by investing in the community of stakeholders and the professional development of educators. Focusing on the professional development of educators, it aims firstly to compile a competence framework for STE(A)M educators and then design appropriate training offers. In this paper, we first discuss the competency-based perspective, alongside with the related work regarding competence frameworks for STE(A)M education. Subsequently, the proposed methodology for the development of a STE(A)M educator competence framework and profile are described, based on a modified Delphi technique and taking advantage of the European Framework for the Digital Competence of Educators (DigCompEdu).

### Introduction

STEM-related careers are considered as “the jobs” of the future; the European Parliament forecasts around 7 million new STEM jobs by 2025 (UNESCO, 2017). However, although students who participate in STEM-related programs may have more experiential learning opportunities, the contemporary advanced world requires much more than a mere understanding of these areas; it requires application, creation and ingenuity. STEAM education allows students to connect their STEM learning with arts practices and elements, design principles and standards so as to have the whole pallet of learning at their disposal (Sanger & Gleason, 2020). However, combining STEM and non-STEM subjects requires a lot of content knowledge for educators. In addition, with the adoption of STE(A)M in classrooms, new teaching methods have emerged, in which educators have multiple roles (e.g. manager, technician, educator etc.).

The EU-funded Erasmus+ project “STE(A)MonEdu: Competence development of STE(A)M educators through online tools and communities” aims to increase the adoption and impact of STE(A)M education by investing in the professional development of all kind

of educators (teachers, trainers, tutors etc.). In this context, STE(A)MonEDU will research how to strengthen STE(A)M education, providing an online environment with an assorted toolset to support the development of an evolving STE(A)M education eco system, where different stakeholders work collaboratively to design, develop and implement STE(A)M educational content, practices, projects and policies. The overall approach of STEAMonEDU is to nominate educators as the pillars of the implementation of STE(A)M education and support their professional development either by blended training or by their participation in a community of stakeholders. In this context, the core project outcome is the STE(A)M Competence Framework (STE(A)MComp), which will detail the competences necessary to design and implement STE(A)M education activities. Based on it, the STE(A)M educator profile will be designed, in which the competencies will be compatible with ESCO (European skills/competences, qualifications and occupations) and the job profile will be mapped to European Qualification Framework (EQF).

In this paper we focus on the STE(A)M Educator Competence Framework, the first result of the STE(A)MonEdu project. At first, the competency-based perspective is discussed, alongside with the related work regarding competence frameworks for STE(A)M education. Subsequently, the proposed methodology for the development of the competence framework together with first results are presented, illustrating the different phases of this process.

## **Challenges of STE(A)M educators**

There is widespread recognition that teaching separate subjects divorced from practical problems and real world practice is not meeting the needs of the 21<sup>st</sup> century (Xun, Dirk, & Spector, 2015). Therefore, there has been a growing interest in cross-curricular and integrated learning over the past years. STEAM education grew out of STEM educational approach and utilizes the following main pillars: Natural Sciences (S), Technology (T), Engineering Sciences (E), Arts (A) and Mathematics (M). This interdisciplinarity allows for a holistic approach to enhance the cultivation of the skills of educated citizens of the 21<sup>st</sup> century (Yakman & Lee, 2012). It consists of learning experiences that help students realize how to focus and learn by putting emphasis on logical, mathematical, experimental, and scientific thinking (Bybee, 2013). At the same time, STE(A)M approach enables the recognition of the diversity of learners' learning needs and enhances the teaching of STEM fields, by utilizing common skills in the STEM and Arts disciplines (Allina, 2018). Integrating aspects that emphasize on the arts and humanities can transform the current emphasis on STEM jobs and domain specific skills to inquiry-centred knowledge development appropriate for STE(A)M-based curricula (Xun et al., 2015). In many advanced countries, mostly in United States and Asia, efforts to integrate various STEM disciplines and subjects in curricula at different levels have been recorded (Anisimova,



Sabirova, & Shatunova, 2020). However, these initiatives create the need for an education system reform in order to support STE(A)M education. Better preparation of educators is one of the main challenges of this required reform, because still there is limited consideration of the challenges that educators face in implementing an integrated STE(A)M curriculum effectively (Ng, 2019). Although what an educator needs to know and be able to do in general for effective teaching and learning has been a subject of scholarly research, relatively less effort has been put into articulating the knowledge educators need for effective STEM teaching (Chan, Yeh, & Hsu, 2019).

The results of the a experimental work with future teachers confirmed that support and active implementation of STE(A)M education should be carried out through targeted development programs.(Anisimova et al., 2020). The results of another study (Nadelson et al., 2013) consistently revealed that the participants' years of teaching experience were not associated with knowledge and comfort with teaching STEM or a greater feeling of effectiveness for teaching STEM. Thus, professional development that attends to STEM knowledge may be needed by educators at multiple stages in their careers. On the other hand, the implementation of STE(A)M education is feasible at all levels of education, ranging from pre-school to professional, often in close cooperation and cooperation of educational and extracurricular organizations (Anisimova et al., 2020). Thus, because educators may have different academic backgrounds, the current content knowledge may different, as the result training needs for STE(A)M education may differ based on the educators' characteristics (Spyropoulou & Kameas, 2020). In the literature, there are several works regarding design and implementation of Professional Development Programs for specific topics of STEM or STEAM education (e.g. problem based learning in STEM), mostly for science teachers (Ahmad, Yakob, & Ahmad, 2018; Ring, Dare, Crotty, & Roehrig, 2017), however, little research has investigated variations of STE(A)M education teaching needs and practices by their background characteristics (Park, Byun, Sim, Han, & Baek, 2016). As a result there is a need for further research on educators needs so that they can effectively teach STE(A)M-related courses (Margot & Kettler, 2019; Stohlmann, Moore, & Roehrig, 2012).

### **A competency-based perspective**

A competence is a broad concept that describes individual's ability and it involves a set of knowledge, skills, values and attitudes that is critical in producing key outputs (Yar, Asmuni, Abu, & Silong, 2008). According to U.S. Department of Education "Competency-based strategies provide flexibility and personalized learning opportunities with a better learner engagement due to the content is relevant to each learner and tailored to his/her unique needs" (U.S. Department of Education, 2017). Depending on the strategy pursued, competency-based systems also create multiple pathways to education and help identify

opportunities to target interventions to meet the specific learning needs of learners (Bartram, 2005). This learning method allows learners to acquire at their own pace individual skills that they find challenging, practicing and refining as much as they need and move rapidly to other skills to which they are more adept (Gervais, 2016). Educators' competencies are descriptions of what a qualified teacher/educator should know and be able to do. To maximize student learning, educators must have expertise in a wide-ranging array of competencies in an especially complex environment where hundreds of critical decisions are required each day (Gump & Jackson, 1969).

A competence profile is an assessment tool that consists of a list of tools that an employee needs to possess to be successful in a position. Competence profiles assist in effective learning and development by identifying the behaviours, knowledge, skills and abilities that are necessary for successful performance in a job (Fletcher & Campbell, 2018). Educators' competence profiles are used to promote "best practices", provide educators with a clear focus of goal setting for professional growth and efficiency, and help guide educator training and institutionalization of professional development activities. UNESCO (2009) has developed a competence profile for educators, which includes a description of the necessary knowledge, skills and perceptions with which an educator should be equipped to efficiently integrate different innovative digital technologies and systems in educational practice. The digital technologies that are approached mainly concern technically the use of mobile computing systems and smart boards, while in terms of applications, the effort focuses mainly on the exploitation of Web 2.0 applications for teaching and learning. European Committee for Standardisation (CEN) has developed the European e-Competence Framework (e-CF), which provides a reference of competences applied within the ICT sector, and understood by ICT user and supply companies, ICT practitioners, managers and human resources departments, the public sector, educational and social partners across Europe. In 2016 the e-CF framework has become a European standard for the ICT competences (e-CF, 2016). In addition, European Commission (Redecker & Punie, 2017) has developed the European Framework for the Digital Competence of Educators (DigCompEdu), which describes a set of digital competences that enable educators to seize the potential of digital technologies for enhancing and innovating education. The DigCompEdu framework addresses educators at all levels and forms of education (formal, informal, non-formal).

On the other hand, there is not much literature for educators' competencies and competency profiles for STE(A)M education, especially across Europe. Corbett et al. (2014) in a report from Pennsylvania Department of Education about a Program Endorsement to certify educators, present 19 types of STEM competences that candidates will acquire by completing their program, including the domains of contents, skill and ability,

instructional practice and assessment, as guidelines for the qualifications of STEM education instructors. However, they apply the specific competencies required based on the Pennsylvania School Code and the report did not describe how they were developed and whether their formulation has been validated. Kim and Kim (2016) developed, through behavioural event interviews and literature review and validated evaluation, indicators of teaching competency in STE(A)M education in Korea. The final evaluation indicators of teaching competency in STE(A)M education were composed of 35 items in 7 areas: Understanding of Subjects, Teaching-Learning Methods, Inducing Learners to Participate in Learning, Understanding of Learners, Learning Environments and Circumstances, Evaluation of Learners and Individual Qualification. However, this work focuses on Korean needs and, as the authors commented, these indicators are limited as they did not establish a hierarchy of importance among evaluation areas, criteria, and indicators and further studies to elaborate them are needed.

### **Methodology for developing a Competence Framework for STE(A)M Educators**

According to the National Academies of Sciences, Engineering, and Medicine (2017), although educators are at the centre of education's expansion into integrated STEM approaches, many of the policies shaping education are formed with little to no input from educators (Shernoff, Sinha, Bressler, & Ginsburg, 2017). In addition, during the research on teaching competency, most studies conducted a literature review to establish factors of teaching competency but did not reflect the opinions of educators in the field (Kim & Kim, 2016).

Our methodology utilizes a modified Delphi technique, a chief methodology to construct core competency models (Green, 2014). More specifically, Delphi has been used for the development of competency models and to identify the needs of teaching community in educational research (Tough, 2009). It refers to multiple rounds of surveys, with groups of participants, which are usually geographically dispersed, and allows them to deal systematically with a complex problem or a task, with the use of quantitative and qualitative data. This section presents the different phases of the methodology.

At first, based on the literature review and our research regarding STE(A)M educators' perceptions about challenges, difficulties, training needs and the role of STE(A)M educator (Spyropoulou & Kameas, 2019; 2020), a draft STEAMComp Profile has been developed. The draft profile contains the following areas:

	Areas
1. Content	1.1 Understand STE(A)M Education 1.2 Content Knowledge 1.3 Selecting content 1.4 Creating and modifying content 1.5 Managing and sharing content
2. Teaching and learning	2.1 Teaching 2.2. Design 2.3 Guidance 2.4 Collaborative learning 2.5 Self-regulated learning
3. Organization and Management	3.1 Classroom management 2.2 Content management 2.3 Teaching organization
4. Professional Engagement	4.1 Communication and cooperation 4.2 Professional Collaboration 4.3 Reflective activities
5. Assessment	5.1 Assessment strategies 5.2 Feedback and Planning
6. Empowering Learners	6.1 Accessibility and inclusion 6.1 Active engagement of learners 6.2 Differentiation and personalization

Figure 1.

Currently, in order to validate this proposal version and identify areas of possible improvement, we are designing a questionnaire-driven online survey, in which participants will be asked to answer some self-reflective questions regarding their expertise level in each area, and to share their opinions for the predefined categories and dimensions, by ranking, adding and/or deleting or rewriting them. By analysing quantitative and qualitative data, a revised STEAMComp Profile will be produced. In the third phase, the mapping of each competence with the European Qualification Framework will be designed. A second round of survey, with semi-structured interviews will be carried out (phase four), where participants will discuss about their opinion for the mapping with the EQF, in order to validate and to revise the alignment. Finally, at the final stage of the methodology, a synthesis of the STEAMComp framework and profile will be developed based on the results. Table 1 illustrate the phases of the proposed methodology.

Table 1: Phases for the Development of the STE(A)M Educator Competence Framework

Phases	1	2	3	4	5
Procedure	Literature review, Interviews /focus group	Online survey	Mapping the competence profile with EQF	Semi-structured interviews	Synthesis of STE(A)MComp Framework and profile
Results	Draft STE(A)M Comp Profile	Validation of STE(A)M Comp Profile	Draft alignment of the STE(A)MComp profile with EQF	Validation of the mapping with EQF	STE(A)MComp Framework and profile

## Conclusion and Future Work

In this paper, a brief overview concerning the competency-based perspective was presented, in order at first, to identify the challenges of and the current research within this topic for STE(A)M education and then to provide the proposed methodology for the development of the Competence Framework for STE(A)M Educators. We adopted a bottom-up approach, by nominating educators as the pillars of our research, in order to develop a STE(A)M educator Competence Framework. Mapping the required skills and competences a STE(A)M educator needs and investigating how he/she may enhance these skills and competences, will lead to more structured training programs with the broader aim to enhance scientific and technological dexterity in fighting exclusion in the forthcoming technology-intensive society and to develop technologically savvy citizens. This competence framework will be designed following a modified Delphi technique, with five different phases along the example of DigComp for Edu framework, including different competence areas and competences that are compatible with ESCO (European skills/competences, qualifications and occupations) and the job profile will be mapped to European Qualification Framework (EQF).

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## **EXTERNAL STRESSORS AND TIME POVERTY AMONG ONLINE STUDENTS: AN EXPLORATORY STUDY**

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### **Abstract**

In this exploratory study, we report results from interviews with 49 students at a large public urban university in the US who enrolled in at least one course online. In line with the literature, many students cited work or family reasons for enrolling in an online course. However, when asked at the end of the interview whether there were any other life events that impacted the time and energy that they had for their studies, 73% of the students cited at least one additional external stressor, and many of them cited up to three or four different categories of external stressors. These included illness/disability, death in the family, caretaking responsibilities, and housing instability, among others. One particularly striking result is that 89% of the external stressors reported by students in response to the final questions of the interview had not been volunteered by students when they were originally asked why they enrolled online or what factors impacted their course outcomes – this suggests that the prevalence of these more complex environmental factors may go underreported in studies that do not ask about them explicitly.

### **Motivation for the Study**

Online students have different characteristics than face-to-face students (i.e. Shea & Bidjerano, 2014; Wladis, Hachey, & Conway, 2015a; 2015b) and research has investigated whether students are at higher risk of dropping out or failing online than in comparable face-to-face courses (i.e. Jaggars & Xu, 2010; Johnson & Mejia, 2014; Shea, & Bidjerano, 2014; Wladis, Hachey, & Conway, 2015b). While many studies account for online students' demographic data, few include data on student characteristics related to external stressors or time poverty. Yet, online students are more likely to be working full time or to have children, and these factors have been correlated with higher stress levels and higher rates of time poverty (Giancola, Grawitch, & Borchert, 2009; Wladis, Hachey, & Conway, 2018). Moreover, other external stressors (i.e. illness or job/housing instability) may also prompt students to enrol in online courses because of a need for flexibility in time and space. These

additional complex environmental factors may also correlate with course outcomes, so it is important to collect data on these particular factors when researching online students. In this exploratory study, we report results from interviews with students at the City University of New York [CUNY] who enrolled in courses online. We use the student narratives from those interviews to investigate to what extent external stressors may have impacted the time and energy that students had available for their studies, and to the extent possible, to explore the extent to which these characteristics may have influenced student online course enrolment decisions.

## **Literature Review**

Online learners are more likely to be female, older, married, active military or to have other responsibilities (e.g., full-time work, children), and are more likely to have other “non-traditional” characteristics (e.g., delayed college enrolment; no high school diploma; part-time enrolment; financially independent) (Shea & Bidjerano, 2014; Wladis, Conway, & Hachey, 2015b). Several large-scale studies report that students who enrol in online courses are at significantly higher risk of course or college dropout (i.e. Xu & Jaggars, 2011a; 2011b), although a some large-scale studies suggest a positive impact of online enrolment (Johnson & Mejia, 2014; Shea & Bidjerano, 2014); so overall, results are mixed. One reason for the mixed results may be how researchers account (or do not account) for online student characteristics and life factors; currently, it remains unclear to what extent differential outcomes may be due to the characteristic profile of online versus face-to-face students (Wladis, Conway, & Hachey, 2016).

Many online students report the need for the flexibility afforded by online courses due to life challenges that make it difficult to attend face-to-face; students often cite lack of time/need for time flexibility, family responsibilities, reduced commute and work obligations as reasons for online enrolment (i.e. Daymont & Blau, 2011; Jaggars & Xu, 2010; Pontes et al., 2010; Wladis, Hachey, & Conway, 2015b; 2016). Yet, such student characteristics are not typically tracked by institutional research data, nor are they often addressed in studies of student characteristics that may impact online enrolment and/or outcomes. These and other environmental factors may be stigmatized and under-represented by online students, since “traditional” college students are not represented as having jobs, families, disabilities, health issues or other major life stressors outside of college (Chao, DeRocco, & Flynn, 2007; Chen, 2017).

## **Theoretical Framework**

Our framework posits that *time poverty* (Vickery, 1977), a by-product of various environmental factors such as family responsibilities and work, influences students’ decisions about enrolling online and may impact course outcomes. Time poverty includes

both quantity and quality of time; in relation to time quality, the flexibility and predictability of available time [which can also often be influenced by external environmental stressors] may be important (Jaggars, 2014). There is clear evidence that student parents and working students are more time poor than their childless and non-working peers (Wladis, Hachey, & Conway, 2018) and both of these groups are more likely to enrol online (Jaggars, 2014). Further, in a previous study, we found that online students are, on average, more time poor than students who enrol in the same course face-to-face (Conway, Wladis & Hachey, 2020).

Another related issue that may impact both enrolment and outcomes online is external stressors; student stress can arise from various environmental factors or from the amount of time and energy required for college study (i.e. time poverty). Academic, social, emotional or financial stress has been shown to negatively impact college students' academic performance (for a review, see Pariat, Rynjah, Joplin, & Kharjana, 2014). In particular, non-traditional students (who enrol online at higher rates), often face additional external sources of stress within their family, job and personal life in comparison to traditional college students (Giancola, Grawitch, & Borchert, 2009). However, little is known about the more complex external life factors that may exist in the lives of online students, and how these may impact online enrolment decisions and/or online course outcomes.

## **Method**

In-depth hour-long semi-structured interviews with 49 students enrolled in online courses at one of the two- or four-year colleges (in an undergraduate or master's program) throughout the City University of New York (CUNY), a large urban public university in the United States. Interviews were conducted immediately after the completion of a semester in which each student had enrolled in an online course. Students were recruited via email, were paid \$20 for their time, and were interviewed over the phone (a few students elected to come in and be interviewed in person). Students were asked about their reasons for enrolling in an online course, about their experiences in the course, and about various complex environmental factors that were present during the semester in which they were enrolled in the course, such as whether they have children (and if so, about their ages and the childcare available to them), their work hours (as well as the impact of work on their studies), and other external life stressors (e.g. health issues) that may have impacted their studies that semester. Interviews were continued until full saturation was reached, both in terms of repetition of common themes in the interviews, as well as representation of various student demographic groups that were present in the overall online student population at CUNY (e.g. gender, race/ethnicity, program and college

enrolment, grade point average, successful versus unsuccessful completion of the online course, etc.).

An emergent coding scheme was developed to determine common themes. First one of the researchers read through all the student responses and developed an emergent coding scheme using constant comparison analysis. Then, two other researchers coded all of the student reasons for course dropout using this coding scheme; all three researchers involved in the coding revised the coding structure throughout the coding process by combining codes, splitting codes, suggesting new codes, re-categorizing codes according to the framework, and re-defining codes. Such changes were undertaken through joint discussion until all three researchers came to a consensus. After two full rounds of coding, with a norming session in between, final inter-rater agreement for all codes used on this sample as measured by Krippendorff's alpha was 0.976.

## **Results and Discussion**

### ***Incidence of Factors Related to Time Poverty and Stressors***

As expected, many students cited work or family reasons for enrolling in an online course; this replicates results already found in existing literature on students' reasons for enrolling in courses online: 51% cited commitments related to paid work; 31% cited family obligations; and 27% cited commute, distance, or convenience as reasons for enrolling online. This is similar to previous studies, and reflects that various external non-academic factors are particularly relevant to students who select courses online at public universities in the US; many of these factors are also related to time poverty (e.g., Wladis, Hachey, & Conway, 2015b) and stress (e.g., Savage, 2006; Grabowski et al., 2016).

However, what was particularly striking and surprising is that, when specifically asked at the end of the interview whether there were any other life events that impacted the time and energy that they had for their studies that semester, many students brought up a whole host of external environmental stressors that they had not originally cited when asked about either their reasons for enrolling online or the factors that impacted their course outcomes. Seventy-three percent of students cited at least one external stressor, and many of them cited up to three or four different categories of stressors. Of those who reported some kind of external stressor, the vast majority were serious health problems (either for the student themselves or a close relative) or the death of an immediate family member. Frequencies of each category can be seen in Table 1 below.

Table 1: Proportion of different types of external stressors cited by online students during the interview

Serious illness/injury (family/close friend)	33%
death in the family/close friend	19%
caring for sick/disabled parent/grandparent	19%
job stressors	19%
Serious illness/injury (their own)	17%
unemployment/job change	17%
moving house or housing insecurity	17%
pregnant/birth of a child	11%
financial issues	11%
childcare issues	8%
romantic relationship stressors, including divorce	8%
disabled child	9%
planning a wedding	3%
domestic violence	3%
immigration	3%

Notes: n = 49

These external stressors were reported by students when they were asked specifically about factors that influenced the amount of time or energy they had for their studies, so this is not a simple recording of all students who experienced any of these events – there may have been students who did experience them but did not report them because they did not feel that they influenced the time or energy they had for their studies (or who did not report them because of desirability bias, influenced by the stigma that may be attached to some of these stressors).

One particularly striking result is that 89% of the factors reported by students in response to these final questions of the interview did not come up when students were asked specifically why they enrolled online, or what factors impacted their course outcomes. Instead, most of these factors arose only when students were specifically asked about other life events that impacted the time or energy they had to devote to their studies. A variety of examples were given to students during the interview, which may have influenced results (e.g. students may have been more likely to report health issues since this was given as a specific example – however, other examples that were listed, such as immigration, were not cited by students at high rates). Some students simply stated briefly without detail an event that had happened (e.g., “My father died last semester”), whereas other students gave significant detail about exactly what had happened and how it had either influenced them to enrol online or impacted their ability to complete coursework that semester. Many students were struggling with multiple challenges at once – often one challenge would lead to others, or several would naturally co-occur for common reasons. We present here a small sample of student narratives from the interviews, to give a sense of the scope of the challenges that many students were facing.

One student was working 40 hours/week to pay for living expenses and was the primary caretaker of two children in primary school. While this student cited work and childcare as having an impact on the decision to enrol online as well as on course outcomes, these stressors were not the only ones:

*“Recently I found out I had kidney stones, you know I was getting a lot of pain, and I thought it had to do with my sleeping habits. I would wake up and I would have a lot of lower back pain. It affected me as far as moving around and certain points it was very painful for me to move around... The semester that I took the classes online, my father actually he was actually dying of cancer, and that was hard of course because I was still in school...he passed [in] November during this time. I did let the teachers know and they were very considerate. You know they said you’ve been a good student and you know if there was an assignment when we were going to have the funeral, they told me you go be with your dad, even though I was trying to do the work the same day I found out... since my dad passed, I also alternate households because I would stay with my mom, because she was by herself. I would stay there a couple of nights and go to my home with my husband and kids, then there would be times when we would all stay there and like that.”*

Another student worked 20 hours/week to pay for living expenses and was the primary caretaker of three children (in high school and primary school), but described other stressors that impacted time and energy for school while enrolled in an online course:

*“I suffer from clinical depression so some days it’s very very hard to get out of bed in the morning. My life tasks let alone any of my other additional tasks that has impacted my education has been fortunate though because I’ve had professors [who are] very very understanding and with dialogue I was really able to do what I had to do to make sure I was reaching my grades even though I was feeling very very overwhelmed...[Last semester] my sister died from cancer... I was very tired. I was being pulled in a lot of different directions and a lot was being expected of me. I think it’s different when you’re a parent and you’re going to school than when you’re fresh out of high school living at home you know, and classes don’t take that into consideration when writing the syllabus. We’re expected to perform as if we’re 18 and have no responsibilities when in all actuality we have 1000 responsibilities. So depression, grief she was very sick you know chemo radiation, all of those things had me being pulled in 1000 different directions and it was hard for me to not only cope but to keep up.”*

This student did not have any children, yet had a challenging work schedule which was the reason for enrolling online; they described work as having a major negative impact on their ability to do well in school:

*“I was working so I was kinda getting bogged down. I was full-time school, I never took an online course in my life, so I figured I’ll try it because I don’t have to go in that day, I’ll be able to go to work and then study at night when I go home...I was working in retail at the time and it was very demanding. Sometimes they wanted you to stay later or if someone else is not doing their job you have to pick up their slack. Working on weekends, no time to yourself, it was very stressful to manage. Yeah in the beginning everything was they had a system set up where it was a set schedule where you knew when you were coming in on the exact days. Then later they changed it where the schedule changes every single week. It was just the worst system so you never knew when you are coming in so you know what to expect. The store got busier and busier and busier... I tried not to make noise about things so I would go home late and still have to study...I was able to do it but I wish I would’ve had more time definitely.”*

Another student described work as the reason for enrolling online, but went on to later describe other challenges, including childcare, financial stress, and housing insecurity, that impacted their ability to do well in courses:

*“There is no adequate affordable childcare and when I was at [the college] they had a daycare center, so I could take my classes there, but the debt that I was accruing because I would have to take student loans to make ends meet it’s why I had to start working. And I’m married, there was a cap, my husband said I could borrow a certain amount of money. And I exceeded that so... [My job] is not very flexible at all I have to be there. I work Tuesday, Wednesday, Thursday, Friday, and Saturday. My Fridays alternate between 7 PM and 7 AM and sometimes there are 11 to 7am... I have two minor children one is seven and one is one. My seven-year-old I had to send to a private school in Pennsylvania but it’s free because I wasn’t making enough money to make take care of her. Once I lost my last job and I started school I had to send her and they accepted her thank God so she’s safely in school. Now that this job and things are getting better I can go get her... I think I could do better as a student if I didn’t have the responsibilities of children. As a matter fact I know I could do better I could do a lot better if I had done it sooner or before I had children... The only problem that I ran into in my first semester was that I was almost homeless. That was the only*

*thing just getting through the first year was a struggle I was absent a lot and I didn't have--I wasn't able to study as much... I just want you to know that this is hard with my responsibilities, like going to school is the hardest thing, but it's the best thing that I've ever done you know it really is it's a real sacrifice now that I'm thinking about it, as I'm listening to myself, it's a real sacrifice..."*

While the external stressors experienced by students in these particular excerpts from student interviews may seem strikingly severe, these examples are fairly representative of the type of challenges that different students described. While some students did not face challenges of these kinds, they were in the minority. In addition, we assume that the sensitive nature of these challenges means that they are likely underreported in these interviews (e.g., Dayan, Paine, & Johnson, 2010; McNeeley, 2012). Our data itself also suggests that these stressors are underreported: Of the students interviewed here, 20% cited general work and/or family or other external factors as impacting their decision to enrol online without ever describing or detailing the exact nature of these stressors, so these stressors were not included in the table above and these students were not coded as having these specific stressors during that semester. Many of these stressors (e.g. disability, illness, and even work and family responsibilities) are often stigmatized, or at least presented as “atypical” of college students (e.g., Chen, 2017), and therefore, students may feel more comfortable keeping these details of their lives private, even though they can have a profound effect on their postsecondary outcomes (e.g. Grabowski et al., 2016).

For example, of those students who originally described family commitments as a reason for enrolling online, only about 60% of them went on to provide specific details about the particular family commitments that impacted the time that they had for their courses. On the other hand, of those students who described family-related stressors that impacted the time or energy that they had for college, only 32% of them had originally cited family responsibilities as a reason for enrolling online. This is likely in part explained by the fact that some students had family-related stressors that were unanticipated and therefore, not factored into their course registration decision. However, it is also possible that students' decisions to take an online course were actually influenced by family-related stressors, but that students didn't always feel comfortable reporting that as their reason for their online enrolment. This could happen either consciously or unconsciously, as students may attempt to focus attention on justifications that might be considered more “acceptable” according to unspoken norms in college, such as citing academic rather than person reasons for enrolment decisions because of desirability bias and the stigmatized nature of many of the stressors that “non-traditional” students face in college (e.g., Chen, 2017).



### ***Limitations***

This is a qualitative study. The results here are exploratory, and suggest key factors that should be further tested by future research. This study cannot establish generalizable causal relationships, and it would not be appropriate to use the results presented here to make larger-scale inferences. In addition, because we only interviewed students taking courses online, and not students who enrolled in only face-to-face courses, we cannot say whether these patterns are specific to online students. However, the high frequency of these external stressors in the interviews with online students, and the specific linking in many cases of these stressors to student decisions to enrol online, does provide some evidence of a link between online enrolment and high incidence of external stressors. While this cannot be used to definitively conclude what the relationship between online enrolment and external stressors may be, it does suggest that further research should be conducted to explore the links between online enrolment and external stressors, particularly those that may limit the time or energy that students have to devote to their college work.

### **Conclusion and Implications**

External stressors and life circumstances that contribute to time poverty were very prevalent in this sample, and included factors such as illness, death in the immediate family, caretaking responsibilities, job stressors, and housing insecurity. Many of these stressors were interrelated and co-occurring. We cannot say for certain if the patterns observed here with students are significantly different for online versus face-to-face-only students or not—this is an exploratory study, intended to identify factors that may have been previously overlooked that might be important to consider when looking to support the college success of students enrolled in online classes. But whether these stressors are more specific to online students or not, it is clear that students enrolled in online courses at public institutions in the US face a host of external challenges that likely impact their ability to successfully complete their courses, and that further research which investigates these factors could be critical to fully understanding how to best support these students. The results of this study suggest that non-academic supports that help students successfully navigate complex external stressors, like those cited by students in these interviews, may be particularly important for supporting the academic success of students who enrol in online courses.

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## **A CONCEPTUAL FRAMEWORK FOR REAL-TIME EMOTIONAL-STATE MONITORING OF STUDENTS IN VLES TO IDENTIFY STUDENTS AT RISK**

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### **Abstract**

Virtual Learning Environments (VLEs) feature rich textual data which lend itself naturally to the identification and monitoring of aspects of students' interactions. While reducing attrition and improving performance remain the primary objectives of learning analytics, we contend that student contributed text can be used to learn about emotions and other extra-rational features. This would help provide a response to the recent cries for help from the sector, seeking a system looking to address the worrying mental health crisis trends. This paper addresses these issues by discussing the necessary mechanisms within a conceptual framework which would sit in a VLE and capture emotional state changes in the students' interaction style or tone. For such a framework, the aim would be to help educators to carry out timely interventions when a potential cause of distress is identified. Experimental results on available datasets from education and psychology serve as a feasibility study for these tasks, and offer a perspective on the potential of the approach.

### **Introduction**

Higher education is witnessing a mental health crisis. The largest mental health survey by the institute for Public Policy Research (Thorley, 2017) reported that the number of students who were diagnosed with a mental health condition had risen dramatically over the past 10 years. Students are at increased risk of dropping out because of the lack of support and treatment for mental health issues. HESA (<https://www.hesa.ac.uk/>) recently reported that almost 38,000 UK students are suffering from some form of psychological distress, with increasing levels of anxiety, loneliness, and thoughts of self-harm.

Current research has explored various Artificial Intelligence (AI) techniques in order to make the learning process more optimised to the behavioural states of students, and AI techniques for monitoring students online have been commonly used to identify behaviour

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patterns with the aim of increasing learning and retention rates (Avella, Kebritchi, Nunn, & Kanai, 2016), or in early prediction of at-risk students (Marbouti, Diefes-Dux, & Madhavan, 2016). The common assumption is that time spent on learning is related to academic performance, either positively (Fritz, 2011) or indeed negatively, as a predictor of some struggle (Lust, Elen, & Clarebout, 2013). So far however very few studies have paid sufficient attention to the analysis of the context around the learning activity, for example by using emotion and/or sentiment analysis or writing style features in addition to the student's educational history for better understanding and prediction of student engagement. We seek to explore the use of emotion and textual analysis to support the educators in understanding whether a situation needs their intervention. We concentrate in our investigation on fully online e-learning systems, and in particular systems where communication from the student's part is solely textual, in the belief that emotions can be detected in different on-line learning contexts (e.g. forum discussions, chat discussions) (Efklides & Volet, 2005). VLEs are rich text-based environments. Students communicate with the lecturer by asking questions, complaining, or seeking advice. This happens over time, during the course of an entire module, and possibly a programme of study. We therefore focus on recognising the features from the textual messages interchanged between students and their peers or teachers to help in monitoring the situation over time, and identify changes in those patterns.

This paper presents an analysis of the issue at hand, by describing a conceptual framework for incorporating an “emotional observer” into a VLE. We identify the tasks that need to be carried out, and we explore the feasibility of such tasks by presenting two experiments which tested each of the tasks on suitable datasets.

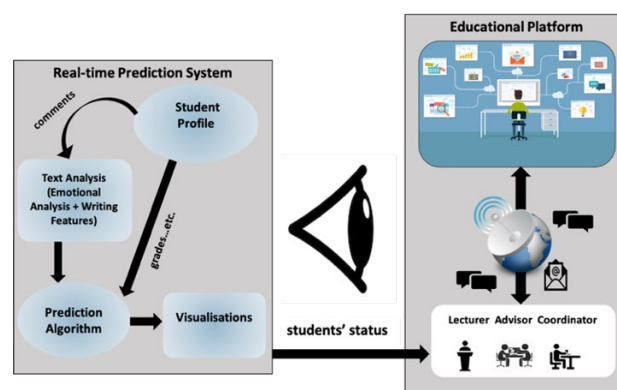


Figure 1. Structure of the “observer” system (Alharbi, Grasso, & Jimmieson, 2019)

## **Towards an Emotional Dashboard – Feasibility Experiments**

The work presented in this paper is aimed at demonstrating the feasibility, as well as any technical challenges, of an “emotional observer” system, which would sit within a VLE and

would be able to support educators in identifying potential situations at risk. Our ideal system is depicted in Figure 1, and would comprise a prediction system, which can decide to intervene, or simply flag, any observed interesting emotional communications. In our design, such a system should be able to analyse online communications happening in a virtual classroom, and identify emotionally loaded text, as well as flag to the educators the situation that such text is associated with. In order to do so, such a system would need to be able not only to perform emotion analysis of a piece of text, but also to identify other factors which could be a sign worthy of attention, for example a change in the writing style of a student, or whether a change can be detected in the correspondence of a specific topic of discussion.

Emotions have been extensively studied in behavioural sciences and psychology, where the two main approaches are the categorical, (e.g. Ekman & Friesen, 1971), which considers only a limited number of “basic emotions” (typically: anger, disgust, fear, happiness, sadness, and surprise) and the dimensional, (e.g. Russell, 1980) which places emotions on a two-dimensional space, with “Arousal” on one level, and “Valence”, positive or negative, on the other. In education, research has demonstrated the significance of sentiment/emotions within the e-learning processes by highlighting their impact on academic achievement (Artino, 2012; Pekrun, 2006), and the role they play in engagement (D’Errico, Paciello, & Cerniglia, 2016). Advances in computational linguistics reassure us that it is indeed possible to extract emotions, opinions and sentiments from text (Strapparava & Mihalcea, 2008).

Our framework proposes to combine emotion analysis with the analysis of style, a task well studied in stylometric analysis (Abbasi & Chen, 2008), typically for the purpose of identification of authorship (Zheng et al., 2006), and as a necessary step in the construction of an observer system as described above, we tested its feasibility, not only from a purely technical point of view, but also as to the practicality of such a solution. We therefore conducted a set of experiments, using well established data analysis techniques, in order to ascertain whether we can in fact find emotionally loaded text in classroom interactions, and up to which extent discovering emotionally loaded text is useful to predict user performances (task 1). We also investigated which emotion is more likely to be a better predictor, and whether we can think longitudinally and identify “trends” in the emotional state and/or writing style of an individual student, with respect to other students in the same classroom, or with respect to previous interactions of the same student (task 2). The latter point would confirm the potential for an observer system to determine a sort of “emotional baseline” for a student, or a class, or indeed a topic, and flag any significant deviation from this baseline as something potentially worthy of attention by a human educator.

The greatest challenge in attempting our experimental studies was to identify suitable datasets, and while task 1 could be performed on datasets coming from educational resources, for task 2 we used material from a different setting. The dataset description, as well as the details of each experiment, are explained in what follows.

### **First Experiment: the Stanford MOOC dataset**

In this experiment, we focused on pre-processing and analysing students' data, and developing a model to predict students' performance using data mining (Kantardzic, 2011). The objective of this analysis is to understand any general relationships between different student's characteristics, including the emotions features, and the prediction of student final assessments. The experiment consisted of two phases, where a prediction of the final grade of a student is attempted without and then with the emotions analysis features. The experiment concludes with the selection of which features, according to ranking, and which emotion feature would provide the best performance.

The dataset used in this phase is excerpted from Stanford MOOCs dataset (<http://datastage.stanford.edu>) by the Center for Advanced Research through Online Learning (CAROL), made available for use by researchers and instructors. The dataset consists of a number of tables containing various anonymised information from the MOOCs activities.

From all the items in the dataset, we extracted 229 records, related to students who could be followed through all data files. Among the tables and views provided, we concentrated on ActivityGrade containing grades, right/wrong answers and student's choice, and submission times; FinalGrade containing the grades computed at the end of the course; EdxForum.contents containing text entries to the discussion forums; and Alldata containing the name of the course, and other attributes such as SessionLength (sec). We classified the final grades into four classes: Fail, <50%; Pass, 50-59%; Merit, 60-69% and Distinction, >=70%.

To analyse the dataset, we used WEKA (Waikato Environment for Knowledge Analysis) version 3.8.2 (Hall et al., 2009), as it allows for an easy delivery of an analysis report and a prediction model. The WEKA classifier used in this study is a Naive Bayes Classifier (NBC), as recommended elsewhere (Mueen et al., 2016; Devasia et al., 2016), in the spirit not so much of finding the best possible prediction, but to simply demonstrate the feasibility of the task using off-the-shelf tools.



### ***Phase 1: Testing the Dataset without Emotions Features***

For the first phase in our experiment, we selected the following features: (Percent Grade, SessionLength, NumEventsInSession, Module Type, and FinalGrade) and we used them to train an NBC, using cross-validation with k-fold 10. The accuracy result for using an NBC to predict a student FinalGrade was 80% (with 0.75 precision, 0.80 recall). We have therefore a benchmark to be able to determine whether adding emotional traits will give us any improvement.

### ***Phase 2: Testing the Dataset with Emotions/Sentiment attributes***

In this phase we wanted to ascertain whether adding emotional features extracted from the students' textual comments would improve the classification. First, we extracted all textual comments related to the 229 records identified in the first phase. This gave us 72 instances containing textual comments made by the students. Three classes were tested: Fail, Pass and Distinction as there were no instances for class Merit. The accuracy result for using NBC to predict a student FinalGrade for the 72 instances was 90.2%, with 0.90 recall.

Then in this phase to extract the emotion features, we employed a sentiment and emotion analysis tool, Synesketch (Krcadinac et al., 2013) for a sentence analysis of the comments and threads, and this extracted seven main emotions: *Anger, Disgust, Fear, Happiness, Sadness, Surprise and Valence*. Then we trained a Naive Bayes Classifier (NBC) using these emotional features plus the ones used in the previous phase. Again, we applied a 10-fold cross validation approach to assess the performance of the models. Including emotions/sentiment features gave us a better classification accuracy of 86.1% overall, with 0.86 recall.

### ***Most Influential Features***

Once established that class interaction textual elements do indeed contain emotional text, and that these could be used to predict the final grade, it is interesting to determine whether there is a specific emotion that is more *useful* than others to this task, and in general which features should be selected to maximise the results (Blum & Langley, 1997). Running a Features Selection process on our dataset suggested that one attribute, Session Length, has the highest correlation with the output class. It also suggested a host of attributes with some modest correlation, SessionLength(sec), NumEventsInSession, percent grade, Sadness, Happiness, Anger, and Up count. If we set our cut-off for relevant attributes equal to 0.1, then the remaining attributes (i.e., Disgust, Fear, Surprise, Valence, Down count) could possibly be removed. The result of the confusion matrix after removing

the non-relevant attributes is 90.27%, with 0.90 recall. This is 4% higher than the one with all the emotion features included.

## **Second Experiment: The Motivational Interviews Corpus**

That emotional features are present in students' exchanges, and that they can be used to a certain degree to predict the final outcome, is perhaps not surprising, and is not a novel result. Our main objective though was to conjecture a system where this information can be used in real time to inform the educators about possible areas of concern. In order for this to happen though, it is not sufficient to determine which student is exhibiting which specific feature, if there is no sense of what is "normal" for that particular student. Lacking any other visual cue which can be acquired by physical interactions, it is not easy to extrapolate whether a particular writing style, or a particular attitude in writing is a peculiarity of a student, or is a sign of a change in the emotional status, or ultimately of distress.

When sensors and physical traits are used to measure individuals, it is typical to create a baseline for vital characteristics, the change in which can be a sign of an underlying cause. Can this be done with textual traits too? To be able to understand whether this was conceivable, we needed to test it on a suitable dataset, and the Stanford MOOC used for the first experiment, or indeed the educational datasets we have been able to access opensource, are not ideal, as they concentrate on parametric values, and very rarely provide access to students' communications, and communication by the same student over time.

In this experiment we turned to the field of motivational interviewing (Rollnick & Miller, 1995) and we created a dataset by using a corpus of transcripts of dialogues, tracking the same individual over time, this providing us with the opportunity to test the feasibility of our approach, to be translated to the classroom environment. The corpus (Counselling and Psychotherapy Transcripts, Client Narratives, and Reference Works, 2008) consists of a searchable collection containing real transcripts of counselling and therapy sessions. The database contains more than 2,000 session transcripts, 44,000 pages of client narratives, and 25,000 pages of secondary reference material. For each transcript, which are anonymised but can track the same patient over a number of counselling sessions, the source provides information on age, gender, marital status, any symptoms or condition, as well as some general information on the therapist, such as gender and level of experience. Out of this corpus, we created a dataset, extracting data related to 76 patients. For each patient, there is a variable number of sessions. Each session is labelled with a title. For the purpose of this experiment, we only considered the patients' turns, we discarded the counsellor comments, and any other comments by the scribe (e.g. annotating pauses etc.).

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We performed a word level classification to the patient text in each session, by using the algorithm in Whissell (1996), using an *emotion clock*. We extracted around 12 emotion types using the clock: Peaceful, friendly, admiring, cheerful, brave, alert, alarmed, furious, sad, distant, depressed, indifferent. We used WordNet (Miller, 1998) and *dictionary.com* for capturing the lexicon and synonyms.

In addition to the emotional status, we wanted to test whether it would be useful to extract some characteristics of the text, which would help form the baseline for each individual, and some notion of “cohort”, which would help form the baseline for a “classroom”. For the first task, we extracted two features: Part of Speech (POS) and vocabulary richness of the text, by following the technique in Suh (2016) who maintains that changes in these parameters is an indication that the writer has changed their usual writing style. For POS we calculate the total number of complete sentences normalised by the total number of sentences in the session. To find the vocabulary richness of the text, we calculate the total number of unique words, normalised by the total number of words.

For the second task, we wanted to aggregate a number of client sessions in order to consider them as part of the same “cohort”. The dataset provides us with a “topic” for each session, which is contained in the session title. We extracted a number of patients for which the topic of each session would align. These correspond to seven main topics: Behaviour, Development, Relationships, Culture, Ability, Personality, and Health.

Once all the machinery was in place, this gave us the opportunity to look at a set of patient sessions, and to use them to simulate the behaviour of a classroom. The working hypothesis is that each “topic” of discussion is the analogue of a topic in the classroom, and that each of the patients will react to different topics in their own different way. The observer system will be able to perform an emotion/sentiment analysis, a POS analysis, and the extraction of a specific topic, and decide if there is a situation to flag.

Row Labels	Max of Postagging	Max. of Richness			
Ability	0.90797546	0.614583333	client423_j	0.303191489	0.294806145
Admire	0.492753623	0.478079332	Culture	0.790598291	0.469333333
Alert	0.642384106	0.487323944	Admire	0.657894737	0.469333333
Brave	0.666666667	0.545112782	Friend	0.790598291	0.302812071
Cheerful	0.618181818	0.451476793	Peace	0.628571429	0.427258806
Friend	0.83203125	0.41560219	Development	0.823529412	0.656441718
Furious	0.61682243	0.467836257	Admire	0.532467532	0.435120435
Not Available	0	0.611111111	Alert	0.823529412	0.554572271
Peace	0.90797546	0.614583333	Cheerful	0.606060606	0.340224454
Sad	0.8	0.604	Friend	0.622377622	0.656441718
client004_a	0.411255411	0.334792123	Peace	0.78030303	0.500866452
client004_j	0.450715421	0.200187091	Sad	0.735294118	0.515083799
client018_d	0.668639053	0.292576419	client018_a	0.699152542	0.248955224
Client032_j	0.451428571	0.287434161	Client019_g	0.38410596	0.275030902
Client112_b	0.595744681	0.397034596	Client038_b	0.523809524	0.388888889
Client123_c	0.366666667	0.570512821	Client123_b	0.310218069	0.31024735
client212_c	0.366666667	0.397427653	Client123_j	0.515957447	0.397268777
			Client123_m	0.521126761	0.356772334
			Client207_b	0.653061224	0.307592472
			Client207_c	0.471875	0.267142291

Figure 2. Example of a Dashboard for the association topic/emotion

We are at the moment considering various strategies for visualisation, but some prototypes would for instance show clients(students) grouped by main emotion, and then by topic, so highlighting the main emotion associated to a topic (Figure 2), perhaps flagging clients/students whose emotion is not in line with the general emotion of the cohort. Or,

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we can explore by individuals, and track their changes over time, to understand whether a change happened, and if this can be associated to a specific topic (Figure 3).

	First Session			Second Session			Third Session			Fourth Session		
	Emotion Compared with GEmotion	Richness Compared with GRichness	POS Compared with GPOS	Emotion Compared with GEmotion	Richness Compared with GRichness	POS Compared with GPOS	Emotion Compared with GEmotion	Richness Compared with GRichness	POS Compared with GPOS	Emotion Compared with GEmotion	Richness Compared with GRichness	POS Compared with GPOS
Client004	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE
Client011	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE
Client016	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE
Client019	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Client031	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE
Client032	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE
Client034	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE
Client110	FALSE	TRUE	FALSE	FALSE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE
Client112	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE
Client123	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE
Client124	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Client137	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Client219	FALSE	FALSE	TRUE	FALSE	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE
Client222	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
Client224	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE
Client405	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE
Client417	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE
Client419	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE	TRUE
Client420	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE
Client421	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	TRUE

Figure 3. Example of a Dashboard flagging clients who are outliers

## Conclusion and future work

The work presented in this paper constitutes the first feasibility study for a system aimed at incorporating an emotional “tracking” mechanism to follow students in a VLE. The feasibility study made use of well-established data analysis, ML techniques and available datasets in order to focus on the selection of tasks that need to be accounted for in the implementation of such a system. Of course, many aspects are still to be developed. First and foremost the level of acceptability/uptake that a system of this sort could have among educators and students. Ethical issues need to be carefully considered before attempting the live deployment of a system of this sort, and we are conducting some focus group experiments with experienced online educators to understand what barriers would prevent the uptake of this solution. From an implementation viewpoint, many aspects need to be investigated further, which might lead to a different decomposition of the tasks. For instance, some automation of the extraction of the topic that caused an emotion arousal could be attempted (Xia & Ding, 2019). And more generally, some dedicated datasets need to be harvested to be able to perform an organic test of the various components. Nevertheless, we believe that this is a worthwhile endeavour which promises to tackle an important health, as well as education, emergency of our times.

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## **WALKING THE TIGHTROPE: ONLINE STUDENT ENGAGEMENT EXPERIENCES**

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### **Abstract**

Studying online is like walking a tightrope for many online students as they try to balance work and caring responsibilities with their learning. This paper reports on a qualitative case study which explored the balancing act of online student engagement experiences. The study followed twenty-four DCU Connected online students over one academic year. The research question for the study was: *What themes are central to online student engagement experiences?* Data was collected via participant eportfolio entries and through semi-structured interviews and was then analysed thematically. Four key themes were constructed via the analytic process, which included: the importance of community, support networks, balancing study with life, and approaches to learning. The findings indicate that successful online student engagement was influenced by a number of psychosocial factors such as peer community, an engaging online teacher, and confidence and by structural factors such as lifeload and course design.

### **Introduction**

Studying online is like walking a tightrope for many online students as they try to balance work and caring responsibilities with their learning. This case study aimed to explore this balancing act for online students and broader themes relating to their experiences of engagement. The setting for the study was the undergraduate online Humanities degree at DCU Connected. There is a dearth of research about the experiences of online students in the Irish higher education (HE) context, with the majority of the relevant literature based in Australia, “the experiences of online students has been somewhat ignored in the literature” (O’Shea et al., 2015; p.57). This study aims to address this gap in the literature by increasing our understanding of online student engagement, in the Irish context.

### **Online Student Engagement**

Student engagement can be defined as “a student’s emotional, behavioural and cognitive connection to their study” which has a direct impact on student success and achievement



(Kahu, Stephens, Zepke, & Leach, 2014; p.523). This section presents contexts from the literature about online student success, learning approaches and engagement through the lens Kahu's (2013) holistic conceptual framework of student engagement which considers the socio-cultural, structural and psychosocial factors aspect, see Figure 1 below.

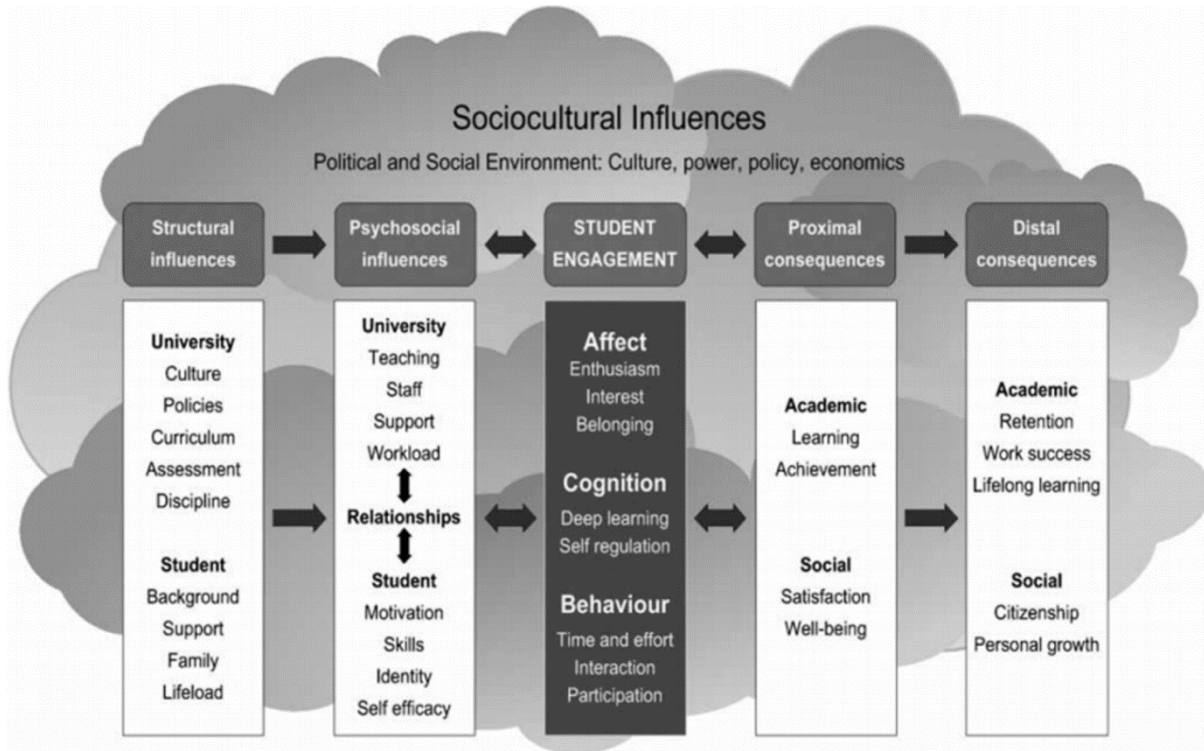


Figure 2. Conceptual framework of engagement, antecedents and consequences (Kahu, 2013, p. 766).

### **Structural**

There are three key structural influence which impact on online student engagement: course design, institutional supports and lifeload. A well designed online course which encourages interaction, community, clear learning path and real world experiences can support online student engagement (Buck, 2016; Frey, 2015). The campus focused structure of support services such as library, careers, counselling and administration can reduce access to vital university supports for online students (Delaney & Farren, 2016). This can lead to online students feeling less integrated and having a reduced sense of belonging to the university community (O'Shea et al., 2015). A critical factor for influencing student engagement is lifeload, which Kahu (2013; p.797) defines as "the sum of all the pressures a student has in their life, including university". Support from family and friends in order to gain time and space to study is crucial to online student success.

### **Psychosocial**

Online student engagement is affected by a number of interrelated psychosocial influences such as teaching support, study skills and time management skills. Effective teaching



support which encourages connection, presence and through synchronous and asynchronous approaches has a positive effect on online student engagement (Stone & O' Shea, 2019). Study skills such as organisation, time management and digital skills play contribute to online student success (Farrell & Brunton, 2020; Farrell & Seery, 2019). Online students who create a structured study routine and a quiet study environment which is balanced with their other responsibilities are more likely to positively engage with their studies (Buck, 2016).

### ***Engagement vs. Disengagement***

The outcomes of online student engagement are a positive learning experience, course completion and a sense of satisfaction (Kahu, 2013; O' Shea et al., 2015). The outcomes of online student disengagement are non-completion, withdrawal, and unsatisfactory learning experience (Kahu, 2013; O' Shea et al., 2015). The majority of students who withdraw do not return to study, emphasising the importance of targeted student success and engagement supports early in the study lifecycle (Brunton et al., 2018)

### **Methodology**

The design of the study was a qualitative case study, and was framed by the following research question:

*What themes are central to online student engagement experiences?*

Data was collected via student eportfolio entries and via semi-structured interviews over the course of the academic year 2016-17. Twenty four students consented to take part in the study. Data was analysed following a data led thematic approach and involved iterative cycles of coding and analysis (Braun & Clarke, 2006). Four themes were constructed through the analytic process and are discussed in the finding section below.

### **Findings**

The five central themes that make up the study's findings highlight key issues of students' sense of community, their support networks, balancing study with life, confidence, and their learning approaches,

#### ***Community***

The data revealed that community was perceived by participants to be an important source of support and contributed positively to their learning experience. Formal and informal communities developed in the course which included student generated WhatsApp groups, study groups and the formal course discussion forums.

*I: “Ok that’s interesting. And then evidence 2 is your WhatsApp group.”*

*P19: “I need those women, that’s my cohort. We are in contact most days supporting one another. Like when I was feeling down and I was thinking I do not want to do this course anymore it’s too much, they were like you’re great and you’re smart. I read your post, your post is really insightful. If I don’t understand a concept we can discuss it. If WhatsApp isn’t sufficient we can ring each other.”*

*I: “So your study group is really important.”*

*P19: “It’s not a study group. My sister when she did her they give you a cohort you do all your classes together. You do all your study groups together, projects together. There’s something about that approach that makes you feel like you’re part of a supportive group.”*

*I: “You’re in something greater than yourself?”*

*P19: “Yeah (P19 Interview 1)”*

### **Online Teacher Support**

The central role of the online teacher as a source of support was strongly articulated by participants in their narratives. The role of the online teacher as a source of social, academic and pastoral support was very significant to the learning experience of participants in terms of clarification of concepts and assignments, encouragement, guidance on reading and approaches to study.

*“As I had been studying these subjects in the unit notes, it was very useful to have a structured discussion on them. When our tutor gives real life examples of the application of these, it makes everything easier to understand and remember” (P8, eportfolio entry 4)*

### **Balance**

Balancing study with work and caring responsibilities was reported by participants to be the most challenging aspect of learning online. Walking the tightrope of finding time to study, complete assignments with work and family commitments caused a lot of pressure for this cohort of online students.

*“For the first time since taking up third level education again, I found it very difficult to juggle my work demands, assignment demands and minor ill health.” (P7, eportfolio entry 2)*

Issues with time management were very prevalent in the data, and was a persistent challenged face by participants over the course of the academic year.

*“It all comes down to time management, which I remember was an issue at this time last year. With all the extra pressures of Christmas from a work and family point of view the study can get squeezed. I may have to do less(no?) housework to facilitate my learning this month. This idea has not been negotiated with my partner and may have to be revised!” (P20, eportfolio entry 2)*

## Learning approaches

The data from the online student eportfolio entries reveals very personal and innovative approaches to learning and gives an insight into when, how and where online students study.

*“I find if I cannot grasp a piece of information through one format, i.e. reading a text, sometimes watching a YouTube video regarding the topic can really help me comprehend the material better.” (P2, eportfolio entry 3)*

Participants included many visual examples of their notetaking approaches in the evidence part of their eportfolio entries, it is striking is how individual each note taking approach was, this is evident in Figure 2 below.

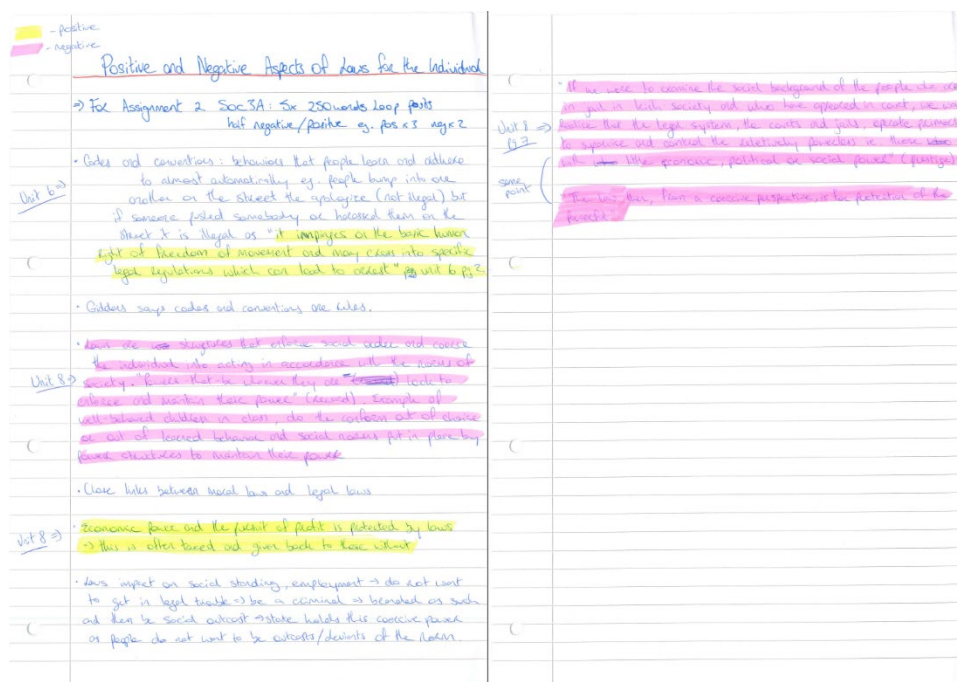


Figure 2. Notetaking example

In addition, participants reported studying in a wide range of places. They studied at home, in the library, on their phone while commuting to work, in cafes, in work, and sitting on

the side of football pitch. In their eportfolio entries, many participants included images of their study spaces, for example Figure 3 below.



Figure 3. Participant study space

## Discussion

The findings of this study indicate that successful online student engagement was influenced by structural factors such as lifeload and course design. This is consistent with the literature which found balancing multiple roles can cause online students to experience considerable stress (Brown et al., 2015). Further, online student engagement was influenced by psychosocial factors such as peer community, online teacher support and study skills and time management. These findings are consistent with previous research on peer interaction in online courses carried out by O’ Shea, Stone, and Delahunty (2015) and the value of informal student networks for online students has been evidenced by Zembylas et al. (2008).

## Concluding thoughts

The purpose of this study was to explore online student engagement experiences in Irish higher education. The findings of this study indicate that being a successful online student was impacted by both structural factors such as lifeload and psychosocial factors like community. Although this study is a small in-depth qualitative study, its findings provide insights into how online degree programmes can support online students to achieve successful and fulfilling learning experiences.

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## WHERE ARE THE STUDENTS? SOCIAL AND LEARNING PRACTICES IN DIGITAL SETTINGS

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### Abstract

The aim of the study is to understand the role of social presence in digitally mediated learning processes and, consequently, to improve the design of the courses we teach at UNED. The spaces of greatest interaction between students are social networks and mobile instant messaging services, not only for social purposes but also for learning. That is why we are researching about students' practices in those spaces while they are studying. In this paper, we present preliminary findings identifying if those social interactions happen within the online courses or in other digital spaces.

### Introduction

UNED Bachelor and Master students increasingly use social networks and mobile instant messaging services to manage most processes related to their presence in the university. Considering this, a group of professors and researchers are working in a project that aims to analyse the use of these digital services by the students and its relation to the UNED distance learning methodology. The purpose is to take advantage of the dynamics that take place outside the virtual campus to improve the quality of distance teaching in Bachelor and Master courses.

The one-year long project (from November 2019 to October 2020) aims to explore the reasons that lead students to increasingly use social networks and digital applications instead of or besides the UNED virtual campus tools. Also, it aims to explore the current practices that take place in those “non-official” digital settings, in order to identify possible gaps or aspects to improve in the UNED distance methodology.

As a hypothesis, it is proposed that UNED students have a series of needs that are related to a set of deficits existing in the cycle of learning of the Bachelor and Master's courses; this makes it more interesting for them to participate in informal social networks that in the formal training spaces enabled by the university as the main learning resource. Thus, the

gap between the students' interests and the learning resources offered by the university, would be one of the main reasons for the lack of student engagement in the settings and activities designed by the teachers in the online courses.

## **Background**

A previous study carried out by the same group of teachers led to this new project. That study (Gil-Jaurena, Domínguez, Izquierdo, & Morentin, 2018; Ballesteros, Gil-Jaurena, & Morentin, 2019) explored the coherence of the distance learning methodology at some UNED courses according to the Community of Inquiry (CoI) model. Among the conclusions of that study we identified the existence of a gap regarding "social presence", the social dimension of the CoI. It seems that the UNED teaching and learning methodology presents limitations in the way of interaction between the members of the community, which makes it difficult to consolidate learning communities in a distance environment. So in the current project we want to delve into the social dimension of the CoI model, to know in which spaces social interaction really happens and to identify the reasons that lead students to underutilize or even leave communication spaces and consultation of learning resources in the virtual course of the UNED.

Besides our research group previous work (Domínguez & Álvarez, 2019; Gil-Jaurena, Domínguez, & Ballesteros, 2020; Gil-Jaurena & Domínguez, 2018; Gil-Jaurena, Domínguez, Theeraroungchaisri, & Yamada, 2018), our background are the different studies focused on the analysis of social interaction in MOOCs, as well as in the field of open education and data-driven digital education (Domínguez, 2020; Kazanidis, Pellas, Fotaris, & Tsinakos, 2018). In addition, for this research we incorporated the evidence from studies on the learning influence of mobile messaging applications (Carpenter & Green, 2017; Kim, Lee, & Kim, 2014; Ogara, Koh, & Prybutok, 2014; So, 2016; Sun, Lin, Wu, Zhou, & Luo, 2018; Tang & Hew, 2017; Tang & Hew, 2020).

## **Methodology**

The research methodology includes the review of scientific literature, benchmarking of digital social spaces, and mixed methodology for the analysis of use of these spaces by the UNED students. The data collection techniques include an online survey and discussion groups with current Bachelor and Master students from the Faculties of Education, Philosophy and Language Studies. The students are registered in courses that the members of the research group teach, and these courses have a diverse number of learners: from less than 25 in Master courses to more than 750 in Bachelor courses.

In this paper, we report on the preliminary results from the online survey – by Google forms –, which collected 320 replies for two and a half months – late January to mid-April 2020. The survey was presented to students using two channels: notification by teachers in

the online course forum; and through social networks and para-academic messaging apps used by students, where student representatives posted the survey. Half of the students in the sample had reached the survey via each way. 80% of the respondents are studying a Bachelor's degree, and 20% a Master Programme. 84% are female learners and the ages are very diverse, ranging from 18 to 79 years old.

The survey asked about the use of different applications and digital resources (Facebook, WhatsApp, Twitter, YouTube, online campus, etc.) both before registering and during the course. Using a Likert scale, the students could state if they had used those tools, ranging from 1 – *no used* to 5 – *highly used*. They were asked, as well, for which purposes they had used each tool in their academic and learning process: get access to course readings, get access to assignments, ask the teachers, ask other students, etc.

## Preliminary results

In this paper we present preliminary results regarding the use of four different online tools by our students: two of them – Facebook (Figure 1) and WhatsApp (Figure 2) – are external tools managed by the students themselves without the presence of the teachers; the other two – online campus (Figure 3) and Intecca-videoconference (Figure 4) – are institutional tools, the first being the LMS of each course and the second being the video repository where the students can find the live and recorded video-lessons made by the tutors in the regional centres. We include a last figure (Figure 5) related to an off-line support structure: the UNED regional centres spread all over Spain.

### Facebook:

320 responses

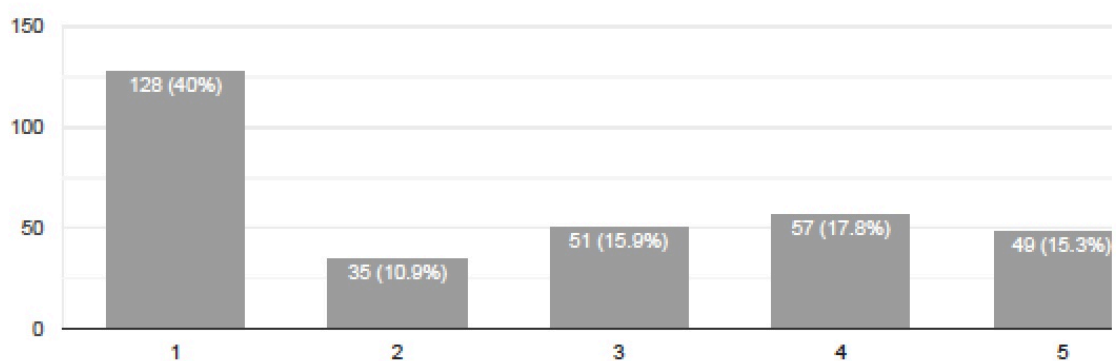


Figure 1. Use of Facebook during the course



#### WhatsApp:

320 responses

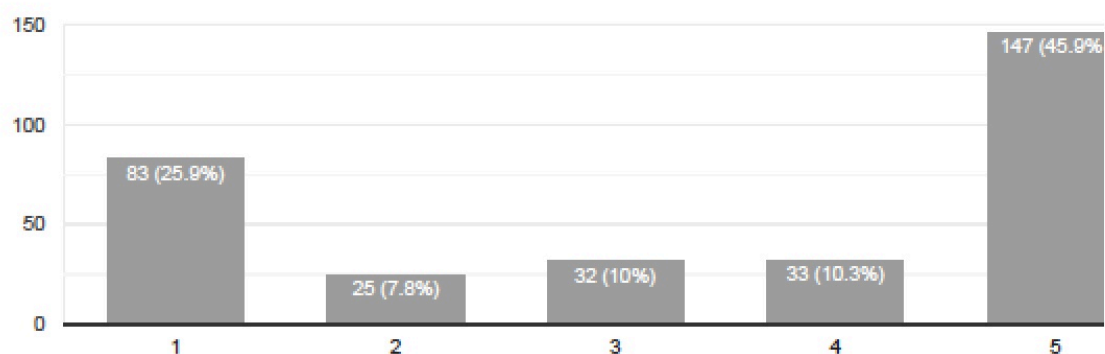


Figure 2. Use of WhatsApp during the course

#### Campus virtual / aLF:

320 responses

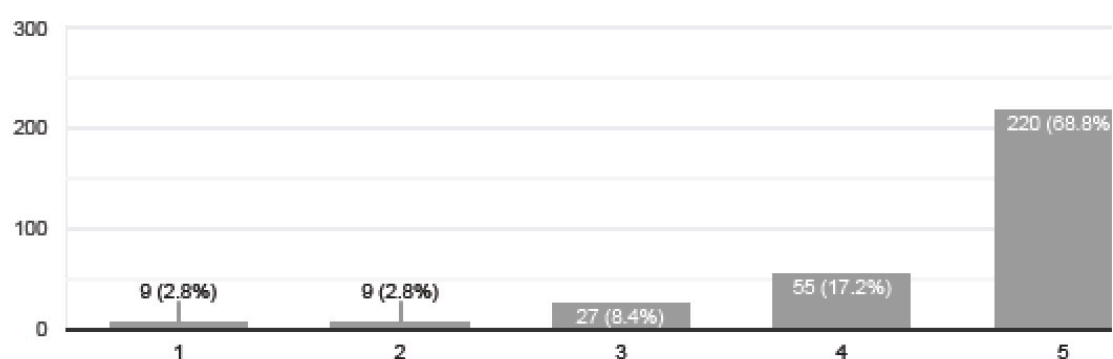


Figure 3. Use of the online campus during the course

#### Canal UNED / Intecca:

320 responses

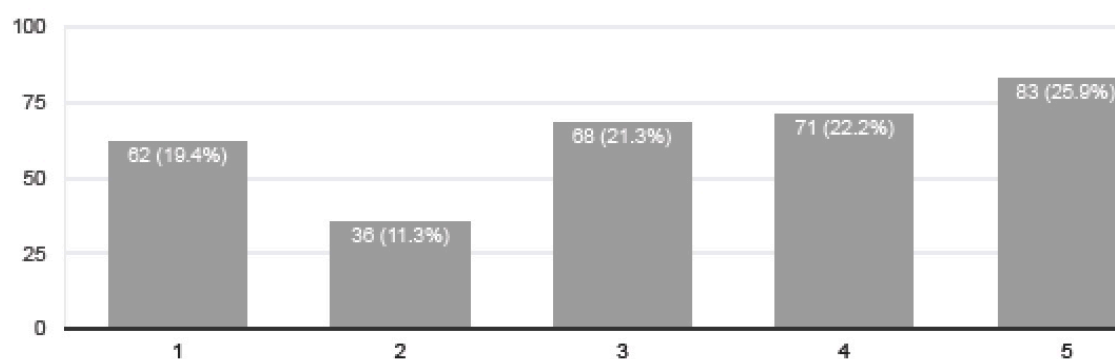


Figure 4. Use of Intecca-videoconference during the course

#### Centro Asociado UNED:

320 responses

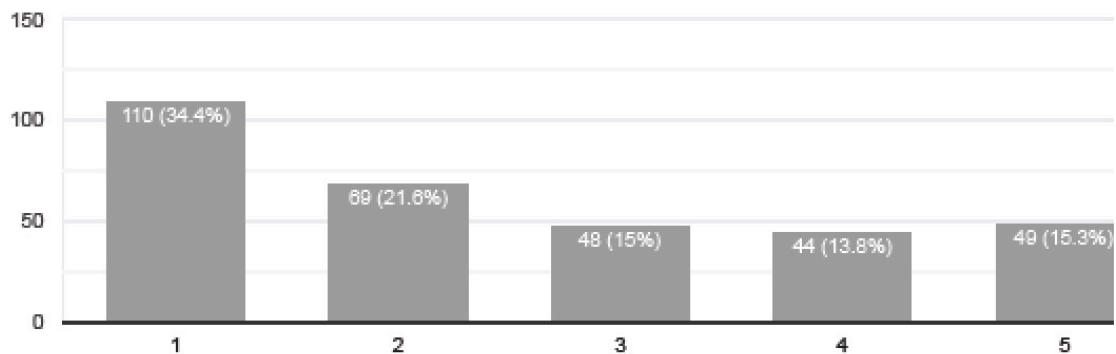


Figure 5. Use of UNED Regional Centres during the course

The figures show that the most used online tool is the UNED online course, used by 97% of the students who completed the survey (Figure 3). It is followed by WhatsApp (Figure 2), despite 25% don't use it at all for academic purposes. The use of Facebook is not so extended (Figure 1): 40% say they don't use it.

A significant number of students (34%) state that they never use the regional centre, which is a relevant on-site resource UNED has. On the other hand, almost 50% of the respondents (Figure 4) say they use a lot the UNED online video repository, where tutors from those same regional centres broadcast live or record the video-lessons.

### Next steps

Once we have got this overview of the students' online social practices in relation to the courses they study, we have planned a series of discussion groups with different students. The purpose is to deepen in the uses of different tools by the students, and their motivations to do so. We expect to complete the discussion groups in May and June, and analyse the results before we start the next semester on October, so we can consider the findings in the design and development of the courses we teach.

The two dimensions that will be explored in this further process will be the following:

- Relationships between the socio-learning practices of students who do not frequently use the online campus (aggregated 31.2%) and those practices of students who use WhatsApp extensively (aggregated 66.2%). Exploring whether students use WhatsApp in any way as a substitute for the online campus.
- Relationships between the learning method in the courses – active and teacher-supported in master versus self-study and with little teacher support in undergraduate – and the channels used to interact and share learning resources

among students. Exploring whether students compensate in any way for the reduced teaching support with the presence of social networks and messaging apps.

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## **EMERGING TRENDS IN OER STUDIES IN CHINA (2001-2019) – A SCIENTOMETRIC ANALYSIS ON CITESPACE**

*Jin Zhu, Open University of China, China*

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### **Abstract**

OER have played a key role in the development of distance education, and even the whole education field in China in the past 20 years. Thus, the papers and the research findings on OER in China, as a part of distance education studies, can show the situation of OER and also can show the situation of distance education in China in the past 20 years.

This research uses CiteSpace, an information visualization tool, to present and analyze the emerging trends in OER studies in China from 2001 to 2019. 563 papers are identified as the reference source from CNKI, the most important academic database in China. Eventually, the author comes up with the following findings: There are still lots of undeveloped land in OER study in China; Distance education institutions are the closest friends with OER studies; OER study is a good breakthrough point for pedagogy marching from macroscopic to microscopic; OER study started early in China; The studies about its development and evolution are abundant; OER studies are not specific and deep enough in China; Most of the researchers are from pedagogy; There should be more researchers from other disciplines, computer and economics for example.

### **Background and Research Question**

In the year of 2001, MIT launched the “OCW” plan. (Yaner, Zhaoshan Liu, 2011; Jianpo Wang, 2004). In 2002, UNESCO held “OER in Developing Countries Forum”, which made the year of 2002 become Year One of OER. More than 20 countries including China joined the OER movement (Liyan Shen, Aijun Zhao, Rong Dong, 2012; Jing Dong, 2015; Songhe Yuan Xuan Liu, 2014). The new trend, centred on the innovative development of information technology and the open communication of digital educational resources, had emerged in some forward-looking institutions, which included top public and private universities, as well as cultural and education-related foundations and international organizations deeply involved in open education programs (Guodong Zhao, 2009; Ying Yang, 2018; Shufang Wu, 2013). Based on online courses and national classic courses, China has opened high-quality video open courses and high-quality resource-sharing

courses in combination with foreign advanced experience, and established OpenEDX, THEOL, Netease open courses and other open resource platforms (Xiaogeng Chen, Dingming Wang, 2013; Yimin Jia, 2008). So, China have made great progress in the field of open education.

OER have played a key role in the development of distance education, and even the whole education field in China in the past 20 years. Thus, the papers and the research findings on OER in China, as a part of distance education studies, can show the situation of OER and also the situation of distance education in China in the past 20 years. So the research question is: Emerging Trends in OER studies in China (2001-2019).

## **Data Collection and Methodology**

### ***Data Collection***

All the data is collected from CNKI by “Advanced Search”. CNKI, who contains about 96% of all kinds of core periodicals, is the most extensive dynamic database of academic papers in China. Data is collected from two kinds of database of CNKI: periodical database and doctor and master thesis database.

1. periodical database: (core journal = Y) and year between (2001, 2019) and ( (topic = Chinese and English expansion (oer, Chinese and English) or title = Chinese and English expansion (oer, Chinese and English) or v\_subject = oer) or (topic = open education resources or title = open education resources or v\_subject = Chinese and English expansion (open education resources, Chinese and English)) or ( (keyword % Chinese and English expansion (oer, Chinese and English) or Keyword % oer) or (keyword% open education resources or Keyword% Chinese and English expansion (open education resources, Chinese and English)))) (fuzzy match);
2. (core journal = Y) and year between (2001, 2019) and ( (topic = Chinese and English expansion (oer, Chinese and English) or title = Chinese and English expansion (oer, Chinese and English) or v\_subject = oer) or (topic = open education resources or title = open education resources or v\_subject = Chinese and English expansion (open education resources, Chinese and English)) or ( (keyword % Chinese and English expansion (oer, Chinese and English) or Keyword % oer) or (keyword% open education resources or Keyword% Chinese and English expansion (open education resources, Chinese and English)))) (fuzzy match). At last, there are 563 papers identified as the reference source data.

### ***Analytical Method***

Statistical tool Excel2007 and information visualization tool CiteSpace are used in this research. Citespace is a mapping knowledge domains tool, which is developed by Chaomei

Based on the primary analytical method CiteSpace, the research question is divided into three research directions:

1. Trace back the number and growth of OER studies, and then reveal their basic characteristics ( literature statistics);
2. Show the development of OER studies by analysing the changes in the publications; (the number of publications, total citation frequency, average citation frequency of different institutions and authors, the keywords with different frequency of occurrence, different keywords, etc.) (literature analysis);
3. Pick up the core author groups and core research contents by the perspective of cluster, to show the changes of the research frontiers, evolution paths and research contents of different stages.

## Core Research Group

CiteSpace is used to do the first kind of operation and Chart 1, Chart 2 and Table 1 are generated.

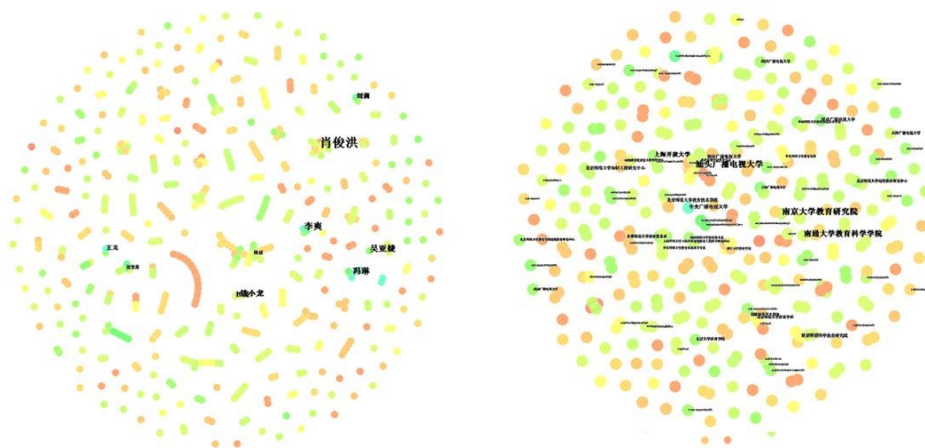


Chart 1. and Chart2. Core author and core organization in OER studies in China from 2001 to 2019

Table 1: Ranking list of the numbers of papers about authors and research institutions in OER studies in China

Core Author on OER Study					Core Organization on OER Study		
Rank	Numbers of Paper	Author	Organization	Initial Years	Numbers of the Paper	Organization (first author)	Initial Year
1.	70	肖俊洪	汕头广播电视大学	2001	32	汕头广播电视大学	2001
2.	20	陈丽	北京师范大学教育学部	2001	10	南京大学教育研究院	2013
2.	20	卡莱娜·博苏	远程教育研究中心	2001	9	南通大学教育科学学院	2014
2.	20	克里斯蒂安·迈 克尔·施特拉克	澳大利亚塔斯马尼亚大学	2001	9	中央广播电视大学 ( 国 家开放大学 )	2006
3.	16	郑勤华	荷兰开放大学	2001	7	上海开放大学	2012
4.	14	赵宏	北京师范大学教育学部	2001	5	北京师范大学知识工程 研究中心	2013
5.	13	爱芭·奥西恩	远程教育研究中心	2001	5	北京师范大学教育学部	2001
6.	12	尼尔森 李爽	瑞典远程教育协会	2001	5	远程教育研究中心	2001
6.	12	李爽	北京师范大学远程教育 研究中心	2007	5	浙江广播电视大学	2014
7.	11	冯琳	中央广播电视大学 ( 国 家开放大学 )	2006	5	陕西广播电视大学	2011
7.	11	吴亚婕	中央广播电视大学 ( 国 家开放大学 )	2011	5	国家开放大学教育研究 院	2015
8.	9	钱小龙	南通大学教育科学学院	2014	4	英联邦学习共同体	2012
9.	8	刘莉	天津广播电视大学	2006	4	首都师范大学教育技术 系	2016
10.	7	王龙	中国人民公安大学	2006	4	北京大学教育学院	2012
10.	7	汪霞	南通大学教育科学学院	2014	4	北京师范大学教育学部	2015
11.	5	祝智庭	华东师范大学	2009	4	天津广播电视大学	2006
12.	5	曹凤余	中央广播电视大学 ( 国 家开放大学 )	2007	4	四川广播电视大学	2012
12	5	李亚婉	中央广播电视大学 ( 国 家开放大学 )	2007	4	北京师范大学远程教育 研究中心	2012

### About the core author

Authors, who started publishing between 2001 and 2011, account for 88% of the total number of core authors and 94% of the total number of core paper authors in the first ten years (2001-2011). However, the numbers of emerging core research authors and their papers are less than 10% of the total in the second ten years (2011-Now). So, we can say in the past 20 years, the number of core authors and their papers are growing.

But after 2011, the new core papers disappeared. It means the core authors shifted their focus.



### About the core organization

From the Table 1, we can see the top 5 research Institutions(universities) are: Open University of Shantou(32), Institute of Education Nanjing University(10), School of Education Science Nantong University(9), Open University of China(9,OUC) and Open University of Shanghai(7).

The first ten years, 2001-2011, is the period of sprout and prosper. The organizations are a few in number. The contents of the papers are mainly about the introduction of the OER and are lack of specific research. The second ten years, 2011–now, is the period of sustained development. There are more new star organizations and the papers from some star organizations formed clusters.

### Research Characteristics

CiteSpace is used to do the second kind of operation and Table 2 is generated.

Table 2: 11 top Clusters in OER Studies Direction in China from 2001 to 2019

Cluster	Aggregation	Research Topic	Key Papers	Methodology	Initial Years
#1	147; 0.47	开放教育资源 OER (Chinese)	混合学习:定义、策略、现状与发展趋势——与美国印第安纳大学柯蒂斯·邦克教授的对话; 大规模开放在线课程的国际现状分析; 基于 SPOC 的翻转课堂教学设计模式在开放大学中的应用研究; 教育变革中的技术力量; 智慧教育体系架构与关键支撑技术; MOOCs 对我国精品资源共享课建设的启示研究; 观照 MOOCs 的开放教育正能量; 开放教育资源:国际远程开放教育领域的热点话题——2007 ICDE SCOP 会议综述	Interview Literature Empirical Analysis Concept Intro Concept Intro Literature Empirical Analysis Interview	2007
#2	88; 0.12	开放教育 Open education	MOOC:一种基于连通主义的巨型开放课程模式国内 MOOC 研究现状的文献分析 混合学习:定义、策略、现状与发展趋势——与美国印第安纳大学柯蒂斯·邦克教授的对话 “后 MOOC”时期的在线学习新样式大规模开放在线课程的国际现状分析	Concept Intro Literature Interview	2002
#3	49; 0.16	开放大学 Open University	开放和远程教育中学生学习支持之理念与模式基于 SPOC 的翻转课堂教学设计模式在开放大学中的应用研究国家开放大学建设:改革与创新移动学习:国际研究实践与展望——访英国开放大学迈克·沙普尔斯教授学生支持服务:大卫·西沃特的理论与实践 中国电大的定位和走向“世界一流开放大学”的道路——国外经验和国际比较的视角	Concept Intro Status Analysis Teaching Model Concept Intro Interview Concept Intro Concept Intro	2011
#4	48; 0.09	Mooc	在线教育的“后 MOOC 时代”——SPOC 解析 MOOC 的发展及其对高等教育的影响 MOOC:一种基于连通主义的巨型开放课程模式国内 MOOC 研究现状的文献分析基于 MOOC 的大学英语翻转课堂教学模式研究	Concept Intro Status Intro Concept Intro Literature Empirical Analysis	2013

#5	44; 0.51	远程教育 Distance education	开放教育的学习质量和设计:OpenEd 框架 MOOC 视角下中国开放远程教育的转型发展远程教育:一种平民教育的新形式 “互联网+”背景下远程教育 with 职业教育融合的模式与路径	Theoretical Innovation Status Analysis Concept Intro Status Analysis	2008
#6	36; 0.45	远程开放教育 Distance Open Education	远程开放教育“内涵型—集约式”发展的现实困境与优化策略全纳教育理念下实现成人远程开放教育的管理体系优化互联网+背景下少数民族地区远程开放教育课程辅导教师专业能力的培养	Status Analysis Concept Intro Status Analysis	2006
#7	14; 0.09	远程教学 Distance Learning	高等教育与远程教育的新动向远程教学资源区域共建共享:现实形态与精神重构	Status Analysis Empirical Analysis	2008
#8	12; 0.05	广播电视大学 Radio&TV university	从电大发展看高等继续教育未来走向	Status Analysis	2009
#9	12; 0.08	Oer	职前教师基于 OERs 的自主学习模式及效果探析 ICTs、混合型学习和 TVET 转型 基于 OERs 的自我调节学习行为对学习成效的影响我国大学开放教育资源项目的实践及其发展	Empirical R Concept Intro Empirical Analysis Status Analysis	2008
#10	10	高等教育 High education	MOOC 的全球化发展与高等教育公平 ICDE 高等教育领导者会议探讨在线学习与社会发展 开放教育资源运动:高等教育的变革与挑战高等教育 e-learning 的设计和评价	Concept Intro Interview Status Analysis Empirical Analysis	2014
#11	\	人才培养模式 Talent Cultivation Model	深化教育领域综合改革的若干思考我国开放教育研究的热点分析及发展建议	Status Analysis Literature	2007

### About the frequency of the research topics

The highest frequency research topics are OER(Chinese), OER(English), open education and distance education. The second frequency topics are the main organizations who run OER, OUC for example. The third are the forms of OER, MOOC for example. The fourth are the related topics about OER, talent cultivation model for example. About the methodology of the papers: interview, literature, concept introduction, status introduction and status analysis are used mostly to introduce the advanced ideas about OER abroad and explain the general situation of the Chinese OER development. Meanwhile, there are a few of empirical analysis and teaching model introductions, which are used to evaluate the validity, judge the factors of the influence and develop the Chinese previous theories and methods in China's conditions based on the foreign theories and methods.

CiteSpace is used to do the third kind of operation and Chart 3 is generated.

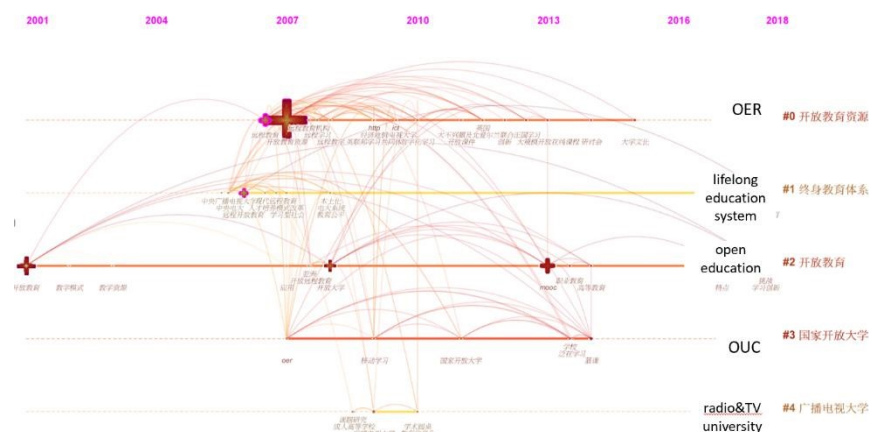


Chart 3. 5 top clusters about key words to 563 papers' titles in OER studies in China from 2001 to 2019

From Chart 2, we can see the top 5 key words about the 563 papers' titles are OER (Chinese), lifelong education system, open education, OUC and Radio & TV University. There are 4 hot points (4 crosses) in this chart. The biggest one is OER in 2007, and the three others are open education in 2001, 2008 and 2013. The arc in this chart means link. If there are lots of lines between two words, it means these two words are always mentioned together in one paper. For example, we can see open distance education V.S. MOOC, OER V.S. UK and OUC V.S. ubiquitous learning are close friends.

OER appeared in the research as a topic from 2001 (It's quite early!), and it turned in a hot topic in 2007. OER study achieved its peak from 2007 to 2013 and OER study began to decrease gradually after 2013.

### Core Papers

CiteSpace is used to do the fourth kind of operation and Table 3 is generated.

Table 3: 2 core papers in OER studies in China from 2001 to 2019

Silhouette 轮廓	Label (TFIDF) 词频	Label (LLR)	Label (MI)	Mean (Cite Year)
0.62	(18.07) oer	oer	mooc	2010
0.713	/	继续教育 (continuing education)	/	2009

This research defines that the number of the silhouette is bigger than 0.5 means core paper, so only 2 papers are collected as core papers. They are: "New Dynamics of Higher Education and Distance Education", Stamenka Uvalic-Trumbic, chief of section for reform, Innovation and quality assurance, UNESCO, Sir John, President of Commonwealth of Learning, 2010; "The Future of the Higher Continuing Education from OUC Perspective", Daoka Ge, president of OUC, 2009. Both of 2 papers are the introduction of the general situation. Both of them are macroscopic and from officers but not researchers.

The number of the high quality papers is few and is increasing slowly and there is no core paper from 2001-2008 and 2011-now.

## **Conclusion**

After the study, we can get the following conclusions:

1. There are still lots of undeveloped land in OER study in China (quantity and quality).
2. Distance education institutions are the closest friends with OER studies.
3. OER study is a good breakthrough point for pedagogy marching from macroscopic to microscopic.
4. OER study started early in China.
5. The studies about its development and evolution are abundant.
6. OER studies are not specific and deep enough in China.
7. Most of the researchers are from pedagogy.
8. There should be more researchers from other disciplines, computer and economics for example (multi-interdisciplinary research).

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## **A REVIEW AND CONTENT ANALYSIS OF THE TURKISH ONLINE JOURNAL OF DISTANCE EDUCATION PUBLICATIONS BETWEEN 2000 AND 2015**

*Cengiz Hakan Aydin, Anadolu Universit, Turkey, Olaf Zawacki-Richter, Carl von Ossietzky University of Oldenburg, Germany, Aras Bozkurt, Anadolu University, Turkey*

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### **Abstract**

This paper presents a review of distance education literature published in the Turkish Online Journal of Distance Education (TOJDE) to describe the status thereof and to identify gaps and priority areas in distance education research based on a validated classification of research areas. The articles ( $N = 784$ ) published between 2000 and 2015 were reviewed for this study. Findings indicated that issues related to educational technology are a popular research area in articles published in TOJDE. Nearly all the articles are theoretical/descriptive, quantitative, or qualitative in nature. According to publication and authorship patterns, TOJDE is an international journal with a special ability to reflect developments in its near region in the field of distance education.

### **Introduction**

In any discipline, to understand the past and the present, as well as to achieve success in the future it is necessary to benefit from what has already been experienced. Within this perspective, it is of the utmost importance to define research areas of distance education and fill in these areas with scholarly experience and research-based evidence. In this regard, this paper addresses questions in the following areas with a special emphasis on Turkish distance education research:

- Distribution of research areas;
- Analysis of research methods;
- Geographical distribution;
- Gender and research methods.

## **Literature Review**

Two other articles have analysed the research trends in TOJDE, in a way that is similar to the aim of this article. The overall objective of those studies was to identify the research trends in TOJDE over a specific time period. Latchem (2009) conducted a content analysis of the Notes for Editors and articles published in the journals issued between 2000 and 2008. The analysis involved determining the articles' countries of origin, sectors represented, and focus and frequency of the topics covered. It was reported that the majority of articles were from Asian countries, with Turkey providing the greatest number of contributions. There were also many papers from the Middle East, Africa, South America, USA, Eastern and Western Europe, and Australia. According to Latchem, some of the papers, presenting non-Western perspectives, are particularly illuminating. The earlier articles tended to be descriptive or theoretical, but the latter papers were quantitative-experimental and qualitative-descriptive studies into distance education and e-learning needs, policies, procedures, practices and outcomes. Özarslan, Balaban-Sali, and Demiray (2012) analysed the articles in TOJDE published between 2000 and 2010 by focusing on research topics, methods, instruments, statistical methods, author numbers and their institutional affiliation. They reported that single-author articles constitute the largest proportion of TOJDE. It was also indicated that Turkey, USA, India, Nigeria, Malaysia, Pakistan, Australia, Canada, UK, Bangladesh, Greece, and Iran, respectively, are the chief contributors to TOJDE. In addition, the researchers identified 17 research topics in TOJDE. Accordingly, (a) Learner and instructor experiences in online learning environment; (b) information about the system and program; (c) economic, social and cultural dimension of distance education, and (d) pedagogical, political, philosophical, legal, ethical reflections in distance education are top four research topics in TOJDE. In terms of method, it was found that the quantitative studies far outweighed the qualitative and mixed studies. Bozkurt, Zawacki-Richter, and Aydin (2019) conducted social network analysis to identify keyword patterns and found that TOJDE largely focused on technology-related issues.

In addition to attempts to identify research trends in TOJDE, the following studies included TOJDE into their research within different perspectives. For instance, Zawacki-Richter, Anderson, and Tuncay (2010) investigated impact of 12 distance education journals (6 open and 6 published in closed format by commercial publishers). The impact and perceived value of the journals was identified through citation analysis of the published issues from 2003 to 2008, and with a survey with the editors of the journals. They found that articles in open access journals, such as TOJDE, are cited more quickly than in closed format journals. They also reported that both open and closed journals are not significantly different in terms of prestige. Zawacki-Richter and Anderson (2011) analysed

the relationships and influences in peer reviewed distance education journals using social network analysis and multidimensional scaling. With this aim, they sampled 1416 scholarly articles published from 2003 to 2008. They used journals as nodes and citations patterns as relationships. In their research, they found that TOJDE is one of the journals in the core of the citation network. This finding was confirmed in a study by Perkins and Lowenthal (2015) who examined open access journals in educational technology through a survey among more than 300 educational technology academics. The reported that TOJDE is one of the most influential open access journals.

## Methodology

This study is a literature review that intends to reach a synthesis by examining articles published in TOJDE. For this purpose, review study benefits from traditional content analysis (Wilson, 2011). This research adopts a quantitative approach, which mostly relies on counting, to identify research themes in articles published in TOJDE. For this study, all the articles published in TOJDE between 2000 and 2015 were reviewed (N = 784). Book reviews and editorial notes were excluded from the sample.

## Results and Discussion

### *Distribution of research areas*

The classification of research areas for this review is based on the framework developed by Zawacki-Richter (2009). When examined, it can be seen that educational technology (23.72%) is the most studied research area. Learner characteristics (16.84%), theories and models (9.44%), professional development and faculty support (7.02%), instructional design (6.51%), and research methods in distance education and knowledge transfer (6.51%) are, respectively, the most studied research areas in TOJDE (Table 1).

Table 3: Distribution of Research areas

AREAS		2000-2003	2004-2007	2008-2011	2012-2015	TREND	2000-2015 COUNT	2000-2015 PERCENTAGE
Macro	1-Access, equity and ethics	1	4	11	14		30	3,83
	2-Globalisation of education and cross-cultural asp	3	5	4	5		17	2,17
	3-Distance teaching systems and institutions	8	23	10	9		50	6,38
	4-Theories and models	7	24	11	32		74	9,44
	5-Research methods in distance education and kno	4	7	19	21		51	6,51
Meso	6-Management and organisation	4	9	7	8		28	3,57
	7-Costs and benefits	0	5	4	1		10	1,28
	8-Educational technology	18	31	75	62		186	23,72
	9-Innovation and change	2	2	4	9		17	2,17
	10-Professional development and faculty support	1	10	20	24		55	7,02
	11-Learner support services	1	6	7	5		19	2,42
	12-Quality assurance	2	6	5	8		21	2,68
Micro	13-Instructional design	5	15	9	22		51	6,51
	14-Interaction and communication in learning comm	2	8	16	17		43	5,48
	15-Learner characteristics	10	23	31	68		132	16,84
PERCENTAGE		8,67%	22,70%	29,72%	38,90%	100%	784	100,00
TOTAL (BY PERIODS)		68	178	233	305	784		



Zawacki-Richter, Bächer, and Vogt (2009) reported that articles published in prominent DE journals between 2000-2008 demonstrated that interaction and communication in learning communities (17.6%), instructional design (17.4%), learner characteristics (16.3%), distance teaching systems and institutions (8.9%) and educational technology (6.9%) were mostly employed in research areas. In a follow-up study, Bozkurt et al. (2015) found that articles in DE journals published between 2009-2013 indicated that educational technology (15%), interaction and communication in learning communities (13%), learner characteristics (12%), instructional design (11%), and distance teaching systems and institutions (8%). The increasing trend of “educational technology” as reported by Zawacki-Richter et al. (2009) and Bozkurt et al. (2015) is confirmed by the findings of the current research (see Table 1). Bozkurt et al. (2015) highlights that DE is strongly related to technological developments and reacts swiftly to these developments.

### ***Analysis of research methods***

This research adopted the schema of research methods proposed by Bozkurt, Akgün-Özbek, and Zawacki-Richter (2017). Research methods and models/designs are coded according to quantitative, qualitative, mixed/triangulation, conceptual/descriptive/other, practice based, and data mining and analytics paradigms. Accordingly, researchers mainly preferred theoretical/ descriptive (40.43%), quantitative (39.92%), qualitative (15.43%), mixed/ triangulation (3.7%) and practice-based (0.51%) methodologies. There was no research from the emerging research paradigm of data mining and analytics. Of all the research models and designs, literature reviews and reports in theoretical/descriptive; surveys, correlational and experimental research in quantitative; descriptive studies and case studies in qualitative; explanatory design in mixed methodology, and finally action research in practice-based research methodologies are mostly used (Table 2).

# A Review and Content Analysis of the Turkish Online Journal of Distance Education Publications between 2000 and 2015

Table 2: Trends in research method and model/design

Method	Model/Design	F	Within Method %	Total %
Conceptual/Descriptive/Other 40,43% (n=317)	Literature Reviews	246	77,6	31,38
	Reports	67	21,14	8,55
	Technical Paper	4	1,26	0,51
	Comparative	0	0	0
	Field Notes	0	0	0
	Opinion Paper	0	0	0
	Position Paper	0	0	0
	Reflection Paper	0	0	0
	Systematic Review	0	0	0
Quantitative 39,92% (n=313)	Survey	191	61,02	24,36
	Correlational	74	23,64	9,44
	Experimental	37	11,82	4,72
	Casual comparative	3	0,96	0,38
	Meta-Analysis	1	0,32	0,13
Qualitative 15,43% (n=121)	Descriptive	66	54,55	8,42
	Case Study	29	23,97	3,7
	Content Analysis	18	14,88	2,3
	Phenemology	4	3,31	0,51
	Delphi	2	1,65	0,26
	Ethnography	2	1,65	0,26
	Grounded Theory	2	1,65	0,26
	Narrative	2	1,65	0,26
	Discourse Analysis	1	0,83	0,13
	Naturalistic Inquiry	1	0,83	0,13
	Historical	0	0	0
	Heuristic	0	0	0
	Meta-Synthesis	0	0	0
Mixed 3,70% (n=29)	Explanatory	15	51,72	1,91
	Exploratory	9	31,03	1,15
	Convergent	6	20,69	0,77
	Embedded	0	0	0
	Transformative	0	0	0
	Multiphase	0	0	0
Practice-Based 0,51% (n=4)	Action Research	3	75	0,38
	Design-Based Research	1	25	0,13
Data mining and analytics 0% (n=0)	Learning Analytics	0	0	0
	Social Network Analysis	0	0	0
	Text Mining	0	0	0
	Log Analysis	0	0	0
	Internet and Traffic Ranks	0	0	0
	Sentiment Analysis	0	0	0

Similarly, Berge and Mrozowski (2001), who examined research trends in distance education between 1990 and 1999, reported that of all the articles examined, 74.83% was descriptive studies. Zawacki-Richter et al. (2017), who examined articles published in IRRODL between 2000 and 2015, also reported that 44.5% of all articles were theoretical/descriptive studies. The majority of theoretical/descriptive studies something expected in distance education journals. The rationale behind this scene might be the nature of the field. Accordingly, distance education is an interdisciplinary and pragmatist field, which frequently benefits from innovative technologies and other developments in educational sphere. Therefore, theoretical/descriptive papers can be considered as the first phase to understand innovative technologies and developments in education field. As indicated in many reports, distance education and educational technology are exposed to constant changes and these types of papers can be considered a natural, expected phase for the adaptation of the field.

**Geographic distribution**

For the analysis of geographical, countrywise distribution of the articles, countries of the first author were included in the analysis. Of all the 784 articles came from 67 different countries (Table 3), almost one third of the articles came from Turkey. India, the USA, Malaysia and Pakistan comprised the countries from where the majority of the articles originated (Table 3).

Table 3: Distribution of articles by country

R	Country	F	%	R	Country	F	%	R	Country	F	%
1	Turkey	250	31,89	18	Romania	4	0,51	21	BH	1	0,13
2	India	72	9,18	18	Russia	4	0,51	21	Botswana	1	0,13
3	USA	61	7,78	19	Argentina	3	0,38	21	CI	1	0,13
4	Malaysia	50	6,38	19	Bahrain	3	0,38	21	China	1	0,13
5	Pakistan	38	4,85	19	Ethiopia	3	0,38	21	Eritrea	1	0,13
6	Nigeria	36	4,59	19	Finland	3	0,38	21	Guyana	1	0,13
7	Iran	25	3,19	19	Israel	3	0,38	21	Lesotho	1	0,13
8	Greece	24	3,06	19	Jordan	3	0,38	21	Mauritius	1	0,13
9	Bangladesh	23	2,93	19	Norway	3	0,38	21	Mexico	1	0,13
10	Australia	20	2,55	20	Austria	2	0,26	21	Moldova	1	0,13
11	UK	19	2,42	20	Barbados	2	0,26	21	Morocco	1	0,13
12	Canada	15	1,91	20	Brunei	2	0,26	21	Netherlands	1	0,13
13	Thailand	11	1,40	20	Colombia	2	0,26	21	Serbia	1	0,13
14	Indonesia	10	1,28	20	France	2	0,26	21	Slovenia	1	0,13
14	Zimbabwe	10	1,28	20	Italy	2	0,26	21	Spain	1	0,13
15	Saudi Arabia	9	1,15	20	Lithuania	2	0,26	21	Swaziland	1	0,13
16	Brazil	8	1,02	20	Oman	2	0,26	21	Switzerland	1	0,13
17	Egypt	5	0,64	20	South Korea	2	0,26	21	Syria	1	0,13
17	Ghana	5	0,64	20	Sri Lanka	2	0,26	21	Taiwan	1	0,13
17	South Africa	5	0,64	20	Tanzania	2	0,26	21	Uganda	1	0,13
18	Cyprus	4	0,51	20	UAE	2	0,26	21	Ukraine	1	0,13
18	Germany	4	0,51	21	Algeria	1	0,13				
18	Philippines	4	0,51	21	Belgium	1	0,13				

\*USA: United States of America; UK: United Kingdom; UAE: United Arab Emirates; BH: Bosnia and Herzegovina; CI: Cayman Islands.

\*only the country of the first author was taken into consideration

First, these findings indicate that TOJDE is an international distance education journal. Secondly, TOJDE is a regional voice of the Asian continent. As was seen in Table 3, a great majority of the articles were published from countries such as India, Malaysia, Pakistan and Iran where distance education programs are part of mainstream education. Finally, to identify the geographical distribution patterns is important as it can be considered an indicator of the research productivity of individual countries or regions. Such analysis could be very helpful for identifying gaps and priorities in research based on the current status of distance education in specific regions.

**Gender and research methods**

According to gender analysis and the methods used, it could be seen that 481 (61.4%) of the first authors were male, 302 (38.5%) were female and 1 (0.1%) was institutional. In

terms of the frequency of the publications, it can be seen that the male researchers showed much more interest than the female researchers (Table 4). The same patterns were also observed by Zawacki-Richter and von Prümmer (2010) who examined articles published in five distance education journals between 2000 and 2008 (Male: 55.4%, Female: 44.6%), and Zawacki-Richter et al. (2017) who examined articles published in IRRODL between 2000 and 2015 (Male: 55.9%, Female: 44.1%).

In the related literature, it was reported that there was a relationship between gender and the preferred research paradigm (Carlson, 1972; Grant, Ward, & Rong, 1987), however some others claimed that there is no such relationship (Goldenberg & Grigel, 1991). Mishra (1997), Zawacki-Richter et al. (2009), and Zawacki-Richter and von Prümmer (2010) further highlighted the relationship between gender and research paradigms in distance education. In order to explore if there is an association between gender type and research paradigm in the sampled articles published in TOJDE, we conducted a chi-square analysis. In order to do this, one paper, which was written by an institute, was omitted from the sample. Data mining and analytics was not counted in by the statistical software because it had a 0 value. Accordingly, in a 5 x 2 table, there was no significant association between gender and the preferred research paradigm  $\chi^2(4) = 4.9, p > .05$ .

Table 4: Cross tabulation of gender (first author) and research paradigms

			Male	Female	Inst.	Total
Method	Quantitative	Count	180	132	1	313
		% within method	57,5	42,2	0,3	100,0
	Qualitative	Count	75	46	0	121
		% within method	62,0	38,0	0	100
	Mixed/Triangulation	Count	16	13	0	29
		% within method	55,2	44,8	0	100
	Conceptual/Descriptive/Other	Count	208	109	0	317
		% within method	65,6	44,8	0	0
	Practice based	Count	2	2	0	4
		% within method	50	50	0	100
	Data mining and analytics	Count	0	0	0	0
		% within method	0	0	0	0
Total		Count	481	302	1	
		% of total	61,4%	38,5%	0,1%	

## Conclusions

The current findings indicated that of all the 15 research areas, educational technology (23.72%) is the most studied research area. Learner characteristics (16.84%), and theories and models (9.44%) are the other most studied research areas. It is also salient that these research areas comprise 50% of all the research areas. In terms of the research methods and models/designs, theoretical/descriptive (40.43%), quantitative (39.92%), and qualitative (15.43%) research paradigms, all of which constitute 95.78% of the research

methods mostly used in articles published in TOJDE. Mixed/triangulation, practice-based, and data mining and analytics were the least preferred research paradigms. Among the many research models/designs, literature reviews (31.38%), and survey studies (24.36%) constituted 56.16% of all research models/designs. Furthermore, it was also seen that the 784 articles originated from 67 countries, which means that TOJDE published articles from nearly one third of the world's nations. It was also seen that TOJDE, as an international open access journal, is the representative of its own region, mostly developing countries, and is also representative of many other countries, which makes it an important publication venue. The analysis on the relationship between gender and research methods was found not to be statistically significant, yet it was also seen that male researchers published more articles than female researchers did.

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## **THE NAME OF THE ROSE: AN ENIGMATIC RELATIONSHIP BETWEEN TACIT AND EXPLICIT KNOWLEDGE TO INNOVATE THE PRODUCTION PROCESS OF EDUCATIONAL RESOURCES**

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### **Abstract**

The objective of this conference consists of presenting a humanistic process for developing support units for knowledge (UAPA: Unidades de Apoyo para el Aprendizaje). Currently, National Autonomous University of Mexico (UNAM), has a production process of these already mentioned educational resources. Based on the results of a series of profound interviews where educational coordinators mediated by technology. We identify this phenomenon as The Name of the Rose. This phenomenon is associated with social relationships between subjects and in particular between the teacher and the pedagogical advisor. This has let us define the theoretical-conceptual basis to outline this process of humanistic production.

### **Context**

The access to teaching knowledge generated in the gaps of superior education has led to a diverse phenomenon related to the process of turning the tacit knowledge of university teachers attainable. The unveiling of teacher's tacit knowledge is the starting point to recognize the phenomenon that interests us for transforming the conversion process from tacit to explicit knowledge. To go into this phenomenon has the purpose of innovating the production process of the educational context, known as learning objects (Polsani, 2006) to achieve higher production and a better quality of these already mentioned resources.

We focus our investigation on a study case. It corresponds to one of the production processes of the educational resources from the National Autonomous University of Mexico (UNAM). This university is one of the main public and autonomous institutions in Mexico. Its enrolment comes to 356,530 students and has a teaching staff of 41,318; from this teaching staff only 12,368 (30%) are full-time teachers (UNAM, 2019). The university's growth according to this large number started from an event known as a student's movement in 1968. In the early '70s, the university introduced the open university system

and in 1999 the distance education mediated by technology with the objective of expanding the educational range mainly through all Mexican territory. In this open space, the production process of digital education resources was developed.

In 2005, the university designed a development process of educational resources to promote the open university system and long-distance education. Support units for knowledge (UAPA: Unidades de Apoyo para el Aprendizaje) are found between these two systems. These resources are available online (<http://uapa.cuaed.unam.mx>) for university students and the general public. The UAPAs that are available online have been viewed more than 1,300,000 times by 6,000 users. These figures reveal the recurrence of the use of these resources.

The theoretical basis of this process corresponds to the conversion or creation of knowledge (Ikujiro & Takeuchi, 1995), which was developed under a cooperative culture, such as the Japanese (Sato, 2007). The basic assumption on which this process was designed is that by having a systematic production process of educational resources and where different subjects with different disciplinary knowledge will have an efficient process. Transfer and usage of this theoretical basis to a university space where autonomy and cathedra freedom are promoted have direct consequences that, of course, were not initially identified. Facing this situation and based on a process of truth or simulation of truth (Badiou, 2004), we formulated the next questions:

- Which phenomenon occurred during the UAPA production process?
- Which consequences have this phenomenon for improving this mentioned process?

### **UAPA current production process**

The process that is currently in operation is formed by five stages in which different subjects participate as working cells (León Martínez, 2017). See Figure 1.

Working cells are basically formed by instructional designers (pedagogical advisors), graphic designers (integrators in digital platforms), style editors and of course, teachers better known as experts in content.

The process begins by training the expert in content (professor) about the process that generates UAPA. Subsequently, the relation between the pedagogical advisor's work and the expert in content for exchanging knowledge begin; the advisor guides the elaboration of the content by monitoring mainly two aspects: congruence between objectives and learning activities watching at all times that each one of the elements that form UAPA are accomplished, emphasizing instructions and didactic language oriented towards the students (see Figure 2). The didactic material which is the result of this mentioned work



[illegible]

EC: Experto en contenido / content expert

With this process, 752 UAPA have been produced in the last four years. Its diversity is oriented to the teaching of English and other disciplinary areas such as medicine, accounting, law, nursing, among others.

The production of these educational resources has caused us to consider several questions based on what has been observed in situ between different stakeholders involved before, during and after this production process.

### Structure of a UAPA Components\*

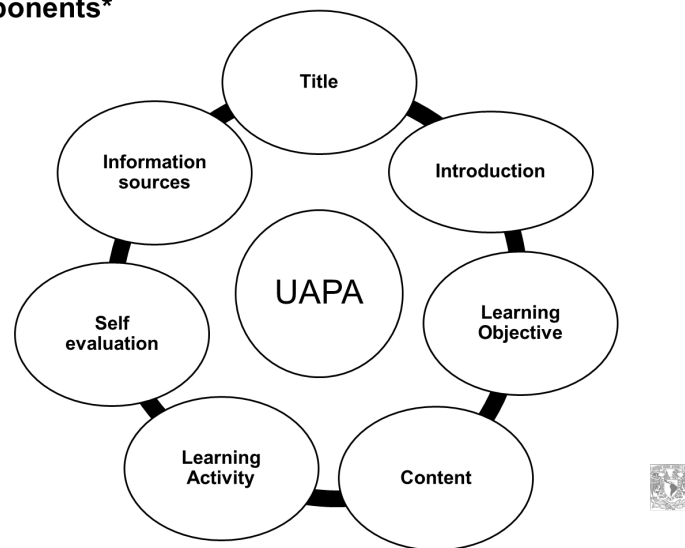


Figure 2. Components of UAPA

### The phenomenon: The Name of the Rose

A profound interview was the tool used to recognize this phenomenon. The interview consists of five open questions. Six technology-mediated education coordinators from different UNAM disciplinary fields participated. As part of these research progress we only describe, in general terms, the outcomes we obtained through two questions:

- What are the reasons why the development of the UAPA has been promoted?
- What obstacles has faced coordination in the development of the UAPA?

Next, we describe, as part of what we have managed to recognize through this empirical qualitative research, two of the main findings regarding the reasons and obstacles that coordinators have faced during the UAPA's production process.

The main reason widely recognized is the learning reinforcement, either in an autonomous way or directed by a professor. The provision of the UAPA has made it possible for students to use them on their initiative to exercise in advance the topics that are reviewed during the class, or to reinforce what was taught in a certain session (class). Some others use them to approve certain subjects without a regular enrolment; that is, to pass the mentioned subject in an extraordinary way.

Those interviewed identified that the main obstacle is the interaction between the pedagogical advisor and the expert in content (professor). We have called The Name of the Rose to the conflict of this relationship. This relation is a determining factor for the creation of a product that allows, promotes and reinforces the student' learning process.

**The Name of the Rose: An Enigmatic Relationship between Tacit and Explicit Knowledge to Innovate the Production Process of Educational Resources**

Transforming an explicit knowledge into a tacit one becomes relevant at the moment in which the expert in content experiences a cognitive process within himself to transform what he has learned and communicates to his students traditionally and verbally and on-site class, in a new written form supported by technology. At this moment, the phenomenon that we have called The Name of the Rose, is produced. In this film work by screenwriter Umberto Eco, it deals with the subject of the property of restrained knowledge for only some privileged that have access to it through the reading of poisoned books, causing death to anyone who accesses it. Under this context, and making an analogy with the film, the tacit knowledge that the expert has, resembles the unreachable book for everyone.

Poisoning occurs from the form of the relationship between the pedagogical advisor and the expert. If this relationship occurs in an imposing or intrusive way by any of the actors, the tacit knowledge that the professor has is unreachable and, therefore, transformation into explicit knowledge is not achieved or hard to obtain. That is the reason why we called this phenomenon as The Name of the Rose.

**Conceptual Framework: Humanism for innovation within the production process of digital educational resources**

Humanism is the practice of an idea to change lives from the individual or collective subject itself. Recognizes the past that has originated the situation and gives its name to the phenomenon that is present in it. It forces us to enter dialectically into the phenomenon (Heidegger, 2008); that is, act in the situation to Change and Continue.

In a context where every time the use of technology is wider, diversification, accessibility and what through it is increasing, personal interaction systems (Lefebvre, 2013) and the recognition of the forms that these relationships adopt have been relegated or have lost importance. This happens apparently because of the prevailing necessity to produce educational resources on a large scale and distribute them through the www, which are of different quality.

Through the event's ethics, developed by Alain Badiou (2004), we hold on to the simulation of truth to transform the production process of the digital educational contents that are in operation.

The epistemological basis of our proposal to improve the process, comes up from the proposals of the phenomenology (Hegel, 2017) and the Theory of life (Bergson, 2007), to generate innovation within education and, particularly, from the educational resources that change the teaching-learning processes.

**The Name of the Rose: An Enigmatic Relationship between Tacit and Explicit Knowledge to Innovate the Production Process of Educational Resources**

According to (Sánchez-Mendiola, Moreno-Salinas, Bautista-Godínez, & Martínez-González, 2019) and (Bautista Godínez, 2019), one of the missing concepts in the educational processes and, in this particular case, in the knowledge conversion processes is the becoming-future, as a dialectic duality for innovating the digital educational resources. The concept of becoming-future, which is where it converges what it was, what it is and what it could have been, it opens the possibility for changing life. This is our starting point to resume and formulates the constitutive dimensions of the new production process of the mentioned UAPAs (see Figure 3a), integrating the concept of space and relation systems (see Figure 3b) to attend more student's needs and in a better way.

Teaching and traditional learning, the instrumental process that is currently happening and the stakeholders have been described in previous sections. To complete the triangle, we have recovered Henri Lefebvre's thoughts, about space production and relationship systems (Lefebvre, 2013). The space, according to this mentioned author, is produced from the social relations and their forms. The resources and the logic with which they are exchanged, take part in this medium. In short, the space is determined by the production concept derived from the productive forces. The forms of the relations are marked by the language in its wider sense, past and community's culture. The space can be static or in motion, it depends on the dialectic exercise. Dialectics promote circular forces fields that trigger innovation.

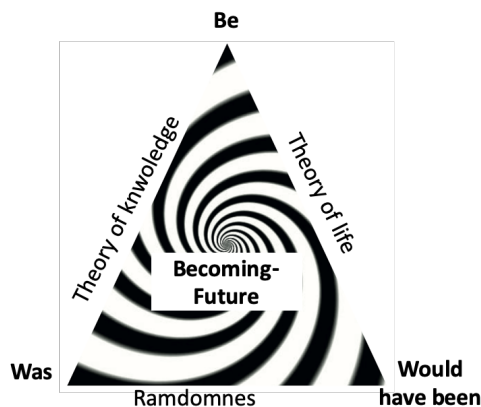


Figure 3a. Becoming-future concept (Sánchez, et al. 2019)

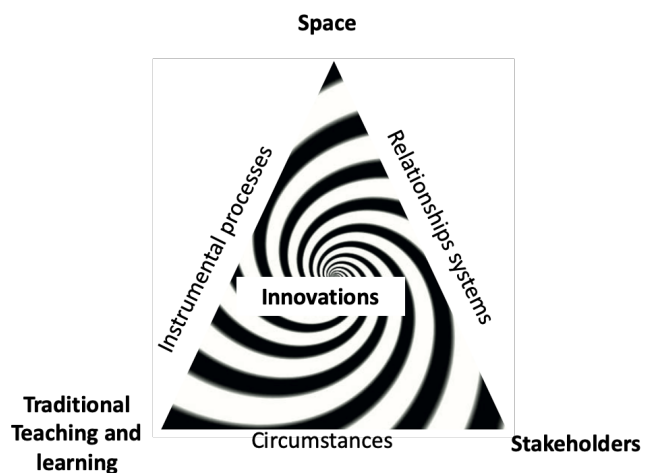


Figure 3b. Dimensions of the humanistic production process

## The humanistic innovation process for the development of support units for knowledge

The production process is formed by one objective axis and a subjective one (see Figure 4). The first one corresponds to the instrumental mechanisms that generate results, which are currently operating.

The subjective dimension emphasizes the necessity of recognizing opinions or the perception of those involved (Hegel, 2017). Based on Hegelian thinking, to carry out the exercise of separation and grouping of perceptions corresponds to the reflection process. Begin the introduction from perceptions or opinions until find what originates the opinions is a consequence of an inductive-deductive process that is applied in the situation like we currently do. An opinion is an expression that is said immediately without having any reference. The perception is a proposition with a true judgment where the senses of an individual subject are involved.

The origin's opinion recognition opens the possibility of identifying the objective concept that originates from opinions. This allows us to identify the humanistic concept that will allow us to display the missing, damaged or new parts that have to create the new UAPAs production process.

The democratic dialogue allows the confrontation of ideas and the creation of new ones. Innovation is created in this way (Žižek, 2013). The cause of change to find why, that is, the origin's opinions are the Hospitality manners among different subjects (Derrida, 1998).

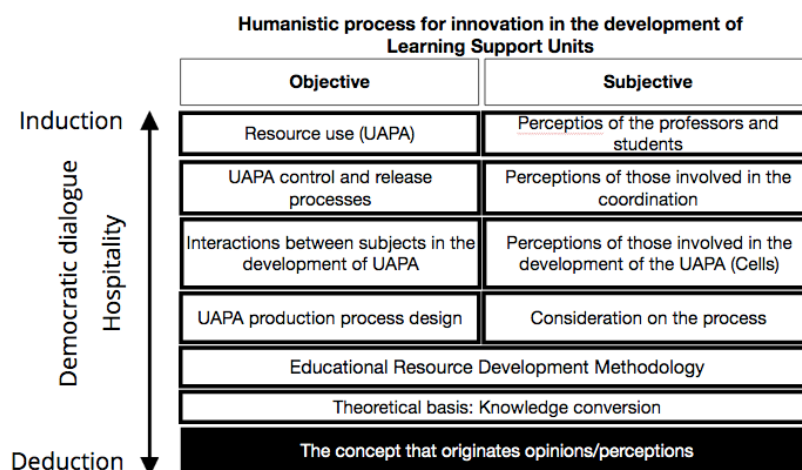


Figure 4. The humanistic innovation process for the developing support units for knowledge

## Conclusion

The conversion process from tacit to explicit knowledge in a college environment where autonomy and academic freedom are promoted because it is from UNAM has developed

support units for knowledge, that reinforces college student's learning and in general of whoever uses those educational resources. The use of the UAPA by a large number of users and by the number of views, as revealed by the large numbers that we report here, pays for the perception that this type of resource reinforces learning, as those who were interviewed have referred. However, the production of these resources is still reduced.

To enhance the innovation of this mentioned process, we have held on to a simulation of truth for the continuous improvement of this process from the situation. This transformation has begun with the phenomenon recognition that has caused the learning objects production, where the main source is the professor's knowledge. The damaged form of the social relation systems that occur in everyday life is the phenomenon before mentioned. We have called it The Name of the Rose due to implications related to the unveiling of academic knowledge. This main finding has opened the door to determine the dimensions that will move the process which will improve the creation of this mentioned educational resource. With this, we have established the parts that shape a production humanistic process of these educational resources. The pending task consists in recognizing the conceptual origins that begin with a hard and enigmatic relationship among professors and pedagogical advisors. To achieve this recognition will allow changing the space and the social relation system.

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## WIKIPEDIA, A SOCIOTECHNICAL RESOURCE?

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### Abstract

The process of digitization is transversal to the different domains of society, including the digitization of encyclopaedias, namely Britannica Online (surpassing its own centennial print edition). In turn, it was surpassed by Wikipedia, which emerged from the advent of web 2.0. Due to the cyclopean proportion that it reached throughout its 19 years of existence, it fulfils an old dream, i.e. to gather, in one place, all the knowledge of humanity – thus, somehow constituting the new library of Alexandria. It also responds to the demands of the digital world, namely by having followed a path aligned with digital and technological evolution, such as the constitution of a community that integrates both human and non-human agents. As Wikipedia is an essential tool when searching on the internet, our aim is to contribute to the understanding of this open resource. Moreover, we address the question of Wikipedia being a sociotechnical system, where bots, non-human collaborators, intervene, either in repetitive automated editions, or progressively expanding its scope, in a sophistication of actions that are not restricted to the content of the articles, but, instead, expand to socialize with the community of users.

### Introduction

We live in a globalized society, with socio-cultural implications that incorporate the so-called new technologies, more commonly known as ICT – information and communication technologies. ICT are the backbone of the networked society, which Castells (2003) perceives as a new social morphology; he also mentions that the diffusion of networks significantly modifies the action and the results of the processes of experience, power and culture (at the core of which we can find encyclopaedias, particularly Wikipedia, as we develop below).

This background evokes to us, among others, the concept of cyber-culture, a cultural and social phenomenon defined by Lévy (1999) as a set of techniques that integrate both material and intellectual techniques, to which are added practices, attitudes, ways of thinking and values that interact with each other. For him, it is through the connection



that virtual communities are built – communities based on affinities, interests and common goals that give rise to the collective intelligence. Thus, he defines it as a globally distributed intelligence, which is constantly valued in real time and which leads to the mobilization of skills (Lévy, 1997).

Moreover, it is by understanding the network as an educational interface that integrates and provides the opening and sharing of knowledge, according to Cardoso, Pestana, and Brás (2018), that we will reflect on the current encyclopaedia – Wikipedia. We'll start by presenting and characterizing this online digital phenomenon, and then focus on the role of human and non-human agents so as to sustain that it is a sociotechnical resource.

### **Wikipedia, an online digital encyclopaedia**

Thacz (2015) argues that encyclopaedias assume themselves as historical artifacts that have offered, over time, an understanding of the world at the time they are written, since they provide a body of knowledge at a given moment. It is in this context that he highlights the relevance of understanding today's encyclopaedia, Wikipedia, namely to identify what constitutes our encyclopaedia of knowledge and what are its limits, how it is organized with regard to the knowledge taxonomy, the creation and edition of articles, the distribution of tasks, the hierarchies of those who contribute to its construction – in short, how the whole Wikipedia project works. We follow this reasoning, and so we are interested in understanding not only the products of Wikipedia (its articles, i.e. its most visible elements), but also the processes involved, specially the role that bots assume in this sociotechnical system.

Looking now more in-depth into Wikipedia, it has nearly two decades, as it was officially launched by Jimmy Wales and Larry Sanger on January 15<sup>th</sup> 2001. This online encyclopaedia called Wikipedia appeared first in English, then in other languages. The Portuguese edition was made available in the same year in June. One way to understand the Wikipedia project is through the interpretation of the narrative that is given to us in its access page. Thus, the Uniform Resource Locator (URL) [www.wikipedia.org](http://www.wikipedia.org) directs users to Wikipedia, where it is possible to see an incomplete spherical puzzle in the centre, and in which each piece includes the letter “w” in different alphabets. The spherical shape is not complete and is assumed as the current Wikipedia logo. It should be noted that this was not always the logo used (cf. Pestana, 2014). Leitch (2014) associates the logo with the cooperative and global nature of the project, showing itself as an unfinished work. Around it you can find a set of access portals that Wikipedia assumes as relevant. In the words of Tankersley (2016), they are the “top ten viewed wiki's by language”. The languages represented are English, French, German, Italian, Polish, Spanish, Russian, Japanese, Portuguese and Chinese. Each has either a reference to the updated number of existing

articles or a translation of motto “The Free Encyclopedia”. The narrative that is transmitted to us through the homepage allows us to highlight the magnitude of the project and the institution that supports it, i.e. the Wikimedia Foundation.

We emphasize that the idea of grouping knowledge in a single place has been a dream that dates back to ancient Greece. These attempts, in a more recent period, have also been present. Because understanding its origin also involves integrating the Wikipedia project into the set of projects that somehow preceded or are contemporary to it, as well as its particular characteristics. Thus, according to Ayers, Matthews, and Yates (2008), Lih (2009), Reagle (2010) and Rosenzweig (2006), Wikipedia was Jimmy Wales’ second attempt to build a free online encyclopaedia. Nupedia’s first designated attempt started in March 2000 and was a failure; also, like Wikipedia, it had as main actors Jimmy Wales and Larry Sanger. Its objective was to design articles that were developed in a top/down structure, characterized by a heavy and academic model, based on a peer-review process (Ayers, Matthews, & Yates, 2008; Rosenzweig, 2006). In other words, it was still organized like traditional encyclopaedias, with an expert advisory board and a long review process. Nupedia can be considered as the genesis of Wikipedia (for a more detailed description see Pestana, 2014). Wikipedia has had a huge growth since its beginning, presenting, according to Wales (2012; 4m: 21s), “a very bright future”. In fact, as he recognises, “Wikipedia has become part of our infrastructure and life” (ibid.; 2m: 24s).

However, a distinctive aspect, in comparison to other encyclopaedias, is the fact that the articles are not necessarily written by experts in the field, nor their review is necessarily done by peers. Moreover, Wikipedia has presented, in its first decade of existence, an evolution in the way in which articles are published (Rosenzweig, 2006). Although maintaining the same principles, there is a set of Fundamentals, Rules and Recommendations that support their publication. According to Ayers, Matthews, and Yates (2008) and Lih (2009), they are the pillars that have evolved since the three founding principles, established by Larry Sanger – 1. Neutral Point of View (NPOV), 2. Verifiability (V), and 3. No Original Research (NOR) –, and are presented as the Fundamentals of all Rules and Recommendations. Those Pillars are the following: Encyclopaedism; Neutrality of point of view; Free license; Community coexistence; Freedom in the rules.

Another important feature is the fact that although Wikipedia is a phenomenon emerging within the Web 2.0, it has been evolving and can be integrated within the phenomenon of Web 3.0 too. For example, the availability of the Objective Revision Evaluation Service (ORES) is:

*“a new artificial intelligence service designed to improve the way editors maintain the quality of Wikipedia. This service empowers Wikipedia editors*

*by helping them discover damaging edits and can be used to immediately 'score' the quality of any Wikipedia article. We've made this artificial intelligence available as an open web service that anyone can use."*  
(Halfaker & Halfaker, 2015)

As also pointed out, for example, by Clément and Guitton (2015) or Niederer and Dijck (2010), Wikipedia involves human agents and non-human agents, which makes it a sociotechnical resource, as we further develop in the following section.

### **Wikipedia, a sociotechnical resource**

In this new era of Wikipedia, one of its major sister projects is Wikidata. In fact, Leitch (2014; p.120) refers that "The Wikimedia Foundation has taken a step into the world of Web 3.0 with Wikidata [...] [it] is designed to provide a more centralized and highly structured repository of information for all the languages used by members of the Wikipedia community and their computers". According to Manske (2014), Wikidata is "a free knowledge base that can be read and edited by humans and machines alike".

Focusing again on Wikipedia, with regard to human agents, Wikipedia is built with the collaboration of a huge and diverse group of volunteers, who produce the articles – the wikipedians. They may have different statutes, according to certain requirements needed to apply for the different roles; its hierarchy is presented below. For Niederer and van Dijck (2010; p.6), the dynamics generated in the creation of content between human and non-human agents are a crucial aspect of Wikipedia's performance, i.e. "The online encyclopaedia's success [...] [is] based on sociotechnical protocological control, a combination of its technical infrastructure and the collective 'wisdom' of its contributors". And, as seen on Figure 1, the permission level depends not only on the type of profile of wikipedians (from blocked users to developers, including human and non-human agents), but also on their functions or responsibilities (four are specified, including the management of Wikipedia access accounts).

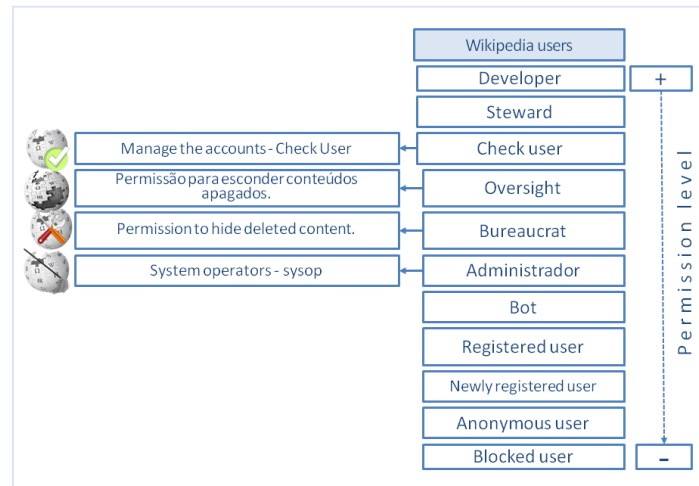


Figure 1. Hierarchy of human and non-human agents in the Wikipedia project (from Niederer and van Dijck, 2010).

As represented on figure 1, the developer and the steward (on top) are associated not only with the Wikipedia project, but also with other Wikimedia Foundation projects. The former, at the software level, and the latter, related to the several Wikipedia sister projects. In the hierarchy above, we also highlight the existence of bots, since they help to control (automatically) the edition of the Wikipedia articles. Bots are seen as non-human collaborators who work under the supervision of humans with regard to repetitive and successive editions (d'Andréa, 2011). According to Niederer and van Dijck (2010), the Wikipedia community, due to the enormous amount of data generated, was forced to implement bots with a view to increasing the quality and structure of the data. Zheng, Albano, Vora, Mai, and Nickerson (2019: 4) further acknowledge that:

*“The first Wikipedia bot appeared in October 2002 [...] Currently, Wikipedia uses a ‘decentralized, consensus-based model’ to regulate bot-related work. [...] Contributors who want to develop and deploy a bot are expected to submit a bot approval request that provides information about the bots’ functions, the bots’ programming language, and the estimated number of pages affected. Then a Bot Approvals Group (BAG) run by experienced and trusted developers will go over the request and discuss its potential influence.”*

Clément and Guitton (2015) find that cohabitation between human and non-human agents is a consequence of the drastic increase in social networks and virtual communities, which reduces the individual response capacity of human agents in favour of emerging tools that help them (i.e. bots). Moreover, they identify two opposite types of bots: the servant bots, with a low level of autonomy, which facilitate the work of users working behind the scenes; the policing bots, controlled by the administrators, act proactively with a high level of autonomy, restricting the work of users and enforcing Wikipedia’s guidelines and

standards. For the authors, the bots were analysed from the following characteristics: the nature of the owner (administrator and registered user); the function of the bot (protection from vandalism, patrolling of materials with regard to copyright, and notices to users) or job assistance (replacing templates, correcting or redirecting false links); the places where changes were made (articles, user page, discussion pages), or behind the scenes (categories, portals and help); automatic way of acting, that is, in “opt-out way” or “opt-in”; degree of autonomy of the bot that is embodied at a high level (some degree of evaluation of user contributions) and at a low level (purely factual or issue management, such as correction of false links or distribution of e-mail around users of the Wikipedia).

Vandalism, “the malicious modification or editing of articles, is a serious problem for free and open access online encyclopedias such as Wikipedia” (Tran, 2015; p.ix). According to Hamiti, Susuri, and Dika (2015), it was only in the beginning of 2006 that bots were programmed to reverse the vandalism, a reversal that is made after the automatic scanning of the editions. It should be noted that previously this work was carried out manually, since vandalism has existed since the beginning of Wikipedia. In their research, the authors conclude that the greatest advances have been achieved by the English, German, French and Spanish communities, with a residual impact on the others. Tran (2015; p.14) identifies two main categories in the anti-vandal software: “automatic detection (bots) and assisting users (editing applications)”; each category includes different editing applications (see below, Table 1 and Table 2).

Table 1: Bots to combat vandalism (from Tran, 2015; p.14)

Notable Bots	Prevailing editing applications
Anti-Vandal Tool	“a bot that monitors the feed of all edits on Wikipedia as they occur. Vandalism is detected by matching words in the edit to a list of vandal words used in past vandalism cases”
ClueBot	“the most active counter-vandal bot from 2007 to 2011. When this bot inspects an edit, a score is determined from a variety of pattern matching heuristics that includes large changes, mass deletes, controversial topics, targeted celebrities, incorrect redirects, vulgar words, minor sneaky changes and others that are added as certain types of vandalism are discovered.”
ClueBot NG35	“the successor to ClueBot and also the first Wikipedia counter-vandalism bot to use machine learning algorithms to improve detection rate and lower false positives.”

Table 2: Most relevant editing applications to combat vandalism (from Tran, 2015; p.16)

Notable editing applications	Prevailing editing applications
Huggle	"a browser application that allows fast viewing of in-coming edits. It allows users to identify vandalism or non-constructive edits, and to quickly revert them."
STiki	"a cross-platform application for trusted users to detect and revert vandalism and other non-constructive edits."
Snuggle	"a browser application designed to allow experienced editors to observe the activities of new editors and distinguish vandals and nonvandals. This application was developed from research [Halfaker et al., 2014] to address the decline in retention of new Wikipedia users. The interface provides four categories to classify edits analogous to STiki, but allows viewing of an editor's editing history and personal messaging to provide feedback to (new) users."

However, and even though bots, as Wikipedia non-human agents, tend to assist human agents in the different work areas of this encyclopaedia (Benevolent bots), according to Tsvetkova, García-Gavilanes, Floridi, and Yasseri (2017), there are also bots outside this sociotechnical system that promote a set of malevolent actions (Malevolent bots). In addition to this situation they identify that sometimes there are bots within the system that conflict. But, Geiger and Halfaker (2018; p.5), in the context of bot governance, state that the situation is already abundantly debated and argue that:

*"Wikipedia's model of automation regulation is generally based on the same principles as editing Wikipedia articles: decentralized consensus-building, scaffolded by formalized policies and processes. Just like with editing articles, Wikipedians sometimes get into intense debates, conflicts, and controversies about whether the Bot Approvals Group ought to approve or deny a particular bot developer's application — and in some cases, about whether the BAG should rescind an approval for various reasons [...] Unapproved bots are not allowed to edit encyclopedia articles; they must get prior approval from the BAG for a specific, well-defined task. The BAG is a standing committee of bot developers and non-developers tasked with reviewing proposals about new bots in line with the community-authored Bots policy."*

## Final remarks

It is not difficult to imagine the volume of interactions of a project with the magnitude of Wikipedia, namely if we consider that it is an encyclopaedia in 309 different languages. Actually, "10 Wikipedias [...] were closed and moved to the Wikimedia Incubator for further development, so there is a current total of 299 active Wikipedias" (List of Wikipedias, 2020). Besides, the fact that theoretically everyone can edit caters for editions

that in some cases fit in the vandalism categories, and in other cases may convey errors in content or yet disrespect in some way the rules of wikification. Therefore, the supervision of the fundamentals, pillars and rules by which the community of wikipedians is guided requires enormous vigilance.

As Halfaker, Geiger, Morgan, and Riedl (2012: 683) recognize, “Wikipedia has changed from the encyclopedia that anyone can edit to the encyclopedia that anyone who understands the norms, socializes himself or herself, dodges the impersonal wall of semi-automated rejection, and still wants to voluntarily contribute his or her time and energy can edit”. In fact, over time, bots have come to play an increasingly important role in Wikipedia, an online digital encyclopaedia that, as argued in this text, is a sociotechnical resource. This system that consists of both human and non-human agents. Ultimately, as educators and trainers, advocating for the quality of open resources, we value pedagogical experiences such as those developed within the Wikipedia in Education Program (e.g. Pestana, 2018). We also value research studies on “the dynamics of the bots with respect their changing functions and the effects of such changes on human editors may be important for understanding the dynamic of coordination in knowledge-creating processes. More broadly, this may help us understand the changing ways automation affects knowledge production and human work.” (Zheng, Albano, Vora, Mai, & Nickerson, 2019; p.15)

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## USE OF ARTIFICIAL INTELLIGENCE TO PREDICT UNIVERSITY DROPOUT: A QUANTITATIVE RESEARCH

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### Abstract

The main aim of the research is to predict, as early as possible, which student will drop out in the Higher Education (HE) context. Artificial Intelligence (AI) is used for replacing repetitive human activities, e.g. in the field of for autonomous driving or for the task of classification pictures. In these areas IA competes with the man with fairly satisfactory results and, in the case of college dropout, it is extremely unlikely that an experienced teacher can “predict” the student’s academic success based on only on data provided by administrative offices. In this study used administrative data of about 6,000 students enrolled in the Department of Education of the University of Roma Tre to train convolutive neural nets (RNC). The trained network provides a probabilistic indicating, for each student, the probability of abandonment. Then, the trained network provides a predictive model that predicts whether the student will dropout. The accuracy of the obtained deep learning models ranged from 67.1% for the first-year students up to 94.3% for the third-year students.

### Introduction

In the comparative study on dropping out of higher education in Europe conducted by Vossensteyn and other researchers (2015), it was found that successful studies are seen as a crucial factor for personal success in 28 of the 35 participating countries. Early recognition of dropout is a key prerequisite for reducing dropout rates: several studies highlight the importance of monitoring individual and social characteristics of students as they have a strong impact on the probability of success of students in higher education. A key objective of the Europe 2020 strategy is in fact to reduce drop-out rates by seeking to achieve at least 40% of 30-34 year olds completing higher education (Vossensteyn et al., 2015). As reported in the literature, students generally leave during their first year of university (Larsen et al., 2013), immediately after upper secondary school: in this period, they must develop their sense of responsibility and self-regulation (Pintrich & Zusho, 2002). Individual skills and dispositions are investigated in different psychological and pedagogical models in relation to the phenomenon of early abandonment in terms of

personality characteristics (Pincus, 1980). Numerous studies have explored the impact of the economic and social status of students (e.g. race or income) and the organisational services provided to students by the university (e.g. faculty-student relationship) on the drop-out rate (Pincus, 1980). For decades, one of the most used and discussed models has been Tinto's "student integration" model, which underlines the importance of the academic and social integration of students in predicting the phenomenon of early school leaving (Tinto, 2010). One of the other main models is the one proposed by Bean (1988), the "student attrition" model, based on the attitude-behaviour of the student, which measures individual and institutional factors and evaluates their interactions in order to predict university dropout. Another interesting model of student/institution integration is the Pascarella model (Pascarella & Terenzini, 2005), which emphasizes the cruciality for student success of having informal contacts with teachers. In other words, in this model, background characteristics interact with institutional factors influencing student satisfaction with the university. Numerous studies have demonstrated the positive effects of student-university interaction on persistence (Pascarella & Terenzini, 2005). Event history modelling is another model much discussed in literature: proposed by Des Jardins, Albourg, and McCallan (1999), this model takes into account the role of the succession of different events in the different stages of the student's educational career, changing the importance of factors from year to year, depending on the time period. In all these models, the relationship between students and institutions is crucial to reduce drop-out rates and several variables have been identified to improve student retention (Siri, 2015). In Italy, due to the very high drop-out rates of university students (ANVUR, 2018), several specific studies were conducted (Burgalassi et al., 2016) which confirmed the value of the baccalaureate vote (and of the entry skills of students more generally) together with the socio-demographic traits of the students (mostly the socio-economic context) as valid indicators of university drop-out compared to the outcome of the first year of study. Many of the models and studies conducted, both national and international, have presented different analyses from the psychological point of view, building psychological-motivational models focused on expectation, reasons for involvement, personal value and motivation in general. These models and surveys all involve the collection of data by interviewing students directly, through the use of tools (usually questionnaires) specially administered. The study presented in this article, however, aims to use only the data available in any university statistical office, without therefore, at least at this stage of research, interviewing students directly. In this regard, it was decided to proceed to the analysis of these data through the use of Artificial Intelligence (AI). Today, AI is used to replace human activities that are repetitive, for example, in the field of autonomous driving or for the task of classifying images. In these areas, IA competes with man with quite satisfactory results and, in the case of abandonment of the educational system, it is extremely unlikely that an experienced teacher will be able to "predict" the educational

success of the student on the basis of data provided by the administrative offices. These recent advances on neural networks have shown that AI may be able to compete (or even exceed) with human capabilities in the tasks of classification and recognition. Here below are then first shown some of the most important studies obtained thanks to the IA, on the prediction of university dropout. Then the metrics for the evaluation of these models and then the methodology used and the results obtained in our research are presented. Preliminary conclusions on the study are therefore briefly drawn.

## **State of the Art**

Many research projects have used data mining techniques to study the Dropout phenomenon. Specifically, in this section we will discuss work that has investigated university dropout by developing predictive models through EDM (Educational Data Mining), or the use of data mining in education, applying computer methods to analyse large data collections. From the analysis of the literature it emerged that the decision tree algorithm (DT) is the one most used for the development of predictive models aimed at identifying university dropout. A research project funded by the Colombian Ministry of Education tried to identify predictive models of early school leaving by analysing 62 attributes belonging to socio-economic, academic and institutional data. Also in this case a decision tree has been implemented (algorithm J48) and for the validation of the model the cross-validation folder has been used with an accuracy of more than 80% (Pereira et al., 2013). Similarly, research was conducted in India to develop a DT based on the ID3 algorithm that could predict students dropping out of university. The study is based on the analysis of 32 variables on a sample of 240 students selected through a survey. Model performance was evaluated using the accuracy index, accuracy, recall and F-measure (Sivakumar et al., 2016). In 2018, research presented a classification based on the DT algorithm. The study analyses 5288 cases of students belonging to the Chilean public university (cohorts of students belonging to 44 university courses in the fields of humanities, arts, education, engineering and health). The attributes selected for the analysis are related to the student's demographic variables, economic situation, and data on previous academic performance prior to his or her admission to university. The accuracy index of the best model developed was 87.2% (Ramírez & Grandón, 2018). In addition to the DT, other classification methods have been used in order to implement models for the prediction of university dropout. Some researchers have used specific methodologies such as CRISP-DM (Cross Industry Standard Process for Data Mining), to predict at the end of the first semester students at risk of dropping out. The dataset consists of over 25 thousand students and 39 variables for each student and the algorithms used are: DT, artificial neural networks (ANN) and logit model (LR). The results show an accuracy of 81.2% for the model developed with ANN (Delen, 2011). Similarly, a research conducted at the University of Genoa, employed the ANNs to detect students at risk of

dropping out. The study refers to a population of 810 students enrolled for the first time in a degree course in medicine in the academic year 2008-2009 and the data come from administrative sources, an ad hoc survey and telephone interviews (Siri, 2015). Another example is the work done at the College of Technology in Mato Grosso. The research presents a model developed with the Fuzzy-ARTMAP neural network using only the registration data collected for a period of seven years from 2004 to 2011. The results show an accuracy rate of more than 85% (Martinho et al., 2013). In Brazil at Universidade Federal do Rio de Janeiro, a research project compared different algorithms (DT, SimpleCart, Support Vector Machine, Naïve Bayes and ANN) analysing data from 14,000 students (Manhães et al., 2014). Similarly, at the University of Technology and Economics in Budapest, using data from 15,285 university students regarding their secondary and university education, 6 types of algorithms were employed and evaluated to identify students at risk of dropping out. Accuracy, recall, precision and the ROC curve are the metrics used for the evaluation and the results showed the best model developed by the Deep Learning algorithm with an accuracy rate of 73.5% (Nagy & Molontay, 2018). A similar research has employed five classification algorithms (LR, Gaussian Naive Bayes, SVM, Random Forest and Adaptive Boosting) analysing 4432 data from the students of the degree courses in Law, Computer Science and Mathematics of the University of Barcelona in the years 2009 and 2014. The research found that all machine learning algorithms reached an accuracy of around 90% (Rovira et al., 2017). The Instituto Tecnológico de Costa Rica implemented a model derived from the algorithms of Random Forest, Support Vector Machine, ANN and LR. The reference sample is composed of 16,807 students enrolled between the years 2011 and 2016 and the best model is that resulting from the algorithm of Random Forest (Solis et al., 2018). The above studies highlight a heterogeneous use of datasets, algorithms, metrics and performance methodologies. Therefore, it is unlikely to be possible to define with certainty which model is better than the other, but research confirms the effectiveness of the EDM approach to the study of university dropout. The main difference that characterizes this work from those present in the literature is given by the introduction of convolutive neural networks to analyse data belonging to the educational field.

### **A quantitative research at Roma Tre University**

One of the most important problems in the field of IA is the problem of classification (LeCun et al., 2015). In this problem you have an object, which can be an image, a sound or a sentence and you want to associate to this object a class taken within a finite set  $K$  of classes. A neural network (RN) can be seen as a function  $\varphi$  that takes an input from a vector  $n$ -dimensional  $x$  and produces a value, called the prediction of  $x$ . The prediction is correct when  $\varphi(x) = f(x)$  and otherwise incorrect. Contrary to the classic programming paradigm, where the programmer to design an algorithm must have a deep and complete knowledge

of the problem of interest such as in (Malvestuto, Mezzini, & Moscarini, 2011; Mezzini, 2010; 2011; 2012; 2016; 2018; Mezzini & Moscarini, 2015; 2016), to implement an RN the programmer may also be completely unaware of the mechanism or semantics of classification.

We collected, from the administration office of Roma Tre University, a dataset of students enrolled in the Department of Education (DE). The years of enrolment ranges from 2009 up to 2014 comprising a total of 6078 students. We found that 649 of all students were still active at the time when we acquired the dataset (August 2018), while the remaining 5429 closed the course of their studies either because they graduated or because they dropped out or by other reasons, explained later. We refer to this set of students as the no active students. Note that in the following when we will refer to the enrolment year (or simply the year) of a student we mean the number of years passed since her/his first enrolment to university, that is, we refer to an integer value between 0 and 9 since no student is enrolled for more than 9 years. In general, each of the no active student is classified in two different classes: Graduated and Dropout. We excluded later all students which do not classified in these two classes, like for example students who changed faculty within the R3U or went to another university. The number of such students is 118. The number of graduated students is 2833 while the number of who dropped out is 2478. We obtained, from the R3U's administrative office, most of the (out of what were available) administrative fields of all students. The attributes relative to the student's academic career are the following: Exam name, Score of the exam, Maximum score of the exam, ECTS of the exam, Exam date (month/day), Academic year, Type of validation. They represent the attributes relative to each test or exam given by the student. Note that the field "ECTS of the exam" refer to the European Credit Transfer and Accumulation System. In order to construct the training set all the domains of the dataset are converted, using an arbitrary bijective function, to a non-negative integer domain. For example, the domain of the attribute GENDER, was converted to the domain  $\{0,1\}$  where 0 correspond to "male" and 1 to "female". We created a table STUDENT, whose schema  $S$  contains all the attributes provided by administrative offices. We limited our tests only to the students that are still active at the year 3 because after that year the number of those students dropping out to university is very small and not significant from statistical and/or practical purposes. If a student ends his/her career in the year  $z$ ,  $0 \leq z < y$ , then  $f_y$  will take the value  $\delta$  for every year  $z < y \leq 3$ . The value of  $\delta$ , which was arbitrarily chosen to be equal to  $-1$ , can be considered as a NULL value and it does not appear in the original domain of any field on the scheme  $S$ . Furthermore, for each year of enrolment  $y \in \{1, 2, 3\}$  an integer  $m$  is set to represent the maximum number of exams sustained by any student on the year of enrolment  $y$ . We found that  $m_1 = 24$ ,  $m_2 = 19$  and  $m_3 = 23$ . Thus, for any field in List 3, for each year  $y$  and for each  $z$ ,  $0 \leq z \leq m_y$ , we added a field denoted as  $g_{y,z}$ . If a student in the year  $y > 0$  of her/his academic career

completes successfully no more than  $j$  exams, then the value of the field  $g_{y,z}$ , is set to  $\delta$  for each  $j < z \leq m_y$ . Overall the table STUDENT has 530 fields (although we collected data up to year 5 totalling 897 fields).

Table 1: Here we report the confusion matrix for the epochs with the best  $F_1$  measure on the validation set. The confusion matrix for the test set was computed using the very same model that achieved the best  $F_1$  measure on the validation set. Column T stands for table type (A, B or C).

Year	T. Arch.	Validation												Test			
		Dropout		Degree		Acc.	Prec.	Recall	F1	Dropout		Degree		Acc.	Prec.	Recall	F1
		True	False	True	False					True	False	True	False				
0	B RNV2	166	105	111	50	64.12%	61.25%	76.85%	68.17%	144	138	121	38	60.09%	51.06%	79.12%	62.07%
0	B INCRV4	183	120	96	33	64.58%	60.40%	84.72%	70.52%	151	155	104	31	57.82%	49.35%	82.97%	61.89%
0	B DFSV1	160	96	132	43	67.75%	62.50%	78.82%	69.72%	159	116	113	54	61.54%	57.82%	74.65%	65.16%
1	A RNV2	65	10	228	20	90.71%	86.67%	76.47%	81.25%	44	16	199	37	82.09%	73.33%	54.32%	62.41%
1	A INCRV4	67	17	221	18	89.16%	79.76%	78.82%	79.29%	50	23	192	31	81.76%	68.49%	61.73%	64.94%
1	A DFSV1	65	22	216	20	87.00%	74.71%	76.47%	75.58%	52	26	189	29	81.42%	66.67%	64.20%	65.41%
1	B RNV2	47	43	186	40	73.73%	52.22%	54.02%	53.11%	33	33	205	52	73.68%	50.00%	38.82%	43.71%
1	B INCRV4	60	74	155	27	68.04%	44.78%	68.97%	54.30%	52	76	162	33	66.25%	40.63%	61.18%	48.83%
1	B DFSV1	62	94	143	24	63.47%	39.74%	72.09%	51.24%	51	87	141	24	63.37%	36.96%	68.00%	47.89%
1	C RNV2	61	23	215	24	85.45%	72.62%	71.76%	72.19%	44	25	190	37	79.05%	63.77%	54.32%	58.67%
1	C INCRV4	54	24	233	17	87.50%	69.23%	76.06%	72.48%	42	34	195	43	75.48%	55.26%	49.41%	52.17%
1	C DFSV1	54	28	229	17	86.28%	65.85%	76.06%	70.59%	45	30	199	40	77.71%	60.00%	52.94%	56.25%
2	A RNV2	35	6	228	15	92.61%	85.37%	70.00%	76.92%	15	6	221	21	89.73%	71.43%	41.67%	52.63%
2	A INCRV4	38	13	221	12	91.20%	74.51%	76.00%	75.25%	17	8	219	19	89.73%	68.00%	47.22%	55.74%
2	A DFSV1	33	6	228	17	91.90%	84.62%	66.00%	74.16%	14	4	223	22	90.11%	77.78%	38.89%	51.85%
2	B RNV2	16	9	243	15	91.52%	64.00%	51.61%	57.14%	11	14	213	41	80.29%	44.00%	21.15%	28.57%
2	B INCRV4	15	5	247	16	92.58%	75.00%	48.39%	58.82%	12	13	214	40	81.00%	48.00%	23.08%	31.17%
2	B DFSV1	17	10	242	14	91.52%	62.96%	54.84%	58.62%	15	21	206	37	79.21%	41.67%	28.85%	34.09%
2	C RNV2	29	7	211	16	91.25%	80.56%	64.44%	71.60%	17	15	237	14	89.75%	53.13%	54.84%	53.97%
2	C INCRV4	32	14	201	13	89.62%	69.57%	71.11%	70.33%	22	23	235	18	86.24%	48.89%	55.00%	51.76%
2	C DFSV1	30	10	205	15	90.38%	75.00%	66.67%	70.59%	25	18	240	15	88.93%	58.14%	62.50%	60.24%
3	A RNV2	19	3	94	6	92.62%	86.36%	76.00%	80.85%	13	11	91	10	83.20%	54.17%	56.52%	55.32%
3	A INCRV4	19	1	96	6	94.26%	95.00%	76.00%	84.44%	13	4	98	10	88.80%	76.47%	56.52%	65.00%
3	A DFSV1	20	3	94	5	93.44%	86.96%	80.00%	83.33%	12	3	99	11	88.80%	80.00%	52.17%	63.16%
3	B RNV2	14	6	91	11	86.07%	70.00%	56.00%	62.22%	7	8	94	16	80.80%	46.67%	30.43%	36.84%
3	B INCRV4	14	4	93	11	87.70%	77.78%	56.00%	65.12%	1	4	98	22	79.20%	20.00%	4.35%	7.14%
3	B DFSV1	16	8	89	9	86.07%	66.67%	64.00%	65.31%	5	10	92	18	77.60%	33.33%	21.74%	26.32%
3	C RNV2	17	3	94	8	90.98%	85.00%	68.00%	75.56%	11	5	97	12	86.40%	68.75%	47.83%	56.41%
3	C INCRV4	18	6	106	4	92.54%	75.00%	81.82%	78.26%	19	8	105	14	84.93%	70.37%	57.58%	63.33%
3	C DFSV1	17	2	95	8	91.80%	89.47%	68.00%	77.27%	12	5	97	11	87.20%	70.59%	52.17%	60.00%

We build a table called Y\_LABEL containing two attributes: STUDENTID and DROPOUT, where the last represents the label of each student. It has a numerical domain with the following meanings: 0, if the student graduated, 1 if the student dropped out. From the table student described above, we derived three type of tables denoted as STUDENT\_A<sub>x</sub>, STUDENT\_B<sub>x</sub> and STUDENT\_C<sub>x</sub> for  $0 \leq x \leq 3$  where  $x$  is the number of years from the first enrolment.

In the schema of tables  $STUDENT\_A_x$  we added all the attributes in List 1 and all the attributes in List 2 (of the type  $f_y$ ), and all the attributes of List 3 (of type  $g_{y,z}$ ) for all  $y = 0, \dots, x$ .

The tables denoted as  $STUDENT\_B_x$ ,  $x = 0, \dots, 3$ , contain only the attributes of List 1 and List 2. That is, we considered in these tables only administrative fields and we excluded the fields related to the academic careers of the students (the ones of type  $g_{y,z}$ ).

The tables  $STUDENT\_C_x$ ,  $x = 0, \dots, 3$ , have been constructed in the following way. We computed, for each student, the following aggregate statistics:  $DIFFYEAR$  and for each year  $x > 0$ ,  $NUMBEREXAMS_x$ ,  $AVGSCORE_x$  and  $SUMETCS_x$ . The first statistic contains the value  $YEAR\ OF\ BIRTH - YEAR\ OF\ BEGINNING\ OF\ STUDIES - 19$  that is, the difference in years between the age of the student (at the date of the enrolment) and 19. The other statistics contains, for each student and for each year  $x = 1, 2, 3$  respectively, the number of exams successfully passed, the average score of the exams successfully passed and the sum of the ECTS gained. We thus obtained the schema of  $STUDENT\_C_x$  by adding to the schema of each table  $STUDENT\_B_x$ , all the above four fields. The idea we want to test here is whether it is better and effective to use only some significant aggregate statistics or, instead, it is better and effective to use all the attributes relative to the academic career (like in tables  $STUDENT\_A_x$ ). For the tests of both CNN and BN we choose a random permutation of all no active students. Next, we partitioned all students in twelve different mutually disjoint groups containing approximately 450 students each thus obtaining a partition  $\mathcal{P} = \{P_0, P_1, \dots, P_{11}\}$ . For all  $0 \leq i \leq 11$  the group  $P_i$  is used as a validation set  $V_i$  and the group  $P_{i+1 \bmod 12}$  as a test set  $T_i$  and the students in the remaining groups, as the training set  $A_i$ . In the validation set for the year  $x$  we put only the students who, at that year of enrolment, were still active. We trained three models based on the CNN architectures mentioned above by taking from each of the table above (A or B or C) the training, validation and test sets from the partition  $\mathcal{P}$ . We got data from a total of 43200 epochs. For each epoch the confusion matrix of both the validation and the test sets were produced. We found that the  $F_1$  measure, was the better indicator for the selection of the best model. We calculated the accuracy for the validation set, for the training set and the  $F_1$  measure. Training and validation data were taken from the table  $STUDENT\_B_0$ . Furthermore, we computed the value of the  $F_1$  measure for the year 1 and for the years 2 and 3 for the three different tables  $STUDENT\_A_x$ ,  $STUDENT\_B_x$  and  $STUDENT\_C_x$ . We observe that in all three cases the value of the  $F_1$  measure relative at the table  $STUDENT\_B_x$  is always worse in every year. This clearly shows that using only administrative data gives very poor performance in predicting the dropout of a student. In Table 1 we report the data of the confusion matrix, for both validation and test sets, in which the validation set, among the twelve possible different sets of the partition  $\mathcal{P}$ , achieved the best score on the  $F_1$  measure.



## Conclusions

We explored the effectiveness of predicting the dropout from university using three different sets of features. The first one, containing all the academic and administrative features (tables STUDENT\_A<sub>x</sub>). The second one, containing only administrative features (tables STUDENT\_B<sub>x</sub>) and the third (tables STUDENT\_C<sub>x</sub>) containing the administrative features and 3 aggregate statistics about the academic career of the students. The experiment showed that using only administrative features does not give good results and the models using only them are always outperformed by models using also the academic career features or aggregate statistics. Furthermore, the models using, besides administrative features, also aggregate statistics perform slightly worse than the models using only and all the academic careers features. From all the above discussion we clearly conclude that the more accurate data we have the more precise and effective the model's predictions could be. Since it is not required that the prediction process is made in real time, we can train hundreds of models and make multiple prediction in order to reduce the random variation found in the early phase of training. Clearly the system can be made finer by introducing a prediction model every semester or even every trimester or it can be extended to other faculty or other types of students.

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## **DEVELOPING AND DELIVERING A HIGH SCHOOL ARTIFICIAL INTELLIGENCE COURSE IN BLENDED AND ONLINE LEARNING ENVIRONMENTS**

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### **Abstract**

The paper outlines the development and delivery of Artificial Intelligence to high school students of the American Community Schools of Athens, either as an independent course, or as part of a S.T.E.A.M. course, and the respective instructional design. The topics developed – Impact of Artificial Intelligence, Machine Perception, and Machine Learning – are discussed, including relevant assessments. Additionally, the transition to the online delivery of Artificial Intelligence is presented, followed by reflective views on student learning and suggested future steps.

### **Introduction**

It was only a few years before the beginning of the 21<sup>st</sup> century that a machine utilizing Artificial Intelligence (AI) – a computer system's ability of effective decision making and problem solving – beat the world champion in the game of chess. Since then, Artificial Intelligence has been increasingly important for the economies and societies of the world, indicatively showcased through the achievements of giant enterprises like Google, Microsoft, IBM, and Amazon. Recently, there have been initiatives to further incorporate Artificial Intelligence into higher and secondary education through projects like Microsoft's AI4All (2020), Google AI (2020), the anticipated creation of the MIT Schwarzman College of Computing (2020), China's Next Generation Artificial Intelligence Development Plan (MOST, 2017) and K12 textbooks (Synced, 2018), and the initiatives of the Association for the Advancement of Artificial Intelligence in the US (AAAI, 2020), among others.

The current paper presents Artificial Intelligence as has been developed and delivered by the author at the high school of American Community Schools (ACS) Athens, as (a) part of a S.T.E.A.M. (Science, Technology, Engineering, Art, and Mathematics) blended-learning course, (b) part of an online S.T.E.A.M course, and (c) a fast-paced semester Artificial Intelligence summer course. Artificial Intelligence at ACS Athens has been

designed as a student-centred, project-based course for technology credits that does not require students to have any prior coding experience.

A sample of learning objectives is the following:

- Demonstrate comprehension of the impact Artificial Intelligence has on societies and economies;
- Demonstrate conceptual understanding of Computer Vision;
- Interact with and conceptually understand the functionality of machines that utilize Artificial Intelligence;
- Conceptually understand the Artificial Neural Networks Machine Learning technique;
- Create Cyber-Physical artworks.

The Artificial Intelligence course has been delivered in context of the 4<sup>th</sup> Industrial Revolution (Schwab, 2016), and has incorporated elements of the Design Thinking methodology to facilitate project-based learning activities.

This article sheds light into the topics and the assessments of the Artificial Intelligence course (blended and online), includes reflections about the development and teaching of Artificial Intelligence at ACS Athens, and suggests future steps.

## **A blended-learning High School Artificial Intelligence course**

### ***Topics***

Figure 1 serves as a conceptual representation of the Artificial Intelligence high school course. The AI course consists of three main topics delivered from the broader (Impact of Artificial Intelligence, bottom of the pyramid) to the narrower in scope (Machine Learning, top of the pyramid), being connected through the Machine Perception topic.

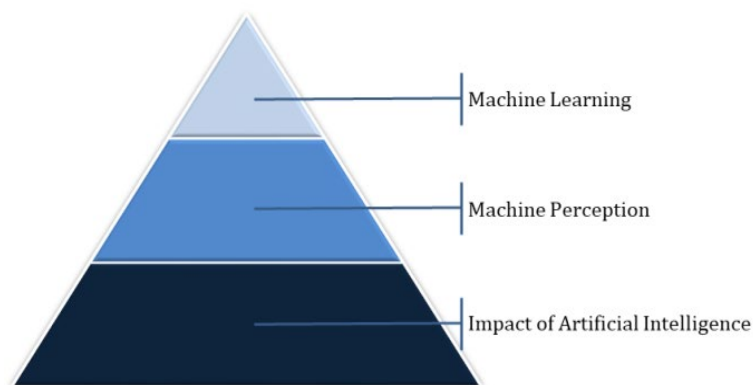


Figure 3. Conceptual representation of the Artificial Intelligence course design

The three topics are outlined below.

### *Impact of Artificial Intelligence*

Aiming in having students become more aware of what Artificial Intelligence is and, most importantly, what is its impact to the world, the course was designed to begin with such an introduction that links the Artificial Intelligence field with societies and economies, as well as with a discussion about the ethical considerations and concerns it brings. AI was presented in context as an important feature, together with 3D printing, Internet of Things etc., of the upcoming 4<sup>th</sup> Industrial Revolution. Similarly to the effect the previous industrial revolutions had in societies and economies, the first one introducing the use of the steam engine, the second one electricity, and the third one the computers, the 4th Industrial Revolution is expected to be transformative as well, bringing a cyber-physical reality of human intelligence collaborating with machine intelligence (Schwab, 2016). There was special attention to presenting students with examples of using AI for a good cause, not only to reveal its importance, but also to provide students with more balanced information about this field so they could start minimizing possible personal biases on the matter, naturally originating from ignorance.

### *Machine Perception*

After having been introduced to Artificial Intelligence and its (current or anticipated) impact to societies, students deepen into machine perception: how AI machines analyse input from cameras, microphones, keyboards to make decisions, similarly to humans using their senses to interpret the world around them and inform their decision-making. Indicative topics and examples discussed are (a) computer vision & autonomous cars, (b) natural language processing & chatbots, and (c) recommendation systems & Amazon. Beyond discussions, students have the chance to chat with chatbots and interact with intelligent machines (e.g. Experiments with Google, 2020) to sketch, compose music and create poetry in collaboration with AI, connecting with the cyber-physical nature of the 4th industrial revolution. The goal is to not only familiarize themselves with such interactions, but to experience and conceptually understand important concepts of machine learning, like the dependence on representative, un-biased, and sufficient data to perform effectively.

### *Machine Learning*

Removing one more level of abstraction, the instructional design narrows down the focus to the algorithms used to make machines “learn” – the machine learning algorithms. Machine Learning refers to software that is capable of learning from data instead of delivering explicitly programmed output. Since the Artificial Intelligence course is designed as an unplugged one in terms of coding, and given the numerous machine learning algorithms, the students are introduced to selected algorithms (neural networks,

minimum spanning trees, linear and non-linear regression, decision trees, k-means clustering) conceptually (Karampelas, 2018). What is highlighted to the high school students is the fact that even though professionals in academia and business employing machine learning do develop sophisticated software that often times requires a deep mathematical understanding, the basic procedural steps of each algorithm remain more or less the same. Therefore, the relevant concepts can be comprehended by them fairly well, and computational thinking can be showcased efficiently. Also, special care is given to students understanding there are common meta-concepts among many of the machine learning algorithms, like seeking for correlations among data and using thresholds to terminate iterations and make decisions.

### **Assessments**

Being delivered in a blended-learning fashion, Artificial Intelligence activities are designed to encourage students' independent thinking as opposed to a situation where the teacher is the only source of knowledge. Students have the opportunity not only to use or explore online informational resources, but also to interact with online intelligent machines that employ AI. Consequently, the teacher uses a number of different assessments to accommodate for a blended-learning delivery of content and skills. Indicative activities and assessments are listed below:

- Research on AI-related topics (e.g. real-life examples of AI used for good and for bad, ethics, cyber-physical art controversy);
- Read and reflect on online articles (e.g. effect of AI on employment, chatbots and democracy);
- Watch and debrief on videos (e.g. how AI works; computer vision; machine learning; neural networks);
- Interact and create with intelligent machines (e.g. chatbots, Google Experiments);
- Showcase computational thinking (conceptual machine learning).

In the case of Artificial Intelligence running as a high school independent course, as opposed to being part of the S.T.E.A.M. course, students have the opportunity to do personal projects, indicatively:

- Use Machine Learning techniques to investigate correlations among data using spreadsheets or coding (e.g. stock market prices' prediction);
- Research and communicate the mathematical concepts related to a machine learning technique;
- Use online AI software to create cyber-physical art.

Depending on the nature of the project, students' choices and experience, the teacher might need to guide students through coding and statistics. The aforementioned activities have been designed for a project-based course and have not been implemented as part of a summative assessment like tests (neither unit tests nor exams).

## **Extending the High School Artificial Intelligence course to an online setting**

The aforementioned S.T.E.A.M. course was adjusted to also become an online course, offered by The Institute of ACS Athens (2020), with the Artificial Intelligence component been included as well with minor modifications, especially in regards with the Machine Learning topic that require more face to face interaction between the teacher and the students than the other two topics (Impact of Artificial Intelligence, Machine Perception). Most probably, a significant factor for the smooth transition from the blended to the online setting was the fact that Artificial Intelligence was already being delivered in a student-centred fashion with the use of online resources and a variety of assessments. The main focus was to make sure the asynchronous learning design was self-explanatory for the online students and that, independently of the content, would specify the ways students could communicate with the teacher shall they need to. The more students that will be taking the online S.T.E.A.M. course and, subsequently, AI as well, the more meaningful and statistically significant the evaluation of the outlined transition will be.

## **Reflections**

Introducing Artificial Intelligence to students through the impact AI has and will have on societies and economies, including discussing on the on-going debates about for example AI-based Art or the ethical use of AI, has been found by the author to engage the majority of the students, individually or in groups. The absence of mandatory coding activities has also contributed to the same end. On the other hand, the minority of the students that have some coding experience or are willing to begin coding are able to engage with the content at an advanced level, practising Machine Learning in real data. What has been found to engage students the most though was the use of online tools that allow for the interaction between students and intelligent machines running AI, as has been outlined regarding the Machine Perception topic). Regarding Machine Learning, its conceptual delivery has made it possible for students to grow as learners in such a novel and timely topic. Given the fact Machine Learning could often be less intuitive than the rest of the delivered AI topics, hence requiring a strong face to face interaction during class, would possibly need to be designed in a more visual and interactive way in order to be fully transitioned into an online environment.



Finally, the scarcity of Artificial intelligence and, especially, Machine Learning resources for the high school makes the development of such a course a challenging task. The author's own experience as a researcher utilizing Data Mining and Machine Learning (indicatively: Moretti et al., 2018; Karampelas et al., 2012) simplified the process, but it also shed light into the necessity of the training educators need to receive to better adjust to the needs of designing such a course.

## **Future Steps**

Artificial Intelligence offered by secondary education curricula is still in its infancy. Therefore, the field is lacking resources and educators with relevant experience, but the opportunities are many. It is to the hands of policy makers, school administrators and educators to provide students with relevant content and skills that are timely and necessary for the near future. The author lists the following indicative next steps regarding Artificial Intelligence and secondary education, that could be also scaled both ways toward primary education and higher education: (a) development of Artificial Intelligence (blended and online, project-based) instructional designs and curricula, (b) training of educators to teach AI, (c) training of administrators to facilitate the inclusion of AI into school curricula, (d) development of AI interdisciplinary and eventually trans-disciplinary activities (within and beyond S.T.E.M.), (e) development of AI educational resources, including textbooks and interactive software applications, (f) focus on the societal importance of AI and its use for good, including the incorporation of the United Nation's Sustainable Development Goals (United Nations, 2015), (g) focus on AI instructional designs that do not require coding or coding experience, (h) development of machine learning educational activities, both conceptual and ones requiring a more advanced used of mathematics and/or coding, (i) foster partnerships between K12 institutions, higher education institutions, and businesses to share expertise and good practises, (j) encourage research on the inclusion of Artificial Intelligence into K12, and (k) ensure inclusion of underrepresented groups in Artificial Intelligence education.

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## HOW DO WE KNOW THEY ARE LEARNING? STUDENT DATA AND THE SYNERGIES OF HUMAN AND ARTIFICIAL INTELLIGENCE (AI)

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### Abstract

Artificial intelligence (AI) and the fourth industrial revolution have rapidly become the latest buzzwords in the education industry. Learning analytics and student data have become a central focal point in understanding and evaluating students in an attempt to improve upon the learning environment and experience. This paper explores the history and application of AI and learning analytics in higher education, and then discusses the role of AI in designing, delivering, and evaluating the online learning experience. The research presented shares the experience of an instructional team for two cohorts of an online graduate course and the team's use of available data and learning analytics in delivering the course. Based on the literature and the instructional team's experience, the paper then proposes a framework for the use of AI in online teaching and learning (OTL).

### Introduction

Traditionally, education has always measured student learning in various forms, from inter alia assignments and observations to examinations and/or practical work. Much of the student data collected has been proxies on which educators and institutions have made evaluations to determine whether students have mastered a particular subject, skill, and/or competency. As higher education institutions increasingly move online and learning and teaching becomes digitised and datafield, a greater variety and granularity of student data, from more sources and often in real-time, is available to institutions, educators and support staff than ever before. Subsequently, there has been increased attention to student data and a proliferation of strategies to harvest student data – from scraping facial expressions, to multimodal data and social network analysis. As more data becomes available, its amount and complexity exceed the human capability to effectively process and analyse that data. In addition, the data revolution is accompanied and also perpetuated by increased hardware and software capacity, tools, and the commercialisation of data. However, in the

final analysis the question remains: how do we know students are learning? What data do educators and support staff have access to, under what conditions and how are they using the data to help students engage more, and hopefully, learn more effectively? This paper explores the use of learning analytics and AI in online teaching and learning through a review of the literature and collaborative ethnography, and then proposes a synergistic framework that uses artificial intelligence (AI) + learning analytics + pedagogical/support interventions for improving both the learning (students) and teaching (instructor) experience and environment.

## **Learning Analytics and Facilitation of Learning**

At the first Learning Analytics and Knowledge conference (LAK'11) in Banff, Canada (<https://tekri.athabasca.ca/analytics/>), an initial definition of learning analytics was introduced by conference organisers, describing learning analytics as: "...the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" (Siemens & Long, 2011; p.34). While there are other definitions of learning analytics, for the purposes of this paper, we will use this definition, particularly due to its emphasis on pedagogy in considering the implications of learning analytics. A large section of research on learning analytics focuses on its *potential* to impact positively on student success and retention, and although some evidence paints an imperfect picture (Ferguson & Clow, 2017; Kitto, Shum, & Gibson, 2018), and there is ample evidence that, depending on a number of variables, learning analytics *do* impact positively on student success and retention (Lim et al., 2019; Pardo, Jovanovic, Dawson, Gašević, & Mirriahi, 2019; Wong & Li, 2019).

However, learning analytics still face several challenges in the broader context of higher education. For example, Klein, Lester, Rangwala, and Johri (2019) map learning analytics at the intersections of institutional commitment and individual action, and Lim et al. (2019) question the value contribution of learning analytics and ask "what changes and for whom?" Aligned to this question is the exploration by Slade, Prinsloo, and Khalil (2019) in mapping learning analytics at the intersections of student trust, disclosure and benefit. As learning analytics mature, researchers acknowledge that learning analytics is, in many ways, still imperfect (Kitto, Shum, & Gibson, 2018), but, there is also a commitment to increase the positive impact of learning analytics (Dawson, Joksimovic, Poquet, & Siemens, 2019). In the context of this paper we accept that learning analytics is used by educators and students on the course level (Long & Siemens, 2011) to provide (personalised) feedback to students on their progression (Gašević, Dawson, & Siemens, 2015) and feedback to faculty and support staff regarding excessive workloads or the unequal spread of tasks over a specific tuition period (Rienties, Cross, Marsh, & Ullmann, 2017). While a significant part

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of learning analytics is on identifying students-at-risk and to inform appropriate interventions, in this paper we point to the potential of learning analytics and the use of AI to increase the appropriateness and effectiveness of teaching for all students, and not just at-risk student – formative interventions from data during the course and summative intervention in design after a course. In light of the variety, volume, granularity, and velocity of student data available in online learning environments, it is increasingly challenging, if not impossible for humans, without some form of algorithmic decision-making system, to make sense of the data, analyse it for trends, and to provide timely feedback to students and inform pedagogical and support interventions. In this collaborative ethnography, we will share experiences and evidence that even in relatively small online classes, some form of algorithmic decision-making system will greatly free educator time, but also increase the effectiveness and appropriateness of teaching and support. Despite, and amid the ethical concerns pertaining to algorithmic decision-making systems, we have to consider the potential of learning analytics to inform pedagogy in ways previously impossible. In the next section we will attempt to define AI in the specific context of online teaching and learning (OTL), after which we will share a brief introduction to our methodology, the findings of our collaborative ethnography and concluding this paper with a number of pointers.

### **Towards a Definition of AI for Online Teaching and Learning (OTL)**

Before offering a practical working definition for AI in OTL, it is worth reviewing how AI has typically been interpreted. In general, the AI construct has been dominated by the idea that computers and/or technology will *replace* functions and tasks typically done by human beings (Newton & Newton, 2020; Selwyn, 2019). It is then a reasonable assumption that AI in education is synonymous with replacing the role of the teacher. In response to this view, AI in OTL can be based upon the following assumptions: (a) AI in concert with design-based data sets enhances and strengthens rather than diminishes the teacher's role; (b) online technical design, course design, and support systems are directly linked to the data sets related to quality teaching and enhanced student learning, and (c) the most important impact of AI in OTL is leveraging data sets linked to student engagement and performance and subsequent learning analytics by teachers and support staff. These tenants suggest that AI in OTL is directly linked to providing data sets supported by scholarly research and practice not only for improving student learning but enhancing teaching. Drawing upon these tenants and OTL research, we offer the following definition of AI in OTL:

*“Artificial intelligence (AI) in online teaching and learning (OTL) is defined as the combination of assumptions about data sets, technical design, learning design, and support systems and the strategies used for gathering and evaluating data sets aligned with quality teaching and learning and based in teacher presence, student engagement and interaction, student cognitive and social presence, and assessment of performance.”*

From this definition emerges the use of AI to create systematic learning analytics that lead to tactical interventions by online teachers/designers, thereby improving and validating not only pedagogical design and student support, but also student learning. From a practical standpoint, innovative design and support features would cover data gathering activities that were previously done manually. This is not replacing the teacher through automation; in fact, it is creating more time for the instructor to analyse data sets and make formative changes to instructional design and delivery as appropriate.

### **Algorithmic Decision-Making as a Pedagogical Tool**

We propose pedagogy as the deliberate and strategic structuring of teaching and learning activities, resources, and sequencing to facilitate and evaluate learning (Prinsloo, 2016). Underpinning this notion of pedagogy are four activities: noticing or sensing student behaviour and engagement, processing the information, adapting the pedagogical approach based on group or individual behaviour or performance, and continuously monitoring the impact of the change in pedagogical strategy or adding activities or resources on student learning. These activities resemble Danaher’s (2015) four essential components in human decision-making: *sensing* (the collection of data from one or a variety of sources); *processing* (organising collected data into useful chunks/patterns as related to categories, goals or foreseen actions); *acting* (using the processing outcome to implement a particular course of action); and *learning* (flowing from the previous three actions, the system learns from previous collections/analyses and adapts accordingly). For example, within the online classroom, the educator may notice that a particular student is not engaging, e.g., has not submitted an assignment or responded to a question. The educator then *processes* the information (classifying the student as at-risk of failing and/or in need of follow-up), *acts* (sending the student a query pertaining to the non-submission), and *learns* (making sense of whether the query changes the student’s behaviour). As level of difficulty increases with the number and intensity of activities, structured engagements, and readings, educators may struggle to notice certain behaviours and to respond timeously to students at risk of disengagement and/or failure, thus justifying the use of learning analytics (Prinsloo, 2017).

## **Brief Notes on our Methodological Design and Norms**

Collaborative ethnography entails the basic and accepted principles of traditional ethnography, but acknowledges the reiterative processes between researcher and/researchers and their research communities to collect, make sense, and understand data. For example, May and Pattillo-McCoy (2000) describe collaborative ethnography as “useful for providing a richer description, highlighting perceptual inconsistencies, and recognising the influence of ethnographers’ personal and intellectual backgrounds on the collection and recording of data” (p.65). Seminal collaborative ethnography is the recognition of the subjectivity of experiencing the same phenomenon, and the fact that sensemaking of reality in a particular collaborative research context is “ultimately unstable and personal” (May & Pattillo-McCoy, 2000; p.66). This raises a particular obligation of researchers doing ethnography to interrogate our narratives and the writings co-produced and collected (Fine & Weis, 1996). Seminal to collaborative ethnography is researching “the *same social phenomenon*... but from *different social settings*” (May & Pattillo-McCoy, 2000; p.66). Collaborative ethnography focuses on the biographical and context-specific factors of each collaborating researcher as a key element in the collection, analysis and interpretation of data (Belgrave & Smith, 1995). Core to this collaborative ethnography is that it was in its core *accidental*, described as “the systematic analysis of prior fieldwork. It utilizes extant data ‘accidentally’ gathered ... to provide insight into a phenomenon, culture, or way of life” (Levitan, Carr-Chellman, & Carr-Chellman, 2017; p.1). Accidental collaborative ethnography describes the reflective process when “practitioners often discover important phenomena that could contribute to research knowledge and organizational improvement, if explored rigorously, reflectively, and practically” (Levitan, Carr-Chellman, & Carr-Chellman, 2017; p.3). Collaborative ethnography not only makes room for different interpretations of and knowledge influencing the interpretation of a particular phenomenon, but also acknowledges “asymmetries among persons working together which shape their joint endeavors” and how the interpretation is entangled in emotion that “deepens the challenge of working together and trying to share knowledge and negotiate power relation (McCabe, & Cultural Connections, 2014; p.13). For a full discussion of collaborative, accidental ethnography also see e.g. Fuji (2015), Lassiter (2005) and Poulos (2009).

## **Trustworthiness and Ethics in Collaborative, Accidental Research**

As already stated, collaborative ethnography foregrounds context-specific factors as well as unique biographical details and experiences of collaborating researchers as key elements in the collection, analysis and interpretation of data (Belgrave & Smith, 1995). The beauty of this is that differences in interpretation of data are not only appreciated but also *foregrounded*. Instead of differences being seen as eroding the trustworthiness of the

analysis, the transparency regarding the differences confirms the trustworthiness. Core to the notion of trustworthiness in collaborative research is the notion of trust – “When people come to trust each other in collaborative settings, a favourable milieu for validating sources of knowledge brought by other team members comes into existence” (McCabe, & Cultural Connections, 2014; p.14). Core to collaborative ethnography is that researchers should “situate themselves in the study by revealing their background and personal perspectives, theoretical stance, style of interaction, political aims, and understandings acquired through the research via ongoing journaling, with participants in dialogue, and in the research write-up” (Lapadat, 2017; p.591). The researchers (one female, and two males) were from different geopolitical contexts (Germany, Romania and South Africa), all with extensive experience in various aspects of OTL ranging from teaching and leadership, management and research. With regard to the ethical issues in collaborative (auto)ethnography, Lapadat (2017) writes that it “adds a multidisciplinary lens to inquiry, thereby reducing the likelihood of criticisms about lack of rigor, narcissism, or self-indulgence” (p.599). Except for realising the potential of multiple perspectives, collaborative ethnography also “provides a structure to support witnessing” and “flattens power dynamics in the team because all the coresearchers are vulnerable in sharing their stories” (Lapadat, 2017; p.599).

## **Research Context and Data Sources**

The authors were all part of an online course in a postgraduate programme at a German public university. The 15week course was an introductory course covering the broad scope of established principles, theories and practices in the use of technology in OTL. All students were practicing faculty and administrators from one university outside of Europe. The first cohort consisted of 10 students (Case 1) taught by one primary instructor assisted by a mentor, and the second of 12 students (Case 2) co-taught by the primary instructor from the previous semester and another instructor, assisted by a mentor. Instructors delivered instruction through highly structured online discussion forums and providing formative feedback on 13 learning activities, which were then incorporated into a final portfolio used as the primary assessment. Automated learning analytics included when and how often students logged into the course, and number of student posts; all other data was manually extracted from the course. In his work of sources of data, Kitchin (2013) refers to three sources - directed, automated and volunteered and all these three sources were available to instructors. Data collected from and provided by students at the point of registration equals directed data as source while the students volunteered data in the profiles and shared written introductions and short introductory videos of themselves. Student posts and responses in the discussion forums also provided some understanding of their engagement with the materials, applications to their respective contexts and



## **How Do We Know They are Learning? Student Data and the Synergies of Human and Artificial Intelligence (AI)**

sharing opinions and insights regarding fellow students' posts. Only the instructors also had access to basic login data consisting of the date and times of student logins which resembles the 'automated' data category. From these data sources instructors could make sense of how students were progressing through the course, the depth of their understanding and, to some extent, the depth of their engagement in the course.

While the same instructional design was used in both cohorts, and the two cohorts both consisting of students of the same institution and context, the first cohort (Case 1) was, from the start actively engaged and almost hyperactive (222 posts) resulting in the instructional team sharing notes of how difficult it was to keep up with the group. During the same period, the instructors posted 234 posts broadly categorised as teaching, social and cognitive presence. The learning and behavioural data (e.g. online engagement, quality and frequency of the posts) provided the instructional team with enough data to assess students' progress and the effectiveness of the pedagogical structure and strategy. The second cohort (Case 2) presented a very different scenario. Some students in the group only started posting introductions in the second week of the 12 week course, and the instructors sent supportive reminders via email, encouraging engagement and offering support. Data available made it difficult for the instructional to assess student progress and whether students were in fact learning. Of the cohort of 12 students in the second case, two students contributed almost half (98) of the total number of posts (209). Posts from the instructional team numbered 218. Despite numerous instructional interventions, nothing seemed to make a difference to the level and quality of engagement in Case 2. Student login data confirmed the lack of engagement by the majority of students. Data used in this collaborative ethnography included archived email communication of and between instructors, archived login data, memories and collaborative storytelling, shared reflections and recalling as "a way of bringing out memories about critical events, people, place, behaviours, talks, thoughts, perspectives, opinions and emotions" (Chang, 2013; p.113). Looking at this data retrospectively, the researchers reflected individually and collaboratively on the potential to AI in OTL. We shared these reflections in emails and in the various drafts of this paper.

### **Emerging Analysis and Findings**

Throughout the two cases, the instructional team communicated via Skype, group and individual emails, and telephone calls. Notes from these meetings, calls, and emails spanning the time period covering both cases formed the basis for this emerging collaborative ethnography. The purpose of this paper is *not* to present the full analysis of these collected data and collaborative, accidental sense-making, but to use background,

## How Do We Know They are Learning? Student Data and the Synergies of Human and Artificial Intelligence (AI)

context and data as the basis for presenting a framework for AI in OTL. Main themes that emerged from the analysis are shown in Table 1.

Table 1: Main themes in collaborative ethnographical analysis

Instructional Team	
Case 1	Case 2
<b>Theme: Making use/sense of login data</b> "Most students have logged in at least once and it is looking good" (Instructor A email end of the first week) "The login data really assisted me to compile the mid-semester report" (Instructor B email, 5th week) <b>Theme: Making use/sense of discussion post data:</b> "Have you seen the latest response by Sandra (pseudonym)? She has really keeps going and are responding to all the other students' posts, often more than once" (Instructor B email, end of week 4) <b>Theme: Instructor experience</b> "Ugh. I just cannot keep up with this group – this is intense!" (Instructor B email end of the second week) "This counts most probably as once of the most rewarding but also exhausting experiences I've had in teaching online. It was like teaching one-on-one for every day for 12 weeks!" (Instructor B email, end of week 9)	<b>Theme: Making use/sense of login data</b> "I checked the login data and some students have not yet logged in once" (Instructor A email end of the first week) "Nothing is happening. They are simply not even checking in" (Instructor A email end of the third week) "Give them time. Though I share your concerns, let us not get impatient. I am sure they will rise to the occasion" (Instructor B to Instructor A end of the third week) "Dear ... according to our view of your login data, we see that you have not logged in for the last 7 days. Is there anything we can assist you with?" (Instructor A email to student) <b>Theme: Making use/sense of discussion post data:</b> "What is happening? Where are the students?" (Instructor B email end of the second week) <b>Theme: Instructor experience</b> "What more can we do? I check the login data every morning just to see which students made an attempt and I reach out to them to see if I can help, but there is just nothing. I am starting to despair" (Instructor B email end of the third week) "This is simply the worst experience I've had of teaching online. Nothing we do makes a difference. This is a nightmare" (Instructor B email, end of week 7)

## Main Findings from the Login and Response Data

Most students logged in at least once in the Very few students logged in during the pre-week. Even during the week preceding the beginning of the first official week of the course, only two students posted the course. Most students logged on every day, required introductions and introductory videos. By the 4<sup>th</sup> week and several students responded to several some students still have not posted the introductions and of fellow student post introductory videos. The majority of students logged in only once every third to fourth day, if not once a week. The level (number of posts) and quality of engagement were, in general dismal excluding the sterling work by two students. In follow-up emails and telephone

## How Do We Know They are Learning? Student Data and the Synergies of Human and Artificial Intelligence (AI)

calls, students complained about accessing and navigating the site, finding the required readings and uploading the tasks and assignments.

While the two cases analysed can be portrayed as two ends of a spectrum, a very active, engaged classroom on the one end and a very unresponsive class on the other end of the spectrum, the final academic outcome of these two cases were not significantly different. The seeming similarity in the outcomes of these two courses, is, however, not the focus of this paper. It is also not the purpose of the paper to speculate on why students, from the same institutional context, responded so differently to the same learning design, cognitive, social and teacher presence, and assessment strategies. Of interest in the scope of the potential of AI in OTL is the *data* the instructional team had access to, how the data informed their strategies and how AI could have *supported* teaching and learning. In both cases, the instructional team observed and sensed certain behavioural behaviours, processed what the behaviour meant, acted, and learned (see our earlier reference to the work of Danahar, 2015).

### Towards a Framework for AI in OTL

In an attempt to bring clarity to the experience, instructors developed a conceptual framework based on the literature and their experiences in understanding the role of learning analytics in adapting and customizing pedagogy to improve the learning environment, Figure 1 presents this conceptual framework, which incorporates components of Garrison, Anderson and Archer's Community of Inquiry (CoI) (2000): teacher, social, and cognitive presence. The outer ring details the design infrastructure necessary for AI (technical-digital systems) to set the parameters for gathering data sets within the next inner ring.

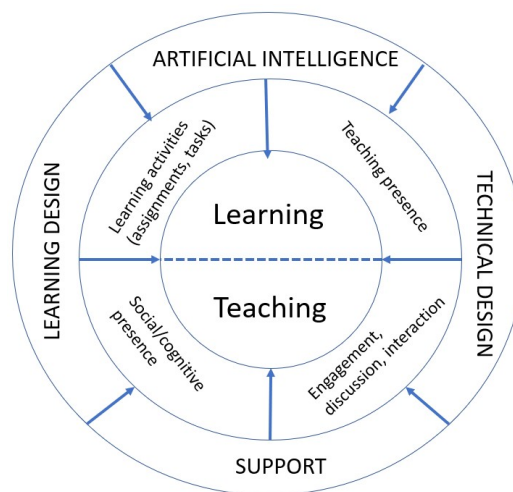


Figure 1. A Framework for AI in OTL

**How Do We Know They are Learning? Student Data and the Synergies of Human and Artificial Intelligence (AI)**

In the second ring are the key data sets: (a) learning activities (login data, cognitive depth and understanding in participation in discussion forums; assignment data); (b) teacher presence (discussion posts, responses to student posts, emails to individual students); (c) student engagement and discussion (number of original posts and responses; network with fellow peers) and (d) student social and cognitive presence (evidence of reaching out socially or cognitively). The data underpinning these four “inner” elements in the nexus of teaching and learning have been confirmed in research (Garrison, 2016; Rockinson-Szapkiw, Wendt, Whighting, & Nisbet, 2016; Wicks et al., 2015). We propose that these four elements can furthermore be embedded, related to, and interdependent on learning design, student support, technical design and AI. General observations in leveraging these data sets for subsequent learning analytics use and interpretation include:

1. Increased engagement and quality discussion interactions (teacher to student, student to student, student to content, student to self, student to community) can lead to deeper learning and critical thinking amongst students.
2. Performance validates knowledge and understanding, measures learning, is directly related to content knowledge and mastery, and is a valid and reliable measure of learning.
3. Cognitive presence is more than student interaction with content; it is also an extension of Piaget’s (1932) constructivist theory of Cognitive Adaptation where students can assimilate and/or accommodate new knowledge into existing cognitive schemes (knowledge banks) and apply that knowledge to practical realworld situations and scenarios.
4. Student social presence in the online classroom is a general indicator of engagement, knowledge, and learning, with learners constructing their realities and learning from social relationships and interactions; students’ social engagement may be linked to greater motivation and psychological comfort in the online classroom, making them feel a part of the group, course, and institution.

Central to realising the potential of learning analytics is the collection, analysis, measurement and analysis of student data. But as we have stated, the complexity of data, as well as the amount of data especially in large classes, may make human sensing, processing, acting and learning increasingly impossible. Danaher (2015) notes a possible solution by mapping the intersections between human and algorithmic decision-making by pointing to the many (256) different possibilities considering when humans are on their own, or humans are together with AI, or AI with humans who supervise, or AI who independently engage with data – sensing, processing, acting and learning. For example, an algorithm can sense that a student has not logged in for a week and alert the instructor

who will make sense of the data, and act by sending an email. Or, the algorithm can sense, process, and act on its own, and only alert the human educator if there is no behaviour change. The two cases discussed above visa-vie AI and selected for learning analytics are consistent with the basic purpose of this paper – AI + learning analytics + interventions = improvements of learning (students) and improvements for learning (teachers). Moreover, teachers and designers may opt to target other data sets pertinent to student behaviours and learning which in turn may influence the specific algorithms chosen. The framework above is a conceptual starting point that draws upon data categories that have been supported in previous empirical study and theory.

How do these factors play out within the context of serving as AI data sets in online classrooms? First, engagement and interaction can be easily measured by student presence in the classroom. In reviewing the numbers in the two cases presented, it would seem that students posted about the same (Case 1: 222 posts; Case 2: 209 posts); however, here we must dig deeper to determine the significance of the data. In Case 1, this scenario may have eased some of the instructor responsibility by making sense of login and posting data and alerting the instructors. Though the student cohort was relatively small, the intensity of the course (both intellectually but also in terms of tasks and assignments) and the flurry of activity meant that the instructor could easily have missed the data. AI could also have supplied some insights in cognitive density or network analysis to assist the instructors making informed pedagogic decisions. We suggest that deeper dialogue and application of knowledge (cognitive presence) is a stronger measure of student learning than infrequent posting and short posts supporting another student's strong posts. Students who contribute moral support to other student posts in discussion forums is admirable, but this is not the same as students who post deep, content based, practical posts in discussion posts. Mutual support is important, but this is not deep learning and analysis. The quality and depth of students' discussion posts is a reflection of their cognitive presence. Students who do the readings, reflect upon this content, assimilate it within their existing cognitive structures then move to discussion posts that reflect valid learning particularly if the student can extrapolate the key concepts to real world practical examples and scenarios. In sum, this means as teachers we must analyse the quality and depth of discussion interactions, not just how many.

Thinking through the potential of AI in a *relative data-poor* context like the one presented in the second case (discussed above) is more difficult. Student engagement is weak if the only measure is how many times the student enters the classroom or how long they are in the classroom. It is also crucial to note that the fact that students do not engage does not, necessarily mean that they are in trouble or not learning. Teacher presence is also a factor and can also be easily established based on analytics. However, here again, we must dig

deeper into the context – and those activities that occur “behind the scenes” (e.g., e-mail interventions). AI can leverage technology to help teachers monitor just what and when students enter the classroom which in turn create data patterns that can validate learning and initiative specific interventions to improve the learner experience; underpinning increasing the potential of AI is, however, the need for students to login. As can be seen from the analysis, the instructors were closely watching the login data to process and act on the information, with no visible impact on student engagement. Data that the instructors did not have access to that may have informed pedagogy and support are, for example, whether students have downloaded the prescribed resources, watched (and finished watching) the prescribed videos, established patterns between login data and moving around on the course site. This data, and use of AI, may have added our understanding of their learning journey. We often assume that if students are not engaging, they are not learning, but as the comparison of the course outcomes suggest, there was no significant difference.

## **Conclusion**

Appropriately and ethically designed AI for OTL can lead to pedagogical interventions in online learning that can produce improvements *in* learning (students) and improvements *for* learning (teachers/designers). Moreover, this synergy of AI and data is consistent with empirical research – data matters – design matters – formative interventions matter – and engagement and interaction in the learning process – matter. Within the proposed definition put forward in this study of AI related to online learning in concert with the framework outlined in Figure 1, refinement of this framework has implications for future research. What is the potential of AI to scale understanding, feedback and support? What ethical considerations and regulatory (GDPR) issues may emerge around online learning? (Prinsloo, 2017) How do the three “Cs” of context-culture-communication enhance or create barriers to the AI-data synergy? Indeed, AI + data + pedagogical interventions may, in fact, create a brave new learning world for online learning students and teachers.

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## DIGITAL EDUCATION, WORK AND ARTIFICIAL INTELLIGENCE: HEALTH AND LAW

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### Abstract

The use and possibilities of artificial intelligence (AI) have been assuming great importance in recent years. This fact led to a greater attention on the topic in various fields, especially in health and law, both in its daily application potential and in learning methods. The aim of this article was to present a brief perspective of the challenges and effects of the AI use in teaching and application on health and law domains. Therefore, to better define the theme it was performed a qualitative methodology of bibliographic review. The applications of artificial intelligence have a great potential in clinical and legal use, facilitating the tasks of those involved by helping to reduce workflow, to avoid errors and in decision-making. However, despite these benefits and new opportunities, there are still obstacles regarding regulation and ethical concerns, as well as some reluctance from professionals in their adoption and formal application. In addition, there also the need to proper implement these technologies in learning to keep up the change and the new challenges currently posed, so there is a path that still needs to be followed.

### Introduction

In 1956, at an event entitled “Dartmouth Summer Research Project on Artificial Intelligence”, at the University of Dartmouth (Hanover, New Hampshire), the term Artificial Intelligence (AI) was probably used for the first time. The definition given pointed out that AI intended to make machines capable of learning and performing certain functions that are normally made by humans (Pinnock, McDonald, Ritchie, & Durning, 2020). To humans, the process of evolution is slow and continuous, from generation to generation, while machines do not have that. In intelligent robotics, which we usually call *cognitive robotics*, there are already experiences of configuring the machine, its hardware and software, adapting it to the context. For example, in 1959, the Checkers program relied on a process similar to genetic algorithms to learn, over time, playing against yourself. The aim of this article was to present a brief perspective of the challenges and effects of the AI

use in teaching and application on health and law domains. There are many definitions of AI in literature. For example, AI is the activity devoted to making machines intelligent, being intelligence what enables an entity to function appropriately and with foresight in its environment. Moreover, AI is the field of computer science dedicated to solving cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition. AI is also the theory and development of computer systems capable of perform tasks that usually require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages (Chassignol, Khoroshavin, Klimova, & Bilyatdinova, 2018). Goksel and Bozkurt (2019), in their article, present more definitions of AI given by several authors. Therefore, to better define the theme, it was performed a qualitative methodology of bibliographic review.

### **Main context of artificial intelligence (AI)**

There are three approaches to AI: strong AI, weak AI, and pragmatic AI. Through the first approach, it is believed that the computer can think in the same way as humans. According to weak AI, the computer would only need to act as if it were smart. In the pragmatic approach, it does not matter if the machines look like humans or not, but what use can be made of them.

Recent achievements coming from AI tools provoke increasing curiosity, generating some discomfort, especially about the possibility of AI replacing human work or the possibility that the machine may think like a human. The idea against treating robots like humans rests on epistemological and ontological arguments. These arguments relate to whether machines can think (they cannot think properly; they react to the input information inserted by humans) and what to be human means. It may be easy to assume that AI is rapidly becoming super intelligent, and gain all the good and evil powers awarded to it in popular culture, which is not the case. AI systems are very limited, and there are technical, social, scientific, and conceptual limits to what they are able to do (Tuomi, 2018). AI companies continue to find ways of developing technology that will manage laborious tasks in different industries for better speed and accuracy. Now, software code controls our lives. Is Man playing gods?

### ***Vital technologies using AI***

Firstly, let us say that AI is an umbrella term, so it has sub-branches, like Machine Learning (ML). AI is a concept that points to the direction we are headed, not a position we have already reached; therefore, we need to specify it more precisely, with notions like ML. At the most primary level, machine learning search to develop methods for computers to improve their performance at certain tasks based on observed data to make future

predictions enabling the extraction of meaningful patterns from examples, which is a component of human intelligence (Erickson, Korfiatis, Akkus, & Kline, 2017; Goksel & Bozkurt, 2019).

In second place, Deep Learning (DL), a most recent domain of AI enables computers to learn and detect patterns in data without being explicitly programmed (Carter et al., 2020). Thirdly, the idea of machines having the same characteristics of human intelligence induces the sense that we are in a science fiction movie, being unable to decide whether the person with whom we communicate is a real person or instead a virtual device, is indeed evidence that DL has taken place in science (Goksel & Bozkurt, 2019).

In fourth place, Natural Language Processing (NLP), also known as computational linguistics, is a subfield of computer science, which uses computational techniques to learn, understand, and produce human language content. The assistants are used to complete a task controlled by software which has an expanded and optimized database algorithm.

### ***The impact of AI on learning, teaching and education: challenges and opportunities***

Computing can provide the personal services of a tutor accessible to all schoolchildren, teens and adults. Digital education can bring efficiency gains provided by automation and intelligent tutoring. Automation represents a superior ability to achieve desirable goals such as the personalization of learning, flexibility and support of social learning. One of the challenges while teaching students is that everyone has a different “momentum” of learning and understanding of instructions and therefore, those who are already ahead of the material could easily be bored, while others might be completely lost in new terms and phenomena. AI provides a possibility to avoid this problem, namely, by the use of personalized learning (Chassignol, Khoroshavin, Klimova, & Bilyatdinova, 2018).

Nevertheless, it is ironic that the taking into account a student’s personality, style of learning and level of engagement is posited as a goal for the next few decades of education, when human teachers have been largely adept at working to this particular configuration of need for decades, if not centuries (Bayne, 2015).

Recently, countless different interactive educational technologies are becoming popular as students use tablets instead of copybooks, teachers utilize different learning platforms such as Google Classroom, Edmodo, Power School, Moodle and there are a large number of Massive Open Online Courses (MOOCs) for the online study such as coursera.com being accessible 24 hours a day, whenever you want to revise information (Chassignol et al., 2018; Khay-Guan, 2019)

However, teaching methods and means of assessments remain traditional being represented by lectures, laboratory works, practical exercises, tutorials. Alternatively, students need to drive the conversation, and adapting to new information as the discussion moves forward. Instead, projects, exams, class participations are used in the same course, which gives an opportunity to deliver more objective grade (Klimova, Bilyatdinova, & Karsakov, 2018). Automated methods are not undesirable (on the contrary, the computational turn in education is fundamental), but the terms on which they are proposed are driven by a productivity-oriented solutionism which has been critiqued for decades now (Bayne, 2015).

Teaching in higher education needs to assume the big questions addressed by critical post humanism. How can we continue to value teaching within an algorithmic culture established by the new potentials of computation and digital data? Teacherbot embodies one way of approaching this question and others (Bayne, 2015). However, where does it leave the human teacher? Let us say that any teacher that can be replaced by a machine should be a teacher.

While a human instructor often works one-on-one, for a specific duration and in constrained spaces, interactive learning environments can be cooperative, omnipresent, and portable. Simply speaking, Interactive Learning Environment (ILE) have unique affordances that human instructors do not, and the next generation of systems should influence those affordances to support learning anytime, anywhere, by anyone (Roll & Wylie, 2016).

The speed of technological change will be very fast, and it will generate high pressure to transform educational practices, institutions, and policies. It is therefore imperative to understand the potential impact of AI on learning, teaching, and education, as well as on policy development since AI could make some functions of education obsolete and emphasize others, potentially enabling also new ways of teaching and learning (Tuomi, 2018). AI can be used to stimulate personalization and better learning outcomes, being also important to regard Data analytics in Education Management Information Systems (EMIS) and the evolution to Learning Management Systems (LMS) (UNESCO, 2019).

AI is now often called *the next electricity*. The transformative impact of general-purpose technologies, like AI, however, becomes visible only gradually, when societies and economies reinvent themselves as users of new technologies. Technological change also brings social and cultural change that is reflected in lifestyles, norms, policies, social institutions, skills, and the content and forms of education (Tuomi, 2018).

Another important point is that intelligent tutoring systems create a digital profile of a student and provide him with a personal tutor that, again, should increase productivity

inside a classroom and out of it. Such digital portfolios of learned subjects and topics can be great as well to help employers (Chassignol et al., 2018).

## **Artificial intelligence in health: work and education**

### ***AI applications in medical fields and health practice***

Fuelled by advances in computing power, data availability, and machine learning techniques, applications of artificial intelligence (AI) are rapidly increasing in a wide range of medical fields for varying purposes (Allen et al., 2019; Becker, 2019). One of the most promising areas of health innovation is the application of artificial intelligence (AI) in medical imaging emerging as one of the most important topics in radiology today (Chan, Bailey, & Ros, 2020; Pesapane, Codari, & Sardanelli, 2018). This is due in part to the remarkable progress in image-recognition tasks, which in recent years has seen growth in the amount of sufficient digital data accumulation and availability as well as significant computational power (Mintz & Brodie, 2019). In addition, that is fairly motivated by the recognition of the significant frequency and clinical impact of human errors in radiology reporting, and the promise that AI can help improve the reliability as well the efficiency of imaging interpretation and analysis.

Artificial intelligence is also being widely used in clinical cancer research due to its feasibility and advantages as well as allowing to perform robotic surgery and to provide personalized treatment plans helping patients and to decrease costs (Aminololama-Shakeri & López, 2019; Geis et al., 2019; Huang, Yang, Fong, & Zhao, 2020; Lakhani et al., 2018). An increasing number of studies illustrate the potential for dramatic changes with the use of AI since image recognition technology might make predictions or recognize diseases as effectively as or even better than physicians showing AI algorithms matching human performance in medicine (Krittanawong, 2018; Mazurowski, 2019).

Current algorithms of artificial intelligence, have been used for several challenging tasks, such as pulmonary embolism segmentation with computed tomographic (CT) angiography, polyp detection with virtual colonoscopy or CT in the setting of colon cancer, breast cancer detection and diagnosis with mammography, brain tumour segmentation with magnetic resonance (MR) imaging, and detection of the cognitive state of the brain with functional MR imaging to diagnose neurologic disease) (Erickson et al., 2017). When applied to chest radiograph (CXR) reading, these algorithms are able to detect up to 14 common anomalies such as: lung nodule diagnosis, tuberculosis diagnosis, detection of pneumonia and detection of common chest radiograph anomalies (Chassagnon, Vakalopoulou, Paragios, & Revel, 2020).

One of the first fields of medical imaging that benefited from the introduction of machine learning algorithms techniques was breast imaging (Carter et al., 2020). In the past years

many studies have been developed about the usage of deep learning algorithms concerning breast cancer detection and identification, including the one by Rodríguez Fernández et al. (2019), that compared the stand-alone performance of an AI system to that of radiologists in detecting breast cancer in digital mammography (DM) where the AI system achieved a cancer detection accuracy comparable to an average breast radiologist in this retrospective setting having higher performance than more than half of the radiologists.

### ***AI applications in medical and health education***

AI will have a direct impact on every aspect of our lives, and there is no reason to believe that medicine and medical education will be spared, being educators' responsibility to prepare themselves and the students for the future with AI, so that quality healthcare can be delivered (Masters, 2019). To date, AI technologies have been used in the medical field by improving clinical workflows, risk assessment, and training (Sheikh & Fann, 2019).

Technology can be seen in two facets: firstly, how technology supports or assists medical education, and second, how it supports and changes the face of healthcare itself (Khay-Guan, 2019). As with other investigations used in clinical practice, students will need to understand evaluative measures such as the recall (sensitivity or the probability that a machine correctly identifies all true positive matches) and positive predictive value (precision or the probability that an outcome categorized by a machine as a positive match is indeed a positive match) of the machines they are using (Pinnock, McDonald, Ritchie, & Durning, 2020). Even so, technology is already transforming medical education as it serves as a mean to engage and interact with students, broadens networks and allows collaborative work, enables personalized medical education and acts as a leveller (Khay-Guan, 2019).

Technology allows the students to personalize medical education since each one can pick an individual scheme of learning, choosing their own materials, including on other medical schools, widening access to those less privileged populations that can access online learning (Khay-Guan, 2019).

As one of the first sub-specialties to broadly discuss the impact of AI on medicine, radiology should therefore take the lead in educating undergraduate students on these emerging technologies, emphasizing the specific challenges that may lay ahead. More specifically, basic knowledge of the technical background of AI in medicine and radiology should be conveyed in terms of what data are needed for which type of task and how AI algorithms should be evaluated (Pinto dos Santos et al., 2019).

### ***Ethical considerations of artificial intelligence in health***

Although AI technologies are attracting substantial attentions in medical research, the real-life implementation is still facing obstacles, being regulations the first hurdle (Jiang et al., 2017). Several medical ethics theories described for human beings are being considered (consequentialist, deontological, virtue, among others) as well as the implications of their use within a machine in order to identify the best way to describe and adapt values from humans to machines (Keskinbora, 2019). Therefore, ethical challenges of AI will need to be addressed, including algorithms mirroring human biases, using information on diagnosis or treatment that is not based on adequate evidence and managing the extensive amount of data collected from patient records to preserve patient privacy (Pinnock et al., 2020). AI systems should privilege “data minimization” using only what they need and delete it when it is no longer required, encrypt data in transit and at rest and restrict access to authorized personnel “access control” (Keskinbora, 2019). The ethics of data are fundamental to AI in all the specialties, especially in radiology and reflect trust in acquiring, managing, and assessing data (Geis et al., 2019).

### **Artificial intelligence in law: work and education**

#### ***AI applications in law practice***

Jurists see the relationship between computing and law as something extremely recent. The legal area implies the scientific foundation of politics and law. Reasoning in law can be reduced to computation, which applies not only to numbers, but also to any area of knowledge, since logic, in law, is about adding words to create affirmations and affirmations to form syllogisms. Law is a combination of concepts, and the identification and combination of the most basic concepts would be the key, so that the solution of any conflict could be reduced to a calculation on the possible combinations of the presence and absence of those concepts in the case description.

AI’s current legal applications help lawyers to perform due diligence and research, and provide additional insights and shortcuts. More specifically, AI’s applications can serve: due diligence, helping to uncover background information; prediction technologies, generating results that forecast a litigation outcome; legal analytics, with the use of data points from past case law, win/loss rates and a judge’s history; document automation, in order to create templates and filled out documents based on data input; intellectual property, so that lawyers can draw portfolios and insights from the content; electronic billing, so that billable hours are computed automatically.

The legal professional who knows how to face AI in order to optimize his work will surely be a better lawyer. The great challenge of research in AI in judicial work will be to transpose it as a useful tool for the solution of conflicts without making it an aim in itself.



In this sense, the use of AI in data search systems, decision-making processes and writing of contracts, for example, must be done with critical reflection. AI will never be enough to solve the problems of our legal culture and we must be careful, even, that it does not deepen them by creating false expectations that, at some point, automatism may release us from thinking.

### ***AI applications in law education***

AI is largely applied to the representation of knowledge and inferences of intelligent agents. There are different logics to represent different dimensions of these processes. For these purposes, it is important that research and university education are open to interdisciplinary and the combination of these sciences, mathematics and law. The novelties powered by AI promise to expand the database access and management capacity; offer better tools for the production of court decisions, petitions and agreements; decrease operating costs and expenses and even the same, in law firms.

These ideas about the progressively more use of technology in law (Legaltech) and also about the way we are working today and will work in the future, led us to the following: Law schools need to understand that the traditional profile didactic-pedagogical that until then provided success to the learning of its students no longer present themselves as the successful formula and the trend is towards the market increasingly demonstrates how retrograde and obsolete this proves to be (Raquel Hogemann, 2018).

It is important to highlight the fact that the use of processing technologies data and digital communication represented a vital gain for both lawyers and the judiciary as a whole (Raquel Hogemann, 2018).

### ***Ethical considerations of artificial intelligence in law***

Ethics is a philosophical discipline, linked (or complementary) to law that studies good and evil and their relationship to morality and human behaviour. Ethics is an idea, a structure or a model of thought and action, a unique concept in abstract terms, but with a variable scope and content. The reason is that the concepts of good or evil, the idea of morality, and models of human behaviour are not perpetual, rigid, or static, but evolve over time and through space (Robles Carrillo, 2020). There is neither a basic social conscience nor a solid and sufficient political determination to face the AI challenge, just as there is also no common language or unique methodology about its uses, skills and objectives. AI can have a positive or negative impact, or both, at the same time, for different audiences or from different perspectives, not having uniform or unanimous assessment of its advantages and/or disadvantages or how to manage them. Overall, the debate is being placed between resistance to change and the sublimation of change implied by AI (Robles Carrillo, 2020).

## Conclusions

The purpose of this article was to present a brief perspective of the challenges and effects of the artificial intelligence use in teaching and application on health and law fields. AI is already been used and has a great potential in clinical and legal use, facilitating the tasks of involved professionals by helping to reduce workflow, to avoid errors and in decision-making. Concerning teaching and learning, digital technology allows students to personalize education using individual organization and promotes equal opportunities. Tutors and institutions need to properly implement, incorporate and promote these technologies in academic curricula. Despite the reported benefits and new possibilities, there are still hurdles regarding regulation and ethical concerns, as well as some reluctance from some professionals in the adoption and real use of AI systems. In order to keep up with the challenges currently posed, there is still a path that needs to be followed. This article will serve to offer a contribution on the discussion about a topic that has been progressively more debated between the scientific community and the general population since the use of such technologies are already present in our everyday lives in a present way.

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## **DIGI-HE – A STRATEGIC REFLECTION TOOL ON DIGITALISATION AT EUROPEAN HIGHER EDUCATION INSTITUTIONS**

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### **Abstract**

Digitalisation is an issue of growing importance at all higher education institutions (HEIs). It is often developed and driven bottom-up. In this regard, the intended self-assessment tool that the present paper aims to present “DIGI-HE” will support higher education institutions in developing their individual approaches to foster digitisation, methodological and conceptual approach. The present paper will outline the methodological procedure of design and subsequent validation of the tool. In a time when experimentation with, and mainstreaming of digital technology use is progressing to develop holistic strategies that encompass learning and teaching, research and innovation, as well as cooperation and outreach DIGI-HE will represent a self-reflection tool adapted to higher education to support the institutional efforts, to develop and implement strategies, which purposeful and holistic in comprising both missions, education and research. It will also furthermore attach particular importance to the need for dialogue among all actors and stakeholders in digitalisation, and address areas of activities relation to cooperation and outreach, including internationalisation strategies and practices.

### **Introduction**

Digitalisation is an issue of growing importance at all higher education institutions (HEIs). It is often developed and driven bottom-up, i.e. by individuals and parts of the institution. Recent studies report progress regarding the increased general acceptance of digital learning and its strategic and more mainstreamed use. They show that a high number of institutions report that they develop or enhance their strategies (Ehlers & Schneckenberg, 2020; Gaebel et al., 2018; p.60). Since digitalisation is often driven by individual actors within institutions such as staff or departments, it develops bottom-up, often organically, based on concrete needs, hence not particularly strategic (Gaebel et al., 2014; Haywood et al., 2015; Ehlers & Schneckenberg, 2010; Ehlers, 2014).

For institutional leadership, the development of an institutional strategy, or a general holistic view on the progress of digital transformation and organisational development in higher education institutions a valid concept and good measure is often missing. This is hindering digital transformation in higher education from an institutional perspective. For institutional leaders it is often difficult to assess the diversity of needs, to get an overview on what is in place, and thus to support strategic planning in this area accordingly. In this regard, the planned self-assessment tool that the present paper aims to present “DIGI-HE” will support higher education institutions in developing their individual and strategic approaches to foster digitisation. It is directed at leaders in higher education institutions. Such a tool already exists for schools, the SELFI tool, but not for HEIs and above all not at a European level (<https://ec.europa.eu/education/schools-go-digital>). Project funded by the European Union; project partners: Dublin City University (DCU), Duale Hochschule Baden-Württemberg (DHBW), Jyväskylä University (JYU), Vytautas Magnus University (VMU).

In this paper, we present the conceptual approach of the instrument (section 2). In section 3 we discuss the four methodological approaches, benchmarking, bench learning, peer review and self-assessment, which underlie the methodological approach of DIGI-HE. Finally, in section 4 we address the specific innovative aspects of DIGI-HE.

## **Conceptual Approach of DIGI-HE**

Due to their identity as professionals, self-evaluation procedures enable the evaluators to simultaneously assume the role of experts in the subject of evaluation and therefore to contribute their intimate and detailed field and process knowledge of the subject of evaluation. In contrast to evaluation procedures that are carried out by external experts, internal evaluation procedures, due to their self-determination character, are also associated with a high level of motivation and, as a result, a willingness to take up an active part of those stakeholders involved. As a result, they hold the great potential of a higher identification with the evaluation results. The evaluations and conclusions derived from the evaluation process are considered valid by the stakeholders involved, since they are assessed as adequate and validated in a dialogical process of communication. The willingness to translate the results into concrete actions can thus be increased.

The approach of developing and implementing institutional strategies, strengthen institutional leadership and enable participatory approaches has been tested successfully also in other thematic areas. For instance, in 2018, EUA together with its partners in the EU-funded EFFECT project, developed a self-reflection tool for the enhancement of learning and teaching in higher education, which took the form of an institutional strategies support package. As part of this self-reflection tool, guiding questions were

prepared for institutional stakeholders (leadership, academic staff), in order to assist them with a sustained reflection on how to improve learning and teaching practices.

The DIGI-HE will be built on existing tested, successful tools, the SELFIE tool for schools, and the DigCompOrg Framework. It will transfer the successful approach of the SELFIE and its lessons learnt from the school sector to the higher education sectors, thereby adapting it to the specific needs of the higher education institutions, considering other European and international instruments, which received sector recognition. This approach is hitherto not existent for higher education and responds to higher education sector needs. In order to ensure a broad and up-to-date knowledge of the needs of universities data on the strategic development of digitalisation in higher education institutions are gathered through a survey of higher education institutions. DIGI-HE will be based on new data on the state of play of and strategic development goals and challenges in digitalisation. The resulting knowledge will inform the development of the tool. This concept of approaching digitalisation from the angle of current challenges ensures that the tool will reflect the actual needs and demands of the sector and key stakeholders. As higher education institutions are in the process of taking up digitalisation, the need to develop more strategic and holistic approaches is commonly acknowledged, at institutions as well as at policy level.

In order to help individual higher education institutions to develop strategies and build capacity for digitalisation the tool will emphasize participatory approaches, in that it demonstrates the need and shows ways for involving the different parts of the institutions, staff and students, and external stakeholders into the process of digital strategy development and implementation. Thus, it will support institutions to develop their own, tailored approaches for digitalisation, in line with their mission goals and specific needs, and result into enduring, sustainable fit-for-purpose approaches.

The DIGI-HE tool aims to reflect a European perspective on digitalisation of Higher Education, accordingly the different systems in the individual European countries must be considered. The project consortium and the Advisory Board, which will be composed of experts, to bring together different complementary expertise, i.e. higher education institutions from different European countries, a national rectors' conference and major European organisations representing universities and colleges (EUA, EURASHE and EDEN). This will ensure the development of approaches and outcomes that will respond to the needs of diverse types of institutions from different countries.

## **Methodological approach**

DIGI-HE will be a self-assessment tool. Self-assessment in higher education is a well introduced method. However, it may be coupled with a peer-review in which institutions



are receiving reflections based on their self-assessment from peers outside the institutions. Both processes can well be used in a benchmarking and bench-learning exercise which can lead to inter-institutional learning processes.

This section reflects on the methods of benchmarking, bench-learning, peer-review and self-assessment that are used as methodological approach of DIGI-HE. DIGI-HE is based on four central methods for quality evaluation and validation that all have distinct characteristics and potential advantages and disadvantages. These methods benchmarking, bench-learning, peer-review and self-assessment need to be discussed briefly as a foundation for further development of DIGI-HE.

### ***Benchmarking***

Kamiske and Brauer (2003; p.10) summarize benchmarking as the process of measuring and comparing one's products, services or processes with the best competitors or with acknowledged market leaders ("best in class"). The target of benchmarking is to learn by comparing with others, to identify best practice and to adapt these methods, processes etc. for the own organisation to achieve improvement, and in the long-term, market leadership or excellence. Benchmarking originates from the field of reverse engineering that is related to physical products, but the concept has been transferred to services and processes. Camp (1989; p.15) highlights that benchmarking leads to objectives when best practices are transferred into targets that may in many cases be of a qualitative nature and indicate a direction of development in the longer term rather than exact (quantifiable) short-term operational targets.

According to Camp (1989; p.16), benchmarking is divided into four main stages, planning, analysis, integration and implementation with a concluding fifth phase: maturity. Planning includes the identification of the benchmarking object, organisations that should be included in the comparison as well as a definition of methods and execution of data collection. This phase includes a self-analysis or self-assessment that is already considered to be helpful to identify areas for improvement (Lemmergaard, 2009; p.182). In a second stage, gaps are identified and possible future performance levels identified. The third phase; integration, includes communication of results and setting of targets for the next phase; implementation. Within this phase, a plan for implementation is developed, the implementation is executed and results are checked. The closing phase maturity includes aiming for a leading position and integration of benchmarking into the organisation's processes (Kamiske & Brauer, 2003; p.15). There are a number of restrictions associated with benchmarking. First, learning from benchmarking is mostly concerned with the past as the "best in class" organisation or competitor has already achieved this level. Secondly, it is argued that there is high uncertainty in identifying the "best in class" organisation or

best practice. Only a step-by-step approach towards a relatively well performing organisation is supposed to be possible (Kamiske & Brauer, 2003; p.18). Lemmergaard (2009; p.182) suggests that benchmarking only focuses on current best practices and is not a source of innovation and possible future best practice. Becker and Gerhard (1996; p.784) also argue that one implicit assumption has to be made to consider benchmarking successful; best practice cases are not specific to one organisation but need to be generalizable to be transferable.

### ***Bench-learning***

Connected to benchmarking is the term bench-learning. According to Freytag and Hollensen (2001; p.26) who define bench-learning as the “process of learning from the ‘best in class’ with the purpose of integrating these best practices in all organisational levels of the company.” Benchmarking is the foundation and bench-learning is the learning process that follows it. Thought needs to be given to the issue of if, and how these identified best practices could be transferred to the own organisation as well as how skills and processes could be improved (2001; p.30). They also distinguish bench-action as the actual implementation of all changes that have been set as targets (2001; p.31).

### ***Peer-review***

Peer-reviews have high practical relevance for external evaluation as well as quality assurance and development according to Gutknecht-Gmeiner (2008; p.19). They are central within research and publishing of scientific papers (Weingart, 2001; p.284); on different levels within the field of education (educational systems, institutions, or levels of individual learners or teachers); in the fields of medicine, nursing, social work- and business-related professions, such as auditing (Gutknecht-Gmeiner, 2008; p.60).

Gutknecht-Gmeiner regards the classification of peer-review as a method of evaluation as rather complex (2008; p.51). Normally, peer-review refers to an external evaluation by experts that belong to a different organisation or, in some cases, may also be colleagues within the same organisation (for instance many cases of peer-review in teaching). This review is supposed to support an organisation or individual in its efforts on quality assurance and development. In contrast to other external evaluators, peers act on the same level, as they possess similar knowledge, experience and competencies as the evaluated individuals/members of an organisation and originate from similar organisations or contexts (Gutknecht-Gmeiner, 2008; p.51). An example is the evaluation of teachers by teachers or the fundamental peer-review culture in scientific publishing. Gutknecht-Gmeiner also mentions the synonym “critical friend” (2008; p.52) for a peer-reviewer that demonstrates the special relationship. Peer-review is also clearly classified as a qualitative method (that may also include quantitative data as a foundation for analysis). Gutknecht-

Gmeiner summarises that a peer-review may be used for both formative and summative evaluation purposes, depending on the specific review's design (2008; p.51).

The design includes the question about what exactly is reviewed by the peer-reviewers, and there are a number of options that differ in how close the review is to the subject of interest (e.g. an institution). A review could focus on the self-assessment report/results to assess if the report has been drafted well. The review could also be more detailed and comprise itself of a review of the data that is provided to prove the conclusions in the self-assessment report, and/or additional onsite visits and interviews with stakeholders could be performed by the peer-reviewers to access more data. Finally, the peer-review could focus on the subject of interest itself, for instance whether a teacher observes a colleague in a teaching situation (Gutknecht-Gmeiner, 2008; p.51). Gutknecht-Gmeiner (2008; p.51) summarizes that in practice, despite the fact that there are numerous possible designs for peer-reviews, the following procedures for a peer-review are well established: The basis for the review is formed by an extensive self-evaluation by the institution or individual, followed by the external evaluation that is, in many cases, accompanied by an on-site visit and leads to a final review report by the reviewers.

Peer-reviews are associated with a number of advantages. If conducted in a formative way, peer-reviews include a (mutual) learning possibility as the work together with the external expert may provide insights for improvement and development on both sides. Furthermore, peer-reviews are considered to have a relatively good cost-benefit ratio compared to an evaluation by potentially expensive and specially trained auditors. It is also assumed that colleagues or experts from the same field of expertise are perceived as more acceptable than external evaluators with possibly no expertise in the evaluated subject matter (Gutknecht-Gmeiner, 2008; p.23).

There are also a number of disadvantages and open questions discussed. Srciven (1991; p.255) considers peer-reviews to be “extremely shaky” and mentions (among others) halo-effects, a possible secret-contract bias or the fear of possible retaliatory action as problematic factors, but he sees a lot of potential for improvement. Furthermore, it is questionable whether peers always possess the necessary qualifications in the field of evaluation as well as communication, social and personal skills and whether they are in all cases as objective as reviewers who are not subject matter experts (Gutknecht-Gmeiner, 2008; p.23).

### ***Self-assessment***

Both benchmarking as well as a peer-review require a prior self-assessment by the organisation. Kamiske and Brauer (2003; p.18) consider (in a broader context) a self-assessment to be a regular and systematic analysis of strengths and weaknesses of a

company or organisation to determine one's position, to identify areas for improvement and to transfer these insights into implementation. The initiative for a self-assessment is supposed to come from the organisation itself and the organisation that conducts the assessment is also responsible for the process. Usually, the self-assessment is conducted against a set of criteria as for example in the standards which are put forth by DIGI-HE.

Table 1: For DIGI-HE the following existing instruments have been analysed and assessed against their usefulness for supporting digital transformation in higher education:

SELFIE	OLC Quality Scorecard Suite
DigiMirror	DigCompOrg Framework
Blended learning self-assessment tool	DigiComEdu Framework
Leibniz Digital benchmarking tool	Opeka
HEInnovate	Ropeka
Maturity Model for Blended education	Oppika
ACODE benchmarking	NSQ National Quality Standards for Online Education
Jisc Digitally-capable Organisation	QQI Blended Learning Guidelines
ENQA - Considerations for quality assurance of e-learning provision	Quality Matters
"E-xcellence - Quality Assessment for E-learning: a Benchmarking Approach (3rd edition)"	Technology Enhanced Learning Accreditation Standards

## Innovative Aspects of DIGI-HE

A European self-evaluation tool such as SELFIE does not exist for higher education institutions. Tools that exist or are under development tend to focus on digital learning and teaching or digital skills for individual member across the university such as staff or students. Furthermore, they seem to resemble more external quality measures and thus they usually require a team of external reviewers, and result into an assessment statement or score of the university's maturity and quality in digital or online education, based on external criteria. Therefore, DIGI-HE will be the first of its kind.

With emphasize on self-review, self-reflection, and measures for strategic institutional development a tool like the DIGI-HE will support the institutional efforts, to develop and implement strategies, which are purposeful and holistic in comprising both missions, education and research. It will also emphasise the need for dialogue among all actors and stakeholders in digitalisation, and address areas of activities in relation to cooperation and outreach, including internationalisation strategies and practices. The tool itself will require the participation of a wider range of the members of the institution, including students, teachers, researchers, administrators and technical staff, and leadership at different levels. This will enable the institutional leadership to explore perceptions and perspectives of different stakeholders across the institution, i.e. leadership, teachers, researchers, administrative staff, technical and IT staff, and students. DIGI-HE will cover the main

missions and areas of activity where digitisation plays a role, in a holistic way: learning and teaching, research and innovation, governance and management, and cooperation and outreach (including internationalisation).

Guidelines and exchanges with institutions will encourage and support intra-institutional dialogue and cooperation. As one of the areas covered by the tool will be cooperation and outreach, this will also consider the role of external parties (companies, NGOs, schools etc.), and point to mutual benefits that this could render for the institution's digitalisation. Consequently, DIGI-HE will inform the intra-institutional strategic dialogue and collaboration processes, thus contribute to mainstream approaches, improve support and more transparent structures for digitalisation, and increase the proactive participation of staff and students. Using the tool and join the community will also enable contacts, exchanges, learning and networking among institutions. From other contexts, peer learning has been confirmed as an invaluable means for innovative institutional development – following lessons learnt from EUA's annual European Learning and Teaching Forum, and thematic peer learning groups bringing together leadership with responsible for education.

The DIGI-HE tool will be useful for institutions at different level of maturity in their digital approaches, which is important given significant country and institutional differences. For instance, according to the Trends 2018, in Greece, Germany, Kazakhstan, Sweden, Switzerland, the UK and Ukraine, all higher education institutions confirmed that digital learning is becoming part of the institutional strategy – which has only been the case at a third of the Polish, a quarter of French and Italian, and a fifth of Czech institutions.

## **Conclusion**

This paper has provided a reflection on strengths and weaknesses of central methods for quality evaluation and validation within the DIGI-HE. Benchmarking and the connected concept of bench-learning are concerned with learning and improvement by comparing with other “best in class” organisations or products and adapting these identified best practices within the own organisation. Self-assessment is described as a (usually) regular and systematic analysis of strengths and weaknesses of a higher education institution to determine their potential, to identify areas for improvement that are usually conducted with the help of criteria catalogues.

A peer-review is characterised as a qualitative method for external evaluation by an expert on the same level that is, in many cases, based on a prior self-assessment and focuses on a review of existing data. Peer-reviews are considered to offer a mutual learning opportunity (“critical friend”) in addition to the review itself and are regarded as offering a relatively good cost-benefit ratio.

As the first of its kind, DIGI-HE will provide a self-assessment tool specifically designed for HEIs, which will enable HEIs to self-reflect and self-review. It will promote the internal dialogue and thus acknowledges the reality of the progress of digitalisation hitherto taking place through a bottom-up process but enables to shape this process in a strategic sense. Encouraging inter-institutional collaboration and support as well as densification in a network will promote mainstream approaches, better support and more transparent structures for digitisation.

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## **INTEGRATING MINI-MOOCs INTO STUDY PROGRAMS IN HIGHER EDUCATION DURING COVID-19. FIVE PILOT CASE STUDIES IN CONTEXT OF THE OPEN VIRTUAL MOBILITY PROJECT**

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### **Abstract**

This paper describes five different pilot case studies which show how mini-MOOCs were integrated into study programs in higher education during COVID-19. The pilot case studies were conducted in five different countries (Germany, Italy, Spain, Romania and Slovenia) in the first quarter of 2020 as part of the Open Virtual Mobility project. Open Virtual Mobility project (OpenVM) is a three year (2017-2020) strategic partnership for innovation and the exchange of good practices founded by the European Erasmus+ program of the European Commission. One of the key outcomes of the Open Virtual Mobility project is the Open Virtual Mobility Learning Hub (OpenVM Learning Hub), an online learning environment for the development, assessment and recognition of virtual mobility skills in higher education. The OpenVM Learning Hub hosts a set of eight mini-MOOCs, each dedicated to a specific competency cluster. Based on small-scale pilots at the universities in the five countries, this paper describes the design of OpenVM mini-MOOC, spotlights different educational approaches for integrating MOOCs into study programs during COVID-19 and highlights diverse objectives, attitudes and expectations of educators who piloted the integration of the mini-MOOCs during the pandemic. The paper explores differences in integration of traditional MOOCs and mini-MOOCs and concludes with recommendations for embedding mini-MOOCs into academic programs in view of rapid (digital) transformations in higher education such as the one caused by COVID-19.

### **Introduction**

In recent years, more and more attention has been directed towards integrating (or embedding) MOOCs into traditional, formal education, including curricula in study programs in higher education. This has been motivated by various economic (e.g.



reduction of study fees and costs of production of online courses, increase in student retention, increase revenues for organisations), educational (e.g. to improve learning outcomes, enhance the quality of content, enable international collaboration, increase passage rates, reduce drop-out rates in MOOCs) and transformation (e.g. innovative educational models, internationalisation of education, cross-institutional collaborations, community outreach, broadening access to less educated audiences) oriented needs of educators and organisations (cf. Hollands & Tirthali, 2014). The various approaches to integrating or embedding MOOCs into study programs and curricula have been termed as “MOOC 3.0”, “hybrid MOOC” or “distributed flip” (cf. Sandeen, 2013; Caulfield, Collier, & Halawa, 2013; Griffiths et al., 2014; Holotescu et al., 2014).

Instead of developing new MOOCs or using MOOCs as stand-alone learning experiences, MOOCs have been integrated into traditional courses to enhance the learning experience while embracing such methods as blended learning, flipped/inverted classroom, autonomous learning, international collaboration, peer-assessment and team-based learning. In this context, Dillenbourg et al. (2014) describe the integration of MOOCs into university education as “a shift from creating content to creating context”. This implies new teaching roles, e.g. contextualising existing content, skilfully selecting and remixing existing content into a coherent story, providing guidance around the use of existing materials combined with teamwork and collaboration, reorganisation of infrastructure, e.g. rethinking infrastructure and facilities in view of the use of personal devices, growing importance of social learning, interaction and collaborative spaces, delivery of content and computer-based assessment, providing orchestration and analytic methods for educators, and the shift in focus from content-oriented activities to independent study and discovery, e.g. inquiry-based models, exploring an existing body of knowledge, discovering new knowledge (Dillenbourg et al., 2014).

A number of different models and approaches have been applied in higher education institutions around the world to achieve a symbiosis between MOOCs and traditional higher education programs, including:

- **Using MOOCs from popular MOOC platforms in alignment with regulatory frameworks.** For example, Kulik and Kidimova (2017) describe the use of Coursera, EdX or Futurelearn at the National Research University Higher School of Economics in Moscow, Russia. The integration of MOOCs is embedded in a regulatory framework which specifies the credit transfer for MOOCs. In this case, the objective for integrating MOOCs into university curricula “is to improve the quality of our educational programs by including courses which allow to achieve

specific tasks with limited resources” such as non-core courses, specialised courses in English, course with unique content (Kulik & Kidimova, 2017; p.6).

- **Creating Blended Massive Open Online Courses (bMOOC model).** For example, Qusay and Norshuhada (2018) describe a blended MOOC model applied at the University of Tikrit in cooperation with University of Baghdad, Iraq. The blended MOOC model was implemented to foster interaction and communication among participants. This was achieved by integrating face-to-face interactions with MOOC components into a flexible model to enhance classroom learning which takes into consideration local culture and language. The learners could take an active role and the openness of the MOOC allowed a large number of participants around the world regardless of their level of education and location to learn together with on-campus students. This approach combined teacher-centred (classroom) and learner-centred (MOOC) methods.
- **Adapting MOOCs to Small Private Online Courses (SPOC model).** For example, Martinez and Campuzano (2015) report on adapting MOOCs into on-campus teaching, by using MOOCs in a blended, SPOC model but at the same time keeping the amount of hours for on-campus teaching to increase the quality of the educational experience. In this scenario, a blended learning approach using the flipped/inverted classroom model was applied in an on-campus environment with a smaller number of students than in MOOCs.
- **Allowing students to choose MOOCs for self-study and/or as resources inside a traditional course.** For example, Andone et al. (2015) describe the use of MOOCs available at popular MOOC platforms such as Coursera, Udemy, Udacity, edX, Khan Academy, Codecademy, FutureLearn, European MOOCs at Politehnica University of Timișoara, Romania (Andone et al., 2015). In one scenario students from the undergraduate course of web programming could choose and participate in different MOOCs as part of the blended learning course. In another scenario, MOOCs were chosen and used by students as external resources in the Instructional Technologies master course. In both scenarios students were given high autonomy for selecting, choosing and participating in MOOCs which matched their own learning needs.
- **Synchronised integration of MOOCs as educational content/learning materials.** For example, Ghadiri (2013) described how rich e-learning content, including video presentations from MIT MOOCs at edX can be integrated as learning materials into classroom teaching in the form of a blended model. The activities with integrated MOOC components included students watching mini-lecture videos of up to 10 minutes each and answering embedded questions online twice a week, reading assigned sections of the edX online textbook twice a week,

solving edX problems and submitting answers online for automated grading by edX once a week, completing weekly edX online lab experiments and submitting answers online for automated grading by edX, watching edX videos of MIT faculty discussing different topics. This model was also described as synchronised integration of MOOCs into the face-to-face teaching by Holotescu et al. (2014).

Taking into account different approaches and models of MOOC integration, this paper describes five case studies in which mini-MOOCs were integrated into academic programs during the pandemic of COVID-19 in 2020. The spotlight of this paper is on the integration of MOOCs in times of (digital) transformations in higher education (such as the ones during the pandemic), during which fast solutions are required to provide online quality learning experiences to students. The five case studies describe the integration of mini-MOOCs, given their specific affordances, as opposed to traditional MOOCs, which have been the dominant object of research.

## **Context of the Study**

The five pilot case studies on the integration of mini-MOOCs were part of the Open Virtual Mobility project. Open Virtual Mobility project (OpenVM) is a three year (2017-2020) strategic partnership for innovation and the exchange of good practices founded by the European Erasmus+ program of the European Commission. One of the key outcomes of the Open Virtual Mobility project is the OpenVM Learning Hub ([hub.openvirtualmobility.eu](http://hub.openvirtualmobility.eu)), an online learning environment for the development, assessment and recognition of virtual mobility skills in higher education. The OpenVM Learning Hub hosts a set of eight mini-MOOCs, each dedicated to a specific competency cluster.

The case studies presented in this paper are based on small-scale pilots at the universities in five countries (Germany, Italy, Spain, Romania and Slovenia) who are partner organisations or network partners in the project. In general, mini-MOOCs are smaller, shorter, cover less content and fewer skills than traditional MOOCs (Clark, 2016). OpenVM mini-MOOCs are designed to enable learners to learn in a flexible, self-directed and granular way, by easily aligning learning in the MOOC with other everyday activities. As described by Buchem, Poce, and Tur (2019), OpenVM mini-MOOCs are based on the principles of micro-learning design and aim to provide alignment of micro-learning objectives, micro-learning activities and micro-learning assessment with micro-credentials based on the Open Badges standard. OpenVM mini-MOOCs aim to support achievement, assessment and recognition of virtual mobility skills in eight competency areas. The eight competency areas were identified through a Group Concept Mapping research study (Rajagopal et al., 2020).

The eight OpenVM mini-MOOCs are

- Media and digital literacy,
- Active self-regulated learning skills,
- Autonomy-driven learning,
- Networked learning,
- Intercultural skills and attitude,
- Interactive and collaborative learning in an authentic international environment,
- Open-mindedness, and
- Open virtual mobility knowledge.

OpenVM mini-MOOCs allow learners to learn at three levels, i.e. foundations, intermediate and advanced, providing learners with a number of e-assessment methods, including pre-assessment, formative and summative quizzes, e-portfolios and peer-assessment. OpenVM Credentials (Open Badges) are issued upon successful completion of each level.

## **Pilot Case Studies**

The eight OpenVM mini-MOOCs were piloted in the first quarter of 2020 at five universities involved in the project. The piloting phase overlapped with the COVID-19 pandemic and so the context for piloting changed from integration of mini-MOOCs into face-to-face on-campus courses to fully online scenarios. All OpenVM mini-MOOCs were facilitated. The role of the facilitators was to support learning activities, communicate important information to participants including schedules and deadline reminders as well as to support students in using technical components in the MOOCs, e.g. group formation, e-portfolio. Each university independently decided about the selection of mini-MOOCs to be piloted and the approach to integration into study programs. The decisions about integration of OpenVM mini-MOOCs included decisions about (a) synchronisation with the existing academic program including grading and credentialing, (b) number of levels to be piloted, (c) mode of participation (e.g. obligatory vs. voluntary). The presentation of case studies below follows five questions:

- Which OpenVM mini-MOOCs were piloted in which departments, study programs and modules/courses?
- What were the changes due to COVID-19 and implications for the integration of mini-MOOCs?
- What were the educational objectives for the integration of mini-MOOCs in each pilot?
- How were OpenVM mini-MOOCs integrated into existing study programs given the micro-learning format?

- What were the value added and the challenges from the perspective of educators?

### ***Pilot Case Study in Berlin, Germany***

The pilot case study in Berlin, Germany took place at the Beuth University of Applied Sciences. Following the COVID-19 pandemic, the summer semester 2020 at Beuth University of Applied Sciences in Berlin started later and teachers were encouraged to offer on-campus courses online. The “Collaborative Learning” mini-MOOC was integrated into “Learning Design” course in the bachelor study program “Digital Business (BSc.)” in Department I Economics and Social Sciences. The “Networked Learning” mini-MOOC was integrated into the “Learning Design” course in the online master study program Media Informatics in Department VI Informatics. All study programs in Department I were transformed from mostly face-to-face on-campus courses to online courses. This required a major makeover of the “Learning Design” course, which previously included weekly teamwork and collaboration on design tasks on campus following the Design Thinking approach. The shift to online format included changing to flipped classroom format with focus on autonomous learning with weekly reading assignments and quizzes. The online master study program Media Informatics did not have to be changed due to COVID-19 as it was already offered fully online before the pandemic. The joint objective for the two pilots to provide students with an opportunity to experience learning in a MOOC in an international setting and to learn the use of OERs, e-assessment including e-portfolio, group formation, and digital micro-credentials. In the bachelor study program, the majority of students reported they have never participated in any online course and never heard about MOOCs before. So, the specific objective for piloting in this course was to enable the first experience with MOOCs and enhance reflection about this form of learning. Another objective was to combine the MOOC experience with theory about learning design which was covered in the course. The specific objective for the Networked Learning MOOC in the online master program was for students to evaluate this mini-MOOC using the expertise about learning designed covered by the course. Both mini-MOOCs were a compulsory activity and were used both as stand-alone courses and as materials in the on-campus course. Students were required to complete three levels and obtain three badges. A specific number of points was assigned for completing each level. Students were given specific time-frames for participation in each level to allow a synchronised participation of students from different universities in activities which required group participation in intermediate and advanced levels. All students could learn at their own pace within specified time-frames and independent from other on-campus students. At the same time, both mini-MOOCs were used as resources in class to cover topics related to collaborative and networked learning. Both mini-MOOCs were used as examples for learning designs and were analysed by students together with the teacher in

interactive online-seminars. The micro-learning approach and the short duration of each mini-MOOC level allowed for a smooth integration of mini-MOOCs as part of self-study in each course and allowed students to experience learning in MOOCs. The key challenge was the coordination of times during group activities in the intermediate and advanced levels.

### ***Pilot Case Study in Rome, Italy***

From the beginning of March 2020, the health emergency caused by the spread of COVID-19 imposed an immediate reorganisation of the CDM (Center for Museum Studies) post-graduate courses in “Museum Studies” at Roma Tre University. The post-graduate courses are aimed at developing professional, transversal and digital skills in future museum educators (<http://centrodidatticamuseale.it/en/covid-19-emergency>). The current mobilisation of the world of culture, in particular of the world of cultural heritage, encouraged the creation of specific teaching units aimed at understanding the current state of heritage institutions and at inventing possible strategies by designing ad-hoc educational activities. Therefore, the post graduate courses’ managing staff prepared a series of units focused on increasing relevant distance learning opportunities to facilitate up-to-date attendance of the educational path started in February. OpenVM mini-MOOCs were aligned with our objectives to develop digital and transversal skills of students, who will be increasingly required to adopt digital tools to design educational paths in museum environments. Students could choose mini-MOOCs they were most interested in. Self-regulated learning skills were explained to students and the focus was on the ability to choose the most suitable learning path for own needs and goals. The MOOC attendance was not mandatory, but the attendance for each mini-MOOC was awarded with points. Participants were not familiar with MOOCs, so clarification was necessary. A presentation in Italian language for post-graduate students was prepared and uploaded to the LMS platform used in the courses. A 30-minute online lesson was organised with students two weeks before the start of intermediate and advanced levels. Students were required to read the presentation before the lesson and prepare their questions to the instructor. During the online session, participants were explained the different kinds of attendance in three levels. Since, intermediate and advanced levels had critical deadlines and steps to follow, most of the time was devoted to explaining these requirements.

### ***Pilot Case Study Ibiza, Spain***

OpenVM mini-MOOCs were offered for PhD students of the Institute of Educational Research and Innovation of the University of the Balearic Islands. There were 37 students from Spain and other South-American countries and the vast majority were doing the online PhD program in Educational Technology. The course was designed as an online

course and thus no changes were needed due to the COVID-19 pandemic. However, the reflective texts submitted by students included references to the educational implications in future times after the pandemics. The learning objectives were to learn about OpenVM and to learn with MOOCs. The online course is designed as a short training to be done autonomously by PhD students. It consists of three main activities. The first one is about getting to know the concepts of virtual mobility, the implications of openness, and the skills that students develop while taking part in mini-MOOCs. Students were invited to read some research articles and to participate in an online forum with their personal experiences. The second activity was to participate in three selected mini-MOOCs at the foundational levels including the pre-assessment and the final quiz. The third activity was to reflect in the forum about the possibilities of OpenVM in higher education, their self-assessment and the implications for their future professional development and educational practice and research. The value added was both the content and the format of mini-MOOCs. Presenting VM and OpenVM concepts introduced a new theme that had never been offered to students before. This was seen as a contribution to internationalisation. The context of autonomous learning in the MOOC is very relevant for the professional development of researchers in HE. The main challenge was using the English language, so the design of the course introduced reading material for Activity 1 in Spanish.

### ***Pilot Case Study in Kranj, Slovenia***

The mini-MOOC “Collaborative Learning” was piloted with third-year students of the Organization and Management of Information Systems program in Multimedia Systems. The course is part of the study program in the Faculty of Organisational Sciences in Kranj, which is a member of the University of Maribor. The content of this mini-MOOC was considered to be most appropriate for a students’ work. Even if the content was not directly related to the content of the course, the new knowledge was considered beneficial for IT students, especially for their professional work in the future as well as a useful contribution for students’ daily work. In Slovenia, COVID-19 demanded a rapid adjustment of the method of implementing the study process at all levels of education in the country. In the period before COVID-19, the Faculty of Organisational Sciences used blended learning methods and techniques in the educational process. The ratio of ex-cathedra and distance lectures is 50% – 50%. Lecturers at the faculty already had a lot of materials for distance education prepared before the COVID-19 period. The leap to full distance education, however, required a great deal of effort and adjustment. The use of OpenVM mini-MOOCs was therefore very welcome. The purpose of integrating the mini-MOOC was mainly to acquaint students with the concept of the MOOC itself. The content of the mini-MOOC was intended to supplement students’ knowledge in educational methods. The mini-MOOC was included in the course as one of the learning activities. Registration and

completion of all activities were mandatory. Students were required to report on the work and the grade of their report on the mini-MOOC represented 10% of the final grade. The added value of working with the mini-MOOC was mainly in acquainting students with the OpenVM project, the mini-MOOC concept and a different way of working than in the course of Multimedia Systems. The challenges included the use of foreign languages and acquiring new knowledge in the field of collaborative learning.

### ***Pilot Case Study Timișoara, Romania***

After the COVID-19 lockdown was imposed on Timisoara, all university activities moved online. Students' progress was discussed via Zoom during regular classes and via email. The pilot took place during the Web 2.0 Technologies course with 4<sup>th</sup> year Bachelor students from the Multimedia Specialization of the Faculty of Electronics, Telecommunications and Information Technology of the Politehnica University of Timisoara. All OpenVM mini-MOOCs were piloted, each student being required to choose two of them for piloting. All students had to complete pre-assessments and then follow each of the 3 levels of selected two mini-MOOCs. All students were required to write a maximum 800 words activity report in which they analysed the OpenVM Learning Hub, their experience in mini-MOOCs and the quality of the mini-MOOCs. Students had to prepare a report with screenshots from the course (e.g. activity completion, forum participation, errors, best parts of the course and badges obtained). The main objective was for the students to learn in mini-MOOCs and to gather important digital skills. Collaboration and active participation was encouraged. Students were asked to summarise and synthesise what they learned. Attention to details was encouraged when finding errors and bugs. The biggest change was the evaluation, which was done in Zoom. Each student presented their report and conclusions about the mini-MOOC, sharing their screen to showcase the most important points. From the educators' perspective, the piloting of the mini-MOOC helped the students to cope with the situation during the COVID-19 pandemic, especially at the beginning of the pandemic. The mini-MOOCs gave students a clear activity to focus on. A large number of courses and activities in the study program were not well prepared for moving online. A big challenge was to continue motivating students due to lack of interactivity in the mini-MOOCs as in that period of time, students in Timisoara were the only ones piloting. Also, because during piloting time some activities were unavailable, students could not receive all badges. This proved to be frustrating to students. OpenVM mini-MOOCs allowed to provide students the opportunity to develop digital and transversal skills required to face the challenges of the evolving and changing museums sector. It was important to provide instructions before students enrolled in mini-MOOCs, especially regarding the intermediate and the advanced level requirements.



## Conclusions

The five pilot case studies presented above show that mini-MOOCs can be a beneficial contribution to on-campus courses especially in times of (digital) transformations such as during the pandemic. The main benefits seems to be the easy integration by educators to existing curricula as well as easy use for self-study by students. Given the micro-learning structure of mini-MOOCs, students can be provided with a short and simple way of experiencing learning with MOOCs. The reports of pilot studies show the diversity of approaches towards integrating mini-MOOCs to study programs. Following the five MOOC integration models proposed by Israel (2015), the pilot case studies both single MOOC and multiple MOOCs adoption, as well as synchronised, wrapped, blended and hybrid, models of integration.

The key benefits of integrating mini-MOOCs to study programs include allowing students to (a) experience self-directed/autonomous learning in MOOCs, (b) experience international collaboration and cultural differences, (c) diverse approaches to education and learning, (d) use diverse study materials, (e) reflect and demonstrate understanding of new concepts, and (f) share experiences with peers outside of the classroom. The key recommendations for the integration of mini-MOOCs include introducing students to self-regulated learning and explaining learning in the MOOC before the start of the MOOC, providing a well-structured and individual facilitation which encourages students to learn, share and reflect as well as creating links between on-campus and in-MOOC learning through “weaving” (Salmon, 2007) and “wrapping” (Israel, 2015).

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## SECONDARY SCHOOL TEACHER SUPPORT AND TRAINING FOR ONLINE TEACHING DURING THE COVID-19 PANDEMIC

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### Abstract

In Italy, due to the Covid-19 pandemic, all schools were closed on March 5, 2020 and it was mandatory to switch to “distance learning”, in order not to interrupt the teaching continuity and to guarantee the right to education for all students. The Ministry of Education suggested several initiatives to teachers, including the PP&S national project. In the paper we analyse why and how the PP&S project, intended for teachers of secondary schools of the STEM disciplines but opened in the emergency to teachers of all disciplines, was able to provide much needed support and not only. Following this opening and the consequent registration of many new teachers, three different phases were carried out: an analysis phase of the teachers’ needs for online teaching, a phase of support and initial help, and a training phase. The results show an extremely high participation of the teachers and a wide online collaboration. All the teachers of the PP&S will certainly have an advantage in the post-covid teaching, since they can take advantage of the work done and the experience and skills gained in the past.

### Introduction

In Italy, due to the Covid-19 pandemic, all schools were closed on March 5, 2020 and will not be reopened until after the end of this school year. After the lockdown of the schools and the suspension of face-to-face lessons, it was necessary to switch to “distance learning”, in order not to interrupt the teaching continuity and to guarantee the right to education for all the students. Not many schools were prepared for this type of change. For example, because they did not adopt online teaching in normal teaching, teachers did not have the adequate digital skills and adequate computers, so teachers and students were not used to working in a Digital Learning Environment (DLE), a shared virtual space. Some schools chose to adopt a unified solution for all classes, while other schools gave teachers the opportunity to adopt the virtual learning environment that they considered most appropriate for their subject. After a reasoned and aware choice of the virtual learning environment to be used for online teaching, the teachers had to quickly learn how to use it and they had to transform the teaching practices that they would have carried out face-

to-face into an online mode. The Ministry of Education created a site dedicated to distance learning, to globally distribute instructions to teachers and schools who had to activate some forms of distance learning and did not know which tools to choose and had no examples of activities to get inspiration from. In fact, according to the Ministerial Decree of 8 March 2020, each School Head was able to activate the distance teaching methods at his/her discretion and liking, for the entire duration of the suspension of educational activities in schools, with particular attention to specific needs of students with disabilities. This site (available at <https://www.istruzione.it/coronavirus/didattica-a-distanza.html>) offers a list of cooperation tools, exchange of good practices and twinning between schools, training webinars, multimedia content for study, certified platforms (also in accordance with the privacy protection regulations) for distance learning. Part of these tools can be used for free during the lockdown period thanks to specific protocols signed by the Ministry of Education. One of the proposed initiatives is the PP&S national project (Barana et al., 2019). The PP&S – “Problem Posing and Solving” – project (available at [www.progettopp.it](http://www.progettopp.it)), headed by the Italian Ministry of Education, promotes since 2012 the training of teachers of secondary schools on innovative teaching methods, through the use of digital technologies, and on the creation of a culture of problem posing and problem solving, with the use of Information and Communication Technology (ICT). Teachers involved in the project learn how to use different kinds of digital tools and new methodologies, in order to enhance their daily didactic. The University of Turin is one of the partners of this project and hosts and maintain the IT infrastructure of the project. Initially, it was intended only for teachers of secondary schools of STEM disciplines but, during the emergency from Covid-19 the project, it was opened to teachers of secondary schools of all disciplines to support them in online teaching. The project also allows the enrolment of the entire school in order to facilitate teachers and students in the use of a single DLE. By enrolling in the project, totally free of charge, teachers have the possibility of having an integrated DLE for all the classes of students they need. Within it, students can be provided with multiple resources (interactive materials, links, videos, theoretical explanations, etc.) and numerous synchronous and asynchronous other online activities. The activities carried out by students can be evaluated, alone or in a group, and it is possible to monitor the students’ actions on the platform and the learning objectives achieved. The teachers who were part of the PP&S before the pandemic and the closure of schools were already using the digital environment integrated in their daily teaching. As a result, it was much easier for them to switch to distance learning. In their case, we believe that we can speak effectively of online teaching. After opening the project to teachers of all disciplines and the consequent registration of many new teachers (Table 1), the first step was to try to detect (through an optional questionnaire) the main needs of teachers for online teaching. For example, on the use of the virtual learning environment, on the activities and resources that can be used, on the assessment of students and on the monitoring of their platform

activities. At the same time, special comments, suggestions and training needs were collected. This phase of needs analysis was followed by a support phase and a training phase for teachers, organized thanks to a group of expert teacher trainers who, from the beginning of the project, carry out face-to-face training activities and online training activities. The support phase, which took place in the first period of school lockdown, was characterized by individual synchronous online training meetings to give teachers a first basic training and to support them in the initial emergency and in the transition to online teaching. Compared to the online training meetings that took place regularly within the project, it was sufficient to increase the hours of training to be able to reach all the teachers who enrolled in the project from time to time and to be able to vary the topics of the training meetings while maintaining the basic training feature. In addition, all the teachers of the PP&S could collaborate on the platform within the Community of the Teachers of the PP&S to exchange tips, teaching practices and ideas, and they always had the support of the teacher trainers of the project, who were available through the Helpdesk service of the platform and through forums. In May, when most of the teachers had started teaching online with the students and had become familiar with the proposed tools, the training phase began. This phase, still ongoing, is characterized by an open vision to go beyond basic training. In this phase, teachers are offered advanced courses on online teaching, which also include activities to be carried out together with the students. This allows teachers to develop advanced skills that will be very useful also in post-covid teaching and to reflect deeply on how to rethink teaching practices and methodologies. The training phase will also include an advanced training phase on specific topics (such as learning object design, use of OER-Open Educational Resources, Learning Analytics, etc.) for teachers who have been participating in the project for many years and use the online teaching in their daily teaching. In this paper we present the analysis phase of the teachers' needs and the support and training phase. As the results show, the participation of the teachers (new members of the project and not) was high and there was a lot of collaboration on the platform between the teachers and between teachers and trainers, especially between teachers already enrolled in the project for a long time and teachers who had just registered. At the end of the school year, all teachers will receive a certification of all the training activities in which they participated and a certification of all the activities carried out on the platform. The activities carried out by the teachers in online teaching and the participation of the students will also be analysed in detail to understand the activities and resources that proved most effective and engaging. Further considerations will also be taken on online teaching and on the change of the school during the emergency, on the proposed training activities, on the repercussions that online teaching had on students and their comments. In the paper we discuss why and how the PP&S project was able to immediately detect the needs and play an important role of

immediate support and useful training for the change of paradigms to which the teaching will be subjected.

Table 4: General overview of the PP&S project, last update May 27, 2020

	Amount		Amount
Users	26037	New users AY 2019/2020	4386
of which teachers	1842	of which teachers	402
of which students	24195	of which students	3984

## Online teaching in an integrated Digital Learning Environment

Distance learning and online teaching are not the same thing. Online teaching, not only during this emergency period, should not be a mere transfer of face-to-face lessons in synchronous online mode via web conference. Here are several reasons why: it is very difficult for students to stay in front of a screen for many consecutive hours; students are not necessarily able to connect due to slow or overloaded home internet connections (digital divide); large families do not necessarily have a device for each family member and there may be organizational problems; there may be privacy problems related to the desire of not using the webcam; there may be technical difficulties in getting students to work (for example in the absence of a blackboard); there may be economic problems in the family to guarantee one or more mobile devices and an adequate internet connection; it is more difficult to stay focused on the lesson and concentrated for a long time outside the school context and in a private context with many distractions. At the same time, online teaching cannot consist of a simple transmission of materials and tasks and exercises. Online teaching is a form of teaching that consists of resources but also and above all asynchronous activities that are always available, which students can carry out when they can and when they prefer. In fact, online learning allows students to study from home respecting their own times and independently organizing the time schedule of the study. It is certainly necessary that the didactic proposals are, as always, built on quality content and that they are structured in a precise way, considering the students' previous knowledge. Resources and activities can be multimedia and can be the result of the integration of different media to facilitate students' understanding and personalization based on each person's characteristics. A fundamental component for Online Teaching is the DLE, an online space shared between teacher and students for the availability and use of training (Rogerson-Revell, 2007). The DLE of the PP&S is based on a Virtual Learning Environment, VLE, a Moodle-learning platform, integrated with an ACE, that is Maple ([www.maplesoft.com](http://www.maplesoft.com)), an Automatic Assessment System (AAS) and a web conference system. The innovative methodologies proposed by the PP&S project are: problem posing and solving using an ACE that supports problem formulation, presentation, resolution and

generalization, and that allows the creation of interactive materials (Barana et al., 2019; Barana, Conte et al., 2019a); automatic formative assessment with adaptive questions aimed at teaching students how to solve problems, guiding them step-by-step with interactive feedback in the solving process, through an ACE and an AAS (Barana et al., 2020; Barana, Conte et al., 2019b).; collaborative learning among teachers in a community of practice for the exchange of ideas, strategies and materials (Barana et al., 2018); collaborative learning among students in a learning community. It is important to underline that the term “Online Teaching” does not only mean the virtual environment for the synchronous interaction between users (videoconference, chat and so on) but also the asynchronous learning (which does not require the presence of users at the same time). Within the DLE it is possible to deliver multiple types of resources such as videos, interactive files, pdf files, conceptual maps, links to external sites, collection of images and photos, podcasts, etc. Students can view the contents created with the advanced computing environment directly within the DLE and explore them interactively. This type of material is very valuable for STEM disciplines because it allows to view and explore mathematical situations (even with two and three dimensional and animated graphics) to study concepts effectively, to develop problem solving skills (and generalization of the solution process), and to develop modelling skills. Within the DLE it is also possible to create multiple types of synchronous and asynchronous activities: discussions, tests with automatic assessment, submission of tasks, sharing of materials, workshops, questionnaires, surveys, logbook, etc. Quizzes can have questions with automatic assessment and with interactive and immediate feedback. This type of questions allows students to carry out the necessary exercises independently, to have step-by-step guided solutions to learn a method, and to make repeated attempts of the same exercise with different parameters and values. This activity promotes students’ autonomy and awareness of their skills and facilitates class management for teachers. All activities within the DLE can be carried out alone or in a group and support students’ collaborative learning. As stated before, all activities can be evaluated: by the teacher, by the student himself (self-assessment) and by the other students (peer evaluation). All teachers enrolled in the PP&S can request the opening of one or more courses on the platform to work with their students and through the helpdesk service they require the accreditation of the students on the platform. Each user of the platform can open a ticket to the helpdesk service at any time to get support for access problems, to get information or help in using the platform. Teachers can customize their DLE as they prefer and design the activities and resources for the students. Within the Teacher Community, which includes teachers from all over Italy enrolled in the project, there are many materials for self-training (interactive materials, training modules, video pills, pdf, etc.) and database of materials for sharing between teachers. The sharing of teaching material is the basis of the project, as well as the sharing of ideas, good practices and teaching methodologies through forums.



## **Analysis of needs and considerations on online teaching during the covid-19 emergency**

To analyse the needs of the teachers during the emergency period, an optional questionnaire inside the DLE was submitted to the teachers to understand if the teachers had already practiced online teaching, if the teachers had already used the new technologies, and which activities and resources they consider most useful for their teaching. We also asked to express their thoughts and experiences on their teaching in the covid-19 time and how their experience was within the PP&S platform. The needs survey showed that 48% of the teachers already practiced online teaching even before the emergency and 90% of the teachers used the technologies for teaching even before the emergency. 44% of teachers have been enrolled in the PP&S for less than 3 months (enrolled during the emergency), 10% of teachers have been enrolled for more than 5 months and for less than a year, 12% have been enrolled for two years and 34% have been enrolled for 3 years or more. The teachers were asked how important they consider various tools related to online teaching with students, expressing a score on a scale from *1 = not at all* to *5 = a lot*. According to teachers all the tools are important, but the most significant ones are video conferencing (to be able to communicate with students and deal directly with them), interactive resources and tests with automatic assessment. The teachers were also asked how much they agree on several statements regarding online teaching with students (on its effectiveness, on the participation of students, etc.) by expressing a score on a scale from *1 = not at all* to *5 = a lot* (Table 2). Most teachers agree that effective online teaching is also possible and that this type of teaching stimulates the development of additional skills in students. The teachers also agree on the need to have material available and to receive more training.

## **Teacher support for online teaching during the covid-19 emergency**

At the end of the needs analysis and the analysis of the teachers' considerations, a first phase of support for the teachers was prepared, in the delicate moment of approach to online teaching and first knowledge of the tools. To respond to the most immediate needs and to offer support as quickly and effectively as possible, the following actions have been implemented: three weekly online synchronous meetings lasting one and a half hours (in some cases repeated) with a part of explanation and a part dedicated to answering questions. The meetings focused on several topics such as the use of the DLE, the automatic assessment system, the design of collaborative activities; forum to be able to express any doubts and receive an immediate response; enhancement of the Helpdesk service and email management to answer promptly to all requests; enhancement of the database of ready and available materials; enhancement of self-training material (always available to teachers).

Table 2: Reflection by teachers on the importance of online teaching tools with students

Online lesson preparation takes longer than face-to-face lessons	4.4
Online teaching stimulates the development of additional skills in students	4.2
Teachers would need resources available for online teaching	4.2
Teachers would need more support for online teaching	4.1
Online teaching should also be used in ordinary teaching	3.9
The participation of my students from home is active	3.8

All these actions offer basic literacy and initial training; very practical and directly usable. In this phase it was essential for the teachers to have constant support from the tutors and to share teaching practices and advice between the teachers of the community. In addition, online extracurricular activities were organized for students to increase their engagement: a mathematical competition on Pi Greco Day and disclosure of materials and quizzes on Dante Day. This support phase actively involved about 200 teachers during synchronous online meetings, but many more teachers on the platform in the teaching community. Table 3 shows data about users in the PP&S between the period Pre Covid-19 (01/09/2019 – 29/02/2020) and during Covid-19 (01/03/2020 to the present date, written in the table caption). These numbers do not only show an increased access to the platform, but they also indicate active engagement and collaborations in the Community of Teacher forum. The collaboration of the teachers on the platform to overcome this emergency was particularly important and significant. The teachers discussed a lot about how to best propose an online teaching, to carry out synchronous online lessons and how to prepare relevant materials and resources. The teachers collaborated mainly through the forum of the Teacher Community (Table 4), where each teacher can open a discussion, write an intervention in a discussion already present or simply consult the forum. The ever-present support of the trainers was also fundamental. The statistics about the usage of the whole platform (Table 3) show a significant increase which proves the effective utilization of the e-learning tools.

Table 3: Comparison between Pre and During Covid-19, last update May 28, 2020

Period	Pre Covid-19 01/09/2019 - 29/02/2020	During Covid-19 01/03/2020 up to date	Increase
New users	1466	2924	+199%
Average of new users per day	11	38	+239%
Average login per day	4875	8418	+73%
Average distinct user login per day	117	1289	+1001%
Educational resources created	375	3199	+853%
Educational online activities performed	159773	2778638	+1739%
Grades received by students	1630	4266	+262%

Table 4: Data from the Teacher Community forum Pre and During Covid-19, last update May 28, 2020

	Pre Covid-19	During Covid-19
Period	01/09/2019 - 29/02/2020	01/03/2020 up to date
Threads created	77	128
Threads read	2203	2877
Posts created	179	318

All the teachers have transformed their teaching into online teaching, structuring the course on the platform and inserting different types of activities and resources for the students. At this stage, the help of the most experienced teachers was certainly very important, in fact they gave valuable advice and constant help to colleagues who had just entered the project. A free online webinar on online education was also organized within the project, open to all interested people (teachers and non-teachers) organized in collaboration with the “Ragazzi Connessi” Project of Genoa. Lastly, we would like to underline that the IT infrastructure was not adapted in response to the new users load in any way: the high-performance and high availability solution (Baldoni et al., 2011) adopted for the PP&S service was able to serve the bigger numbers without affecting the user experience.

### **Teacher training for online teaching during the covid-19 emergency**

Starting from the month of May, when most of the teachers were regularly teaching online, a phase of teacher training began (still in progress). The objective of this phase is to offer training that allows teachers to develop skills also from a post-covid perspective, to rethink their teaching in order to integrate online teaching into their future face-to-face teaching or to practice blended teaching. It is particularly important to reflect on how new technologies can allow adaptive learning, thus supporting students’ cognitive processes, increasing their involvement and allowing the inclusion of the most disadvantaged or disabled students (Erik Duval, 2017). First, a training module was proposed to the teachers, consisting of: 4 one-hour synchronous online meetings on important topics: the design of the virtual classroom environment; activities and resources for students’ collaborative learning; online formative assessment, self-assessment and peer evaluation; adaptive strategies for personalized teaching and for monitoring the learning processes; creation by teachers of multimedia material for learning a specific topic; creation by teachers of an activity for assessment or collaborative learning; documentation on how the resource and the activity created are used by students. The training module will end in June, but training activities will also continue. At the end of the school year, additional questionnaires will be offered to teachers to collect thoughts on online teaching in the emergency period and on its impact on students.

## Conclusions

After a first phase of needs analysis, the emergency evolved in a broad-spectrum training action: in a first phase of digital literacy for teachers and in a second, more advanced training phase. Both phases are characterized by the teacher's ideas on the necessary change of perspective about teaching during this emergency. As the results show, the participation of teachers in the training activities and the collaboration among teachers on the platform were relevant. Post-covid teaching will probably be a much more blended teaching (in attendance but also online). Doing online teaching now definitely allows teachers to acquire new skills and to prepare teaching materials that can be used in future teaching. Online teaching should be understood as an additive and not a substitute paradigm for classroom teaching. The teachers of the PP&S will certainly have an advantage and will be able to take advantage of the work done and the experience and skills gained. At the end of this school year, the activities carried out by the teachers and the participation of the students will be analysed in detail in order to understand the activities and resources that proved most effective. Further investigations will also be carried out on teachers and their students on online teaching during the emergency and on the use of the platform. Such a strong action of supporting and training to teachers of the secondary school was made possible because the PP&S was an already consolidated reality that in the emergency has expanded its range of action in order to turn an emergency into an opportunity for the future.

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## **CAN E-LEARNING BE A SOLUTION FOR EGYPTIAN HIGHER EDUCATION IN THE TIMES OF COVID-19? A LOOK AT TECHNOLOGICAL CAPACITIES AND DIGITAL SKILLS**

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### **Abstract**

This paper investigates whether e-learning is a viable solution for higher education in Egypt under the circumstances of the COVID-19 pandemic and policy responses to it. The analysis uses rich cross-sectional data from the 2018 wave of the Egypt Labor Market Panel Survey Body to assess what prerequisites for e-learning students and teachers meet in terms of technological capacities and digital skills. Overall, the paper confirms that Egyptian higher education largely meets those prerequisites. Over 90% of students have access to the internet, although not necessarily rapid or affordable access, and most students access the internet through mobile devices. Widespread computer and internet use, including using the latter for education purposes, suggest that students' digital skills are generally well-developed. However, students' technological capacities and digital skills reflect important divides along gender, socioeconomic background, and location. Finally, higher education teachers appear to be largely well-prepared as well, as most have access to digital devices and computers and three quarters of teachers already use the internet for their work. Based on these findings and a review of the regional literature, a set of policy recommendations for policy makers concludes.

### **Introduction**

On March 12<sup>th</sup>, 2020, in the heart of Cairo, the City International School in Zamalek was closed by authorities after fears that students had been infected with SARS-CoV-2. Two days later, a presidential decision suspended schools and universities (Tayea, 2020) and the Supreme Council of Universities cancelled midterm exams at all universities and delayed final exams until after at least May 30<sup>th</sup>, 2020. As a result, higher education in Egypt has been forced to move comprehensively and abruptly to distance education formats, a change that mirrors the global reaction of higher education institutions to the disruptions caused by COVID-19 and governments' attempts to contain the pandemic. In doing so, higher education in Egypt can build upon the surge of e-learning initiatives witnessed

throughout the 2010s, including the emergence of Massive Open Online Course (MOOC) platforms. However, while e-learning – defined herein as a type of distance learning that uses the internet and electronic devices to support remote interaction among students and teachers for learning purpose – can certainly broaden access to education, its implementation and impact have been fraught with challenges and shown to be highly contiguous on the presence of certain prerequisites and success factors (McPherson & Bacow, 2015), especially in developing countries such as Egypt.

Despite an abundance of case studies on the use of e-learning in Egyptian higher education, a nation-wide assessment of key prerequisites and success factors of e-learning adoption has not yet been undertaken, even though a lack of ex ante assessments, especially concerning “institutions” technological capacity, has been identified as one of the main reasons for failed adoptions of e-learning (Al-araibi, bin Mahrin, Yusoff, & Chuprat, 2019; Ali, 2018); performing this assessment regarding technological capacities and digital skills is the key contribution of this paper. The remainder of this paper is structured as follows: following this introduction, Section 2 reviews the literature on key success factors for e-learning adoption with a focus on the Egyptian context, with an emphasis on technological capacity, digital skills, e-learning system, organisational support and culture. Section 3 presents the data used in the analysis, which is taken from the 2018 wave of the Egypt Labor Market Panel Survey (ELMPS), while Section 4 presents the results of the analysis. Section 5 concludes with a summary of the main findings and caveats, discusses their policy implications, and highlights avenues for further research.

## **Background**

A vast literature has studied the determinants of e-learning readiness and adoption. Since such determinants may be specific to certain regions, this review limits itself to the literature on e-learning in higher education in developing and emerging countries, with a strong focus on the Middle East and North Africa (MENA) and Egypt. A cornerstone of the literature is the perspective that both individual factors (e.g. the characteristics of learners and instructors as well as their extrinsic motivation) and institutional factors (e.g. institution and service quality) along with the characteristics of the e-learning system itself, matter for e-readiness in general and e-learning readiness in developing countries in particular (Dada, 2006; Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012; Barclay, Donalds, & Osei-Bryson, 2018). In keeping with this perspective, the review groups the discussion of success factors into five parts: (a) technological capacity, (b) digital skills, (c) e-learning system (esp. ease of use), (d) organisational support and (e) culture.

### ***Technological Capacity***

At its basis, e-learning requires learners and teachers to have access to internet-capable devices, the internet and complementary software. More broadly, the technological aspects of e-learning readiness include software, hardware, connectivity, security, system flexibility, technical skills and support, and the availability of a data centre (Al-araibi, bin Mahrin, Yusoff, & Chuprat, 2019). Such technological capacity is a key bottleneck in developing and emerging countries, with e.g. 87% of the Jordanian students surveyed in Al-adwan and Smedley (2012) who “did not have access to a reliable computer [...] in good working order that did not normally crash and had all necessary software installed”. To the extent that the unequal distribution of such technological capacities reflects underlying socioeconomic inequalities, these digital divides exacerbate educational inequality as learners in the Arab world’s small towns and rural areas struggle to access e-learning offers (Adham & Lundqvist, 2015), while well-educated and digitally literate learners are well-placed to take advantage and benefit most from e-learning opportunities. With access to mobile phones in developing countries steadily growing, interest in mobile learning (M-Learning) and the use of social media for learning and teaching has risen in the last years, although proper adoption of M-Learning in the Middle East will require more awareness, training and motivation (Khan, Al-Shihi, Abdullah, & Sarrah, 2015). Nevertheless, it has the potential to offer easier access to education for learners without access to the infrastructure needed for online education and is well accepted among students (El-Sherbiny Attalla, El-Sherbiny, Mokbel, & El-Moursy, 2012). Through approaches such as bring-your-own-device (BYOD) or mobile learning programs, though with challenges of their own, can be implemented at “low cost and high speed” (UNESCO, 2012; p.22). The use of social media for learning purposes goes hand in hand with M-Learning adoption. Sobaih, Mohamed, and Ghandforoush (2016), for example, showed that though underutilised among teachers, social media (e.g. Facebook, WhatsApp) can have a high added value for academic purposes in Egypt. Nonetheless, traditional technologies such as printed material, radio, television and instant messaging can still be effectively used for education in those (rural) areas where the lack of ICT infrastructure remains a key constraint (Gulati, 2008; World Bank, 2020). Finally, reliable and affordable access to electricity often remains an impediment to e-learning in many developing countries, albeit not in Egyptian higher education.

### ***Digital skills***

As teachers and learners are key e-learning users (Kim & Park, 2017), their ability to use digital devices and the internet effectively – their digital skills – makes them more likely to accept e-learning. This is underlined in Abbad’s (2009) observation of prior digital experiences, such as frequency of internet use, as a success factor for the adoption of e-



learning by Jordanian students. Concurring, Al-Adwan, Al-Adwan, and Smedley (2013) highlight a lack of ICT skills and confidence in technology use as significant barriers to e-learning adoption in Jordan, whereas Kanwal and Rehman (2017) highlight a positive influence of computer self-efficacy and internet experience on Pakistani students' perceptions of e-learning's ease of use (see further below). As for teachers, Ahmed (2013), for instance, finds that their intention to participate in e-learning systems increases with their experience with computers and the internet and their perceptions of the possibility to test e-learning prior to implementation. More elaborately, using data from the private Egyptian university, El Afly, Gómez, and Ivanov (2017) find that teachers' technological readiness has a direct negative effect on their intentions to adopt e-learning, perhaps because they anticipate implementation challenges, but increases them by generating more positive attitudes towards e-learning technology. The lack of awareness of the fundamentals of e-learning is another obstacle mentioned in the literature, with e.g. El-Gamal (2014; p.199) attributing Egypt's slow adoption of e-learning in spite of technological readiness to a lack of knowledge about e-learning. This leads to it being perceived as "only limited to providing more educational opportunities to a limited sector of students in non-practical fields". This lack of awareness is also one of the biggest challenges in the use of MOOCs in the Arab world (Adham & Lundqvist, 2015). More generally, Bhuasiri et al. (2012) emphasises raising technology awareness as important for successfully implementing e-learning solutions in developing countries. Importantly, teachers' and learners' e-learning adoption is affected differently by personal factors in the use of ICT (Kim & Park, 2017), as teachers' previous computer experience and ICT innovativeness have a stronger effect on computer self-efficacy and technology use. This could be explained by the fact that students are generally better prepared to benefit from e-learning initiatives through their relatively higher exposure to ICT whereas teachers require more technical support, e.g. to digitalise learning materials (Shraim & Khlaif, 2010).

### ***E-learning System***

Independent of the technological capacities and digital skills of its users, the characteristics of the e-learning system have a strong influence on its adoption. Particularly important among these characteristics is how easy it is for both learners and teachers to use the e-learning system (Abdel-Wahab, 2008). For example, ease of use is fostered by making e-learning systems in general and e-learning interfaces in particular informative, interactive and/or simple, especially for inexperienced users. Integrating e-learning systems with different multimedia may further foster the perception of ease of use by increasing users' enjoyment. This also applies to various features the e-learning system might offer; e.g. in El-Seoud et al. (2014), students in Egypt highlight their interest in using e-learning to be

able to give and receive feedback on activities, to vote on priority topics, and to share research papers and other files. However, achieving satisfactory levels of the ease of use of e-learning systems is particularly challenging in developing countries where access to information and communication technologies (ICT), especially for disadvantaged groups and people in remote areas, remains an issue, as good quality devices and high-speed internet are needed to exploit e-learning's potential fully. Although scarcely mentioned in the literature, the content and relevance of e-learning can also be assumed to play a key role in whether e-learning is adopted.

### **Organisational support**

While adopting e-learning, teachers and learners may benefit strongly from dedicated organisational support. Such organisational support may e.g. target technical bottlenecks through tech support, raise the use of e-learning among teachers through instructional support or improve students' perceptions of ease of use and usefulness through offers of computing support and training (Lee, 2008; Zheng, Wang, Doll, Deng, & Williams, 2018), with e.g. Kanwal and Rehman (2017) suggesting to make computer training a prerequisite for graduate programmes in Pakistan. Computer training is also essential for teachers, for instance, Sadik (2007) finds that the majority of teachers from a wide range of faculties at South Valley University in Egypt considered themselves to have "limited competence and little experience in e-learning", although "they perceived e-learning [...] to have the potential to support their teaching-related activities". Organisational support is also essential for teaching teachers how to use ICT to develop content or transform existing content for the use in e-learning formats, which teachers otherwise need to invest additional time and effort into in addition to their regular workload (Al-adwan & Smedley, 2012; Farid et al., 2015), which can disincentivise them from engaging in e-learning.

### **Culture**

A growing body of research studies the cultural aspects of technology acceptance e.g. Strite and Karahanna (2006), and specifically e-learning acceptance within the Arab culture. Therein, key aspects include the consideration of local cultural values when introducing new technology, which may require a more locally participative approach to e-learning, e.g. in terms of co-creating the content and technological format of MOOCs (Bali & Aboulmagd, 2020). Moreover, students' motivation and behavioural intentions towards the use of e-learning are related to the cultural factor, with Arab learners accustomed to a teacher-centric education process struggling with self-directed and unsupervised learning (Al-adwan & Smedley, 2012; Adel, 2017; Weber & Hamlaoui, 2018). Furthermore, students in Arab cultures are highly sensitive to the influence of their peers and teachers or other social structures (see e.g. El-Masri and Tarhini (2017) for evidence from Qatar), which

implies that raising the general acceptance of e-learning in students' social environment may be highly effective, e.g. by mandating the use of e-learning systems and/or convincing early adopters through e.g. social media about the advantages of e-learning (El-Masri & Tarhini, 2017; Tarhini, Hone, Liu, & Tarhini, 2017).

## Data

This paper uses the 2018 wave of the Egypt Labor Market Panel Survey (ELMPS), a comprehensive longitudinal and nationally representative panel survey (Krafft, Assaad, & Wahedur Rahman, 2019), which covers 61,231 individuals from 15,746 households from all governorates except North and South Sinai, New Valley, Red Sea and Matrouh. Data were collected mainly from late April till November 2018. Analytical sampling weights provided as part of the ELMPS are used to make the results representative at the national level. The data analysis uses data from two nationally representative samples: (a) a sample of 1,131 persons currently studying in higher education (college or university) in 2018 and (b) a sample of 42 persons teaching in higher education in 2018. Descriptive statistics for these samples can be found in panels A and B of Table 1. In terms of residence, nearly 46% of students live in the Delta, followed by 25% living in Upper Egypt, 18% in Greater Cairo, and 11% in Alexandria and the Suez Canal region. We identify persons working in education through their occupation group, which follows a modified version of the International Standard Classification of Occupations (ISCO), and we focus on teachers in higher education. Unfortunately, the ELMPS does not permit to identify professionals, e.g. research professors, teaching at university if doing so is not their main activity or they belong to special types of education (e.g. musical education). Using this restrictive approach, we obtain a sample of 42 observations. Finally, the ELMPS 2018 has extensive information on access and use of ICT, including on (home-based, personal) ownership of ICT devices, internet access and (purpose of) use as well as computer skills as job requirements, which are marshalled to proxy individuals' digital skills.

Table 1: Sample characteristics of higher education students and teachers

	Panel A: Higher education students			Panel B: Higher education teachers		
	Mean	Median	Min / Max	Mean	Median	Min / Max
Female (%)	48.84	-	-	47.36	-	-
Age	21.85	21	18 / 98	44.12	39	25 / 73
Rural (%)	46.90	-	-	54.73	-	-
Observations		1,131			42	

Source: Own calculations based on ELMPS 2018.

## Analysis

As highlighted in Section 2, a key prerequisite of e-learning are students' and teachers' technological capacities. Starting with students, key statistics are presented in Figure 1.

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Overall, while only a quarter of students own a computer or tablet and another quarter could access one at home (which may be used by others), at least 80% own a mobile phone capable of connecting to the internet. Only 9% do not have home-based or personal access to a computer, tablet, smartphone, or internet-capable mobile phone. At home, only 37% of students have access to rapid DSL internet, which is generally a prerequisite for flat-rate internet access, although an additional 37% use the internet through data plans on their mobile phones. For 85% of higher education students, home is the place where they use the internet most frequently, therefore the quality of home-based internet access is important, especially if other pathways of access – e.g. at work or at friends' places – become restricted due to lockdowns.

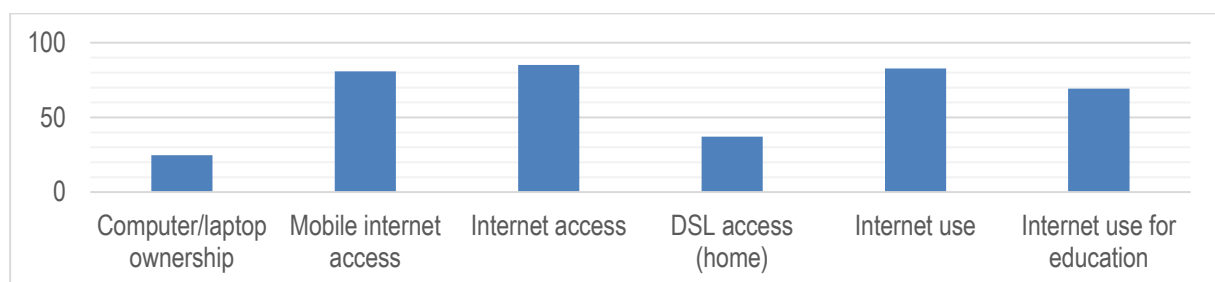


Figure 1. Share of higher education students by technological capacity and digital skills (Source: Own calculations based on ELMP52018)

However, while students' technological capacities are a necessary condition for most types of e-learning, they may not be a sufficient one, as digital skills are a clear predictor of successful e-learning adoption (see Section 2). Taking the perspective that internet skills are experientially acquired through internet use, it is worth highlighting that 82% of students were using the internet through their mobile phones or computers. However, only a third of students had used the internet through a computer or tablet in the month prior to the interview, thus again pointing to the dominance of mobile internet. Positively, already 69% of students using the internet list education or their studies among the top three purposes for their internet use, with 56% highlighting education as the main reason; besides education, access to news and information as well as socializing and communicating with friends are also highlighted as key purposes of internet use.

There are significant gender differences in technological capacities among students. First, while 84% of male students own a mobile phone and use it to access the internet and 28% own a computer or tablet, only 77% and 21%, respectively, of female students do. By contrast, 74% of female students highlight education as one of their top reasons for internet use, compared to only 65% of male students. Important differences in access to e-learning also exist depending on students' household wealth score: whereas 97% of students belonging to the top quintile of wealthiest households have home-based or mobile access to the internet, that share drops to slightly more than 50% for students from the bottom

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quintile. Similarly, as shown in Figure 2, the share of students with internet access varies strongly across governorates, being particularly low in Sharqia, Suez, and especially Aswan governorates. It also displays a clear rural-urban divide, with the share of urban students with internet access about 10 percentage points higher than that of students living in rural regions.

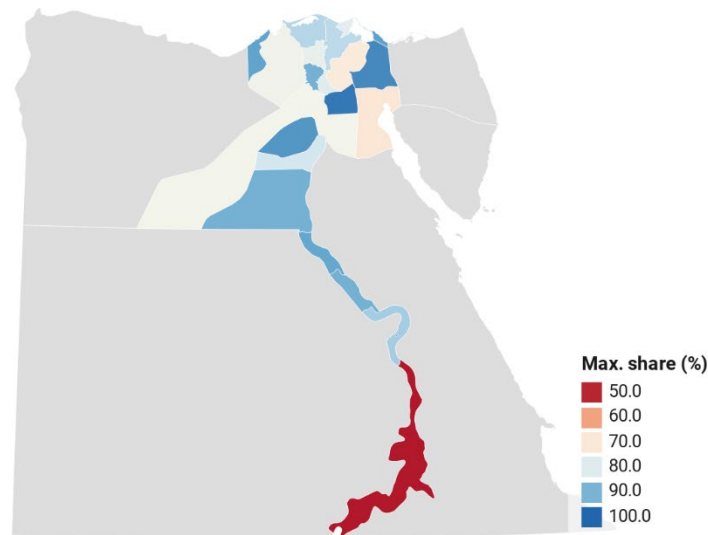


Figure 2. Share of higher education students with internet access by governorate (Source: Own calculations based on ELMPS2018)

Turning to higher education teachers, only 13% of them do not own a computer or tablet or could access one at home, which suggests that the vast majority of personnel doesn't have to rely on access to devices at higher education institutions in case of lockdowns. In line with the view that higher education personnel is experienced in using computers and the internet, nearly 90% indicate that they use a computer connected to the internet at work, while 87% confirm that computer skills are part of their job requirements. However, it is not clear how comfortable teachers are in terms of using the internet, as 43% hadn't used the internet on a computer or tablet in the month prior to the interview, which suggests that – as with students – teachers tend to rather use the internet through their mobile phones. Through whatever means that access may take place, among those using the internet, 87% of teachers list using the internet for work among the top 3 purposes for its use, including 74% who use it primarily for work. Finally, only one person in the teacher sample mentioned a computer course as the main training programme for their job.

## Conclusion & Recommendations

Considering the Egyptian government's efforts to use e-learning as a substitute for presence-based education during the COVID-19 pandemic, this paper studies the pre-conditions for successful e-learning in higher education in Egypt. Overall, the paper

confirms that Egyptian higher education largely meets key pre-conditions for e-learning in terms of technological capacity and digital skills. Over 90% of students have access to the internet, although affordable access to rapid internet remains an issue, as most students access the internet through mobile devices. Widespread computer and internet use, including with a strong focus on internet use for education purposes, suggest that students' digital skills are generally well-developed. However, students' technological capacities and digital skills reflect important divides along gender, socioeconomic background, and location. Finally, higher education teachers appear to be largely well-prepared, as most have access to digital devices and computers and three quarters of teachers already use the internet for their work.

Several caveats need to be mentioned. First, the data used in this study are from 2018 and thus neglect the substantial efforts undertaken by the Egyptian government in 2019 and early 2020 to improve the state of ICT and the use of technology in higher education. Second, because it does not have data from North or South Sinai, Matrouh, Red Sea and New Valley governorates, the ELMPS falls short of covering the whole of Egypt, although the ELMPS nonetheless provides representative results for over 98% of the Egyptian population since those governorates are among the least-populated. Third, this study makes claims about the viability of e-learning based on technological capacities and digital skills as key prerequisites. However, it does not directly observe e-learning outcomes nor address alternative success factors, e.g. organizational support or culture, since such data is not available in the ELMPS 2018.

These caveats notwithstanding, the analysis points to several important policy implications. First, although M-Learning is still in its infancy in Egypt, it is worthwhile looking into M-Learning solutions considering that they are well-accepted among students, require relatively low technical capacities, and that nearly all students and teachers own mobile phones and use them to access the internet relative to other devices. Second, linking social media with e-learning solutions could play an important role in fostering learning since (a) students already use the internet to socialize, (b) social media tend to have particularly user-friendly interfaces that make them especially easy to use for inexperienced users, (c) can increase the acceptance of thusly augmented e-learning solutions through social media's entertainment and socializing functions, (d) generally don't require additional introduction or training. However, care needs to be taken to avoid social media from distracting students and reducing their engagement in e-learning. Third, given that students tend to use the internet for entertainment and socializing purposes, functions like instant messaging, topical voting options, pop quizzes, feedback functions, etc. should be integrated in mobile and e-learning design in order to increase students' acceptance, especially since many students don't have access to internet flat-rates. Fourth,

promoting interactivity as part of mobile learning, especially in connection with social media, may also increase students' acceptance through peer effects, a point likely to be particularly salient in the cultural context of MENA. Fifth, it is essential for institutions to provide instructional support and computer courses to teachers, be it online (through professional development offers or online technical support) or offline (e.g. as a hotline). Moreover, teachers must be incentivized to invest sufficient time and effort in designing e-learning solutions (e.g. in terms of financial rewards or career development). Sixth, considering the digital divides highlighted in the analysis, the government should ensure that marginalized students can participate in e-learning, e.g. by improving internet access in Aswan, Sharqia and Suez, providing students from poor households with internet vouchers or by offering female students without internet-compatible devices opportunities to purchase devices at subsidized prices. Finally, it is important to bear in mind that the policy recommendations are attuned and specific to the COVID-19 pandemic and may not be generalizable to other situations without further analysis.

E-learning in Egyptian higher education presents several extensions for further research. First, while e-learning is most prominent in higher education, it would be of interest to expand the analysis of this paper to other sectors of education. Second, process and impact evaluations of the e-learning initiatives undertaken in Egypt in response to the COVID-19 pandemic would be of interest in order to better understand what challenges and bottlenecks were faced and how the policy measures impacted students' education and labour market outcomes, a vital aspect in informing Egypt's response in case of future epidemics. Third, specifically regarding the integration of social media approaches, further research and especially data from learners is needed before reaching more general conclusions.

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## **SUPPORTING VIRTUAL MOBILITY SKILLS IN A MOOC: PRELIMINARY RESULTS**

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### **Abstract**

In the last years, the concept of *Virtual Mobility* has receiving a growing attention from educational policy makers and institutions, because it has the potential to make more accessible and effective students and teachers mobility in Higher Education. Virtual Mobility could be defined as institutional ICT-supported activities that trigger or facilitate international collaborative experiences in the context of teaching and/or learning. Despite the interest, there is still a few empirical researches regarding actual effectiveness of Virtual Mobility implementation and which technological solutions could be adopted. The present paper describes a research project aimed at designing an Open and Accessible Virtual Mobility Massive Open Online Course, by involving students and teachers from six European countries and higher education institutions. 716 participants completed and assessed the Open Virtual Mobility MOOC. Participants expressed a positive evaluation of different MOOCs features: (a) Badges; (b) Technical features; (c) Gamification. Four out of eight MOOCs obtained the highest evaluation: (a) Collaborative learning; (b) Autonomy-drive learning; (c) Open-mindedness; (d) Intercultural skills. Future research trajectories would be described.

### **Introduction**

Many institutional mission statements and national higher education strategies aim to prepare students to live in a globalized world in which they are being challenged to become global citizens (Teichler, 2004). The strategies to achieve the internationalization goal in higher education have been changed their nature in recent years. Among these, virtual mobility experience and projects have been developed to complement or substitute for physical mobility (de Wit & Hunter, 2016). Virtual mobility initiatives were indicated as one of the cost-effective ways to increase the access to educational mobility by Maastricht message in 2009 (ICDE Executive Committee, EADTU Executive Committee, 2009). According to the European Commission, youth mobility and academic mobility can foster

a genuine European area of knowledge and contribute to the competitiveness of the European economy.

Despite the growing acknowledged of Virtual Mobility, only a few researches have investigated the impact of Virtual Mobility initiatives on participants, and most of them includes small scale studies (Hilliard, 2004; Frydenberg & Andone, 2010; Costa & Balula, 2014; Poce, Amenduni, Re, & De Medio, 2020). A large-scale study was conducted by Poulová, Černá, and Svobodová (2009) with a group of more than 2000 participants in a time-frame project of four years to assess the efficiency of a Virtual Mobility program that involved 8 European Universities. They found out that less than 50% of students who started the program passed their subject and gained the final credit. From the analysis of a survey, they identified different reasons of the students' drop-out, included a lack of self-regulated students' skills, especially in terms of time management and study-goal settings. Although more research is necessary to understand what are the most important variables of a successful Virtual Mobility experience, the results of the previous experience suggest the critical role of participants' transversal skills in Virtual Mobility Experience. Rajagopal and Firssova (2018) recently identified 8 transversal knowledge and skills necessary to be involved in a Virtual Mobility experience, by applying a group concept mapping methodology and involving 49 experts in the domains of virtual mobility: (a) Intercultural Skills; (b) Collaborative learning; (c) Autonomy-driven learning; (d) Networked Learning; (e) Media and digital literacy; (f) Active self-regulated learning; (g) Open mindedness; (h) Knowledge of Virtual Mobility and Open Education.

A Massive Open Online Course (MOOC) aimed at developing the eight transversal skills identified by Rajagopal and Firssova (2018) has been developed by the authors of the paper in the context of the Erasmus+ project "OpenVM: Opening Education for Developing, Assessing and Recognising Virtual Mobility Skills in Higher Education". The project is based on the idea that VM could be enhanced by adopting the principles of open education in the Open Virtual Mobility MOOC, a massive open online course aimed at developing Virtual Mobility Skills in higher education students (Buchem et al., 2018; Buchem, Tur, & Urbina, 2018). The need to adopt a non-formal approach to virtual mobility based on the principles of Open Education has been recognized by many authors (Tovar & Lesko, 2014; Wilson et al., 2011). Open education is understood as a mode of undertaking education using digital technologies and providing alternative, less restrictive access routes to formal and non-formal education. This broad perspective enables a comprehensive view, thus encompassing, for instance, Open Educational Resources (OERs), MOOCs, and recognition of open learning. MOOCs are now being considered and applied by many institutions around the world as a valid internationalization instrument (Knight, 2014). However, Amirault and Visser (2010) show that virtual program offerings do not

automatically cross borders, nor result in the same effects everywhere. The context of the partnership of the European Project allows to involve students from 6 European countries and institutions: Roma Tre University (Italy); Beuth University (Germany); Universitatea Politehnica Timisoara (Romania); Universitat de les Illes Balears (UIB), AUNEGE, Open Universiteit – Welten Instituut (Netherlands).

## **The Open VM MOOC design and structure**

The aim of the Open VM MOOC is to help educators and students developing a defined set of VM skills and applying them to Virtual Mobility programs, actions and activities in various academic disciplines (Yuan & Powell, 2013). The MOOC Canvas (Alario-Hoyos, Pérez-Sanagustín, Delgado-Kloos, 2013) was adopted to support the design, and to promote discussions between the different project partners involved in the creation of a MOOC. In line with the features proposed by Bates (2015), the OpenVM MOOC was conceived in conformity with the xMOOC definition.

Eight areas have been identified (Rajagopal & Firssova, 2018) as main contents for the OpenVM MOOC: (a) Intercultural Skills; (b) Collaborative learning; (c) Autonomy-driven learning; (d) Networked Learning; (e) Media and digital literacy; (f) Active self-regulated learning; (g) Open mindedness; (h) Virtual Mobility Knowledge. For each area, a miniMOOC was created. Three levels are then proposed for each miniMOOCs: (a) foundation level: focused on knowledge acquisition; (b) intermediate level: focused on knowledge application in a collaborative learning environment; (c) advanced level: focused on self-reflection and meta-reflection. Each miniMOOC has a pre-assessment activity: participants are required to fill in a quiz and, according to the score they obtain, they will be directed to the foundation level, intermediate level or advanced level. Each combination between the level and the miniMOOC is defined a subMOOC. Thus, the OpenVM MOOC is composed by 24 subMOOC, 8 miniMOOCs for 3 levels (Figure 1). Each subMOOC has different forms of assessment and tasks. More specifically, in the foundation and in the intermediate levels there are mainly quizzes (e.g. multiple choices, true or false and drag and drop exercises), whilst in the advanced level there are also e-portfolio and peer-assessment activities. In the intermediate level, there are also collaborative learning activities, supported by the use of the Matching tool, an algorithmic solution for building learning groups (Konert, Burlak, & Steinmetz, 2014). At the end of each subMOOC, participants obtain a badge that certifies the skills acquired in that specific subMOOC.

## **The pilot-phase iterations**

The pilot-phase was realized in order to understand how OpenVM MOOCs participants assessed the quality of the MOOC main components. We tried to answer the following research questions:

## Supporting Virtual Mobility Skills in a MOOC: Preliminary Results

- To which extent students enjoyed the OpenVM MOOC design and its main components?
- Are there any differences in the assessment of the 8 miniMOOCs and subMOOCs?

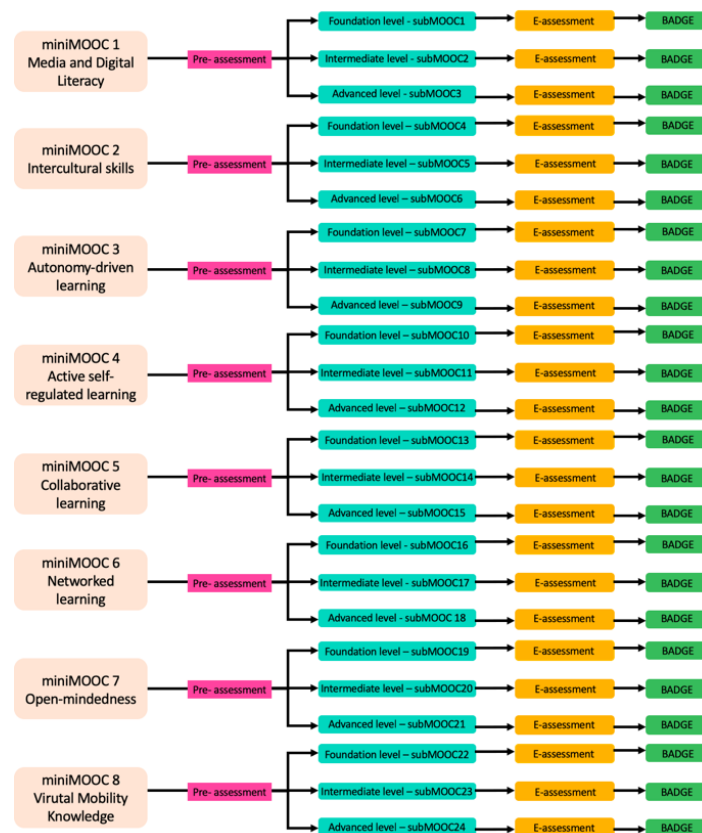


Figure 4. The OpenVM MOOC structure

At the end of the subMOOC, MOOC participants (N = 716) were invited to fill in an online questionnaire, designed by the authors and implemented by other involved partners. OpenVM Evaluation Questionnaire is organised in eight sections. In all eight sections participants were required to express their level of agreement with a set of statements related to specific MOOC design elements on a Likert scale from 1 – *strongly disagree* to 5 – *totally agree*. OpenVM Evaluation Questionnaire was created using a Google Module and encompasses eight sections:

1. Personal details: age, gender, affiliation and role. In this section participants are required to say which of the eight mini-MOOCs they are assessing;
2. Questions regarding the overall MOOC design: learning experience, quality of content instruction and support for learning;
3. Questions regarding digital credentials and meaningful gamification: quality of design, motivation, engagement and possibilities of choice;
4. Questions regarding technical aspects: use and usability;

### Supporting Virtual Mobility Skills in a MOOC: Preliminary Results

5. Questions regarding the foundation level of a mini-MOOC: duration, language, content, use of multimedia;
6. Questions regarding the intermediate level of a mini-MOOC: extending questions from the foundation level by questions related to the matching tool and group formation activity, which are specific design elements used at this level;
7. Questions regarding the advanced level of a mini-MOOC: extending questions from the foundation and intermediate levels by questions related to e-portfolio and peer-assessment activities, which are specific design elements at this level;
8. Questions related to the investigation about the extent to which MOOCs supported self-regulated learning. In this section participants are required to answer also to open-ended questions.

Descriptive statistics (average, standard deviation, frequencies) were calculated in order to answer to the abovementioned research questions

## Results

716 (F = 498; M = 215; Not specified = 3) participants took part in the pilot-phase. Most of the participants were university students and only 14 teachers participated in the survey. As shown in Figure 2, 27% of participants participated and assessed the MOOC “Active Self-regulated Learning”, followed by Media and Digital Literacy (22%), “Open-mindedness” (15%), “Intercultural Skills” (14%), “Networked Learning” (7%), “Autonomy-drive learning” (6%), “Collaborative Learning” (5%) and “Open Education and Virtual Mobility”.

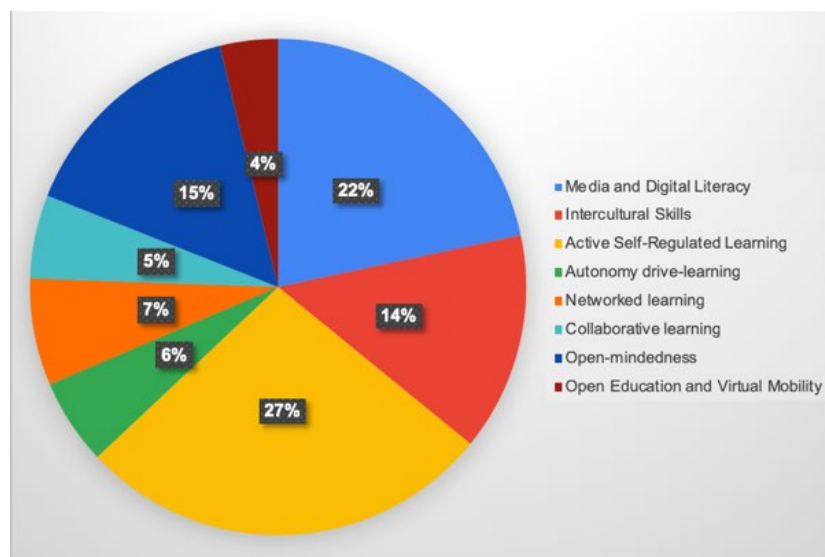


Figure 2. Percentage of participants who attended each miniMOOC



The results of the OpenVM MOOC evaluation and its main components are presented in Table 1. The general evaluation of the MOOCs quality was quite positive. The average score for each MOOC is always higher than 3.5 out of 5 points (we used a Likert Scale from 1 to 5, where the median is 3). Also, the general evaluation of the badges was quite positive. The average score for badge is always higher than 3.5 out of 5 points. The general evaluation of the gamification features was still satisfactory because the average score was more than 3. However, it was lower than the technical features evaluation of the MOOCs was quite positive. The average score for each MOOC is always higher than 3.5 out of 5 points and the total average was 3.79. skills. From a general overview we can conclude that four MOOCs at the moment were the best assessed: (a) Collaborative learning; (b) Autonomy-drive learning; (c) Open-mindedness; (d) Intercultural skills.

## **Discussion and conclusive remarks**

In the context of the Erasmus + Open Virtual Mobility, a Massive Open Online Course (MOOC) aimed at developing the eight transversal skills identified by Firssova and Rajagopal (2018) has been developed. The present study describes the assessment results collected by 716 participants who participated in a pilot phase from September to December 2019. Participants expressed a positive evaluation of different MOOCs features: (a) Badges; (b) Technical features; (c) Gamification. Four out of eight MOOCs obtained the highest evaluation: (a) Collaborative learning; (b) Autonomy-drive learning; (c) Open-mindedness; (d) Intercultural skills. Future research would be necessary to understand the reasons why these four MOOCs are preferred compared to the other. One possible explanation is that the other MOOCs, specifically the Media and Digital Literacy MOOC, the Networked MOOC and the Open Education and Virtual Mobility are based not only on transversal skills but also on digital and technological skills and they could be considered more difficult. In addition, the MOOCs “Collaborative learning, Autonomy-drive learning” and “Open-mindedness” were not formally introduced by University teachers partner but they were chosen spontaneously by the participants. This could indicate that they were more motivated and interested in the topic of the MOOCs compared to the participants who were formally invited to follow a specific MOOC chosen a priori by the teacher. In order to better understand the impact of the MOOC on the student’s experience, it would be necessary triangulate different sources of information. In future research, we are going to integrate the survey results with analytics collected by the platform.

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Table 1: The results of the OpenVM MOOC evaluation and its main components

General evaluation of the MOOCs			
	Average	N	SD
Networked learning	3.5945	50	1.02593
Media and Digital Literacy	3.6938	155	0.65947
Collaborative learning	3.7203	39	0.72619
Active Self-Regulated Learning	3.7381	194	0.6769
Open-Education and Virtual Mobility	3.7542	27	0.61802
<b>Average</b>	<b>3.7689</b>	<b>716</b>	<b>0.72937</b>
Open-mindedness	3.8182	109	0.769
Autonomy drive-learning	3.8477	40	0.72797
Intercultural Skills	3.9661	102	0.71558
Badge evaluation			
Active Self-Regulated Learning	3.5351	194	0.78093
Networked learning	3.56	50	1.06904
Media and Digital Literacy	3.591	155	0.84741
Intercultural Skills	3.6922	102	0.76853
Open-mindedness	3.7193	109	0.84989
Collaborative learning	3.7385	39	0.83874
Autonomy drive-learning	3.93	40	0.72402
Gamification features evaluation			
Networked learning	3.18	50	0.94868
Collaborative learning	3.2487	39	0.69995
Media and Digital Literacy	3.2613	155	0.66189
Active Self-Regulated Learning	3.2964	194	0.62216
Open Education and Virtual Mobility	3.3148	27	0.6125
<b>Average</b>	<b>3.3226</b>	<b>716</b>	<b>0.68037</b>
Open-mindedness	3.3917	109	0.69949
Autonomy drive-learning	3.41	40	0.68605
Intercultural Skills	3.4578	102	0.63315
Technical features evaluation			
Open Education and Virtual Mobility	3.5704	27	0.66957
Networked learning	3.6449	49	1.09412
Media and Digital Literacy	3.6768	151	0.8339
Active Self-Regulated Learning	3.7403	191	0.71642
<b>Average</b>	<b>3.7946</b>	<b>704</b>	<b>0.8078</b>
Collaborative learning	3.8378	37	0.78717
Autonomy drive-learning	3.88	40	0.77499
Open-mindedness	3.9	108	0.83184
Intercultural Skills	4.0436	101	0.74222

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## About the Authors

A. Poce coordinated the research presented in this paper. Research group is composed by the authors of the contribution that was edited in the following order: A. Poce (Introduction, Discussion and Conclusive Remarks) F. Amenduni (The OpenVM design structure), M.R. Re (The pilot phase iterations), C. De Medio (Results).

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Exchange of Good Practices, Strategic Partnerships for Higher Education, Project Number 2017-1-DE01-KA203-003494 (<https://www.openvirtualmobility.eu>). The creation of these resources has been (partially) funded by the ERASMUS+ grant program of the European Union under grant no. 2017-1-DE01-KA203-003494. Neither the European Commission nor the project's national funding agency DAAD are responsible for the content or liable for any losses or damage resulting from the use of these resources.

The project is coordinated by Beuth University which contributed to the assessment pilot phase, presented here, drafting the questionnaire administered with the first group of MOOC users. Data collected are described below.

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## INTRODUCING 360-DEGREE VIDEO IN HIGHER EDUCATION: AN OVERVIEW OF THE LITERATURE

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### Abstract

According to international research and institutions, the Higher Education sector needs to deeply innovate his didactic methodologies. In this sense, the integration and use of ICTs have been seen as a possible driver for the improvement of education' quality, and showed good affordances for teaching and learning in terms of engagement, communication and collaboration. New emerging technologies are now under experimentation, especially as for immersive environments from augmented to virtual reality. In this paper we will focus on 360-degree video, offering a first overview of its potential in educational contexts, as they emerge from a systematic literature review.

### Introduction

In the last decades, digital technologies have been viewed as a main factor of innovation of higher education. On one hand, information and communication technologies (ICT) have progressively penetrated academic practices of teaching and learning. More specifically, almost all European universities have undertaken initiatives related to online learning: as emerged from a survey carried out by the European University Association (EUA) in 2013 (Gaebel, Kupriyanova, Morais & Colucci, 2014), 91% of Higher Education institutions in Europe deliver blended courses, integrating traditional forms of teaching with online delivery methods, while 82% declared they offer online courses. This reflects a general trend on a global level, especially considering the industrialized countries. According to a 2013 ECAR international study on the state of digital education at university level (Bichsel, 2013), almost all organizations are interested in online learning: indeed, 80% offers a high number of online courses, while more than 50% provides a good number of digital programmes.

On the other hand, ICTs have been seen as a driver for the improvement of quality of education (Hénard & Roseveare, 2012). Several authors have emphasised the pedagogical affordances of digital devices highlighting their potential for teaching and learning in terms of increased level of collaboration, sharing and networking (Dron & Anderson, 2014),

living authentic experiences in safe spaces (see, for example, simulations) (Landriscina, 2012), creating digital artefacts (Hobbs, 2017) and so on. More recently, scholars have analysed the exploitation of digital emerging technologies, such as virtual learning environments (Boulton, Kent, & Williams, 2018), mobile devices (Crompton & Burke, 2018), virtual reality (VR) (Freina & Ott, 2015), augmented reality (AR) (Azuma, 1997), and 360-Degree video (Aguayo et al., 2017). In particular, it is increasing the attention towards computers and visualization technologies as means to improve productivity, quality, and safety in higher education (EDUCAUSE, 2019).

Although these emerging technologies are not new, their educational potential is still under examination. Indeed, the aim of the European Project SEPA360 – Supporting Educators in the Educational Application of 360 video is that of identifying possible benefits on learning related to the innovation of higher education didactics through the use of 360 videos. In this paper we will report some preliminary results of the scoping study carried out in the first months of the SEPA360 project: we will provide an overview of the literature on a specific device, which is 360-Degree video, which is gaining momentum for its increasing affordability. Before going into the results of the overview, some background is provided on main characteristics of devices supporting visualization for learning in order to better understand the potential of 360-Degree video for educational purposes.

## **Background**

Recent developments in immersive technologies – as for visualization and interactions – have made these devices increasingly attractive to scholars and educators. The latest VR head-mounted displays (HMDs) enable learners to have intensive immersive experiences. In literature, immersion is defined as “a perception of being physically present in a non-physical world by surrounding the user of the VR system created with images, sound, or other stimuli” which makes user feels to be actually “there” (Freina & Ott, 2015). In other words, immersion entails for the user to be disconnected with the real world in terms of time and space, while generating a sense of “being” in the task environment.

Looking specifically to VR technologies, they have been largely employed for professional learning and development in high-risk jobs such as engineer, fireman, and soldier mission, but also in higher education. It is based on two of the five senses, that is sound and sighting, and gives a sense of authenticity through a complete sensorial involvement. The standard mode of VR is a 3D animation that “can cause interactively at a mobile computer, commonly by a handle or the remote control so that the image of the digital content shift in some setting” (Jantakoon et al., 2019; p.145).

Great attention has also been payed to AR and the opportunities it offers for improving construction processes in situ. It integrates the physical world with related synthetic data,

so that virtual and physical objects do co-exist in an augmented space (Azuma, 1997). Several research studies have been carried out on AR applications improving on-site safety performance to some extent (Park, Lee, Kwon, & Wang, 2013). A crucial feature of AR is its interactivity, which provides relevant potential for teaching, learning and assessment. Students may develop new understandings grounded on experiences and interactions with virtual objects which bring underlying data to life.

As far as 360-degree videos are concerned, they are becoming more affordable (Aguayo et al., 2017), and mobile technologies have become powerful enough to play 360-degree videos (Martín-Gutiérrez et al., 2016). Experiencing real-life classroom events through 3D videos may give to the learners a sensory and imaginary feeling close to real-life experiences. To watch 360-degree videos seems to be more attractive for students since it generates an immersive experience, disconnecting the user from the “real world” (Olmos-Raya et al., 2018). It gives also a feeling of presence (Yoh, 2001) and a sense of embodiment (Kiltner, Groten, & Slater, 2012) in a virtual environment where the learner is engaged in a realistic and authentic situation, although he or she is not physically present.

## **Methods**

As underlined in the previous paragraph, international research is progressively approaching the theme of immersive technologies in order to evaluate their educational affordances: however, the analysis of the specificities of different technical solutions should be further carried forward, in order to understand possible learning gains and obstacles connected to 360-degree videos, 3D models, virtual and augmented reality. The European project SEPA360 specifically aims at investigating the potentiality of 360 video technology, defined as the results of a video recording that capture the complete surroundings utilizing two or more wide angle lenses and combining their images afterwards. A systematic review of the literature on the topic was realized in order to obtain an overview of current uses of 360 video in educational settings, with a focus on possible application to the higher education field. In this paper, we focus on the use of 360 video in education and answer the following questions:

- How is 360 video currently used in different educational settings and contexts?
- What type of research is carried out on the use of 360 videos?
- What are the technical issues, barriers and opportunities around the use of 360 video?

Based on our results, we draw the state of art of the topic, providing an overview of current literature as for descriptive characteristics, educational context, possible benefits/problems and typology of research design, thus identifying possible gaps to be covered in future research.



### ***Review process and literature search method***

The systematic review of the literature was conducted according to the PRISMA workflow (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). Six scientific databases were selected due to their coverage of peer-reviewed and educational research (ACM Digital library, EBSCO, ERIC, IEEE Xplore, SCOPUS, Web of Science). The keywords used for the database scan included 360 video written in different ways and possible educational areas of use. The query adopted was (“360 video” OR “360 degree video” OR “360-degree video” OR “360° video”) AND (“education” OR “university” OR “higher education” OR “professional development” OR “school”): a time and language constraint was applied in order to select only English contributions of the last 10 years. This search yielded 1024 papers: 38 were duplicates and were removed, thus obtaining 986 for the screening phase. In this phase, papers were excluded according to the following criteria: (a) focus only on technological topics or tools; (b) focus on simulation and virtual reality; (c) superficial use of the 360 video: the technology was mentioned, but not used for or central to the research. According to these criteria, 933 papers were excluded and 53 papers were considered for full-text analysis: at the end of the whole process, 28 papers were considered for the systematic review.

### ***Data analysis***

As for the analysis, the papers were coded and classified into different categories, which were defined by the SEPA360 team of researchers in the first project transnational meeting. One researcher therefore proceeded with the codification of the 28 papers, adopting the criteria discussed within the research group.

The fields identified attempted to capture: (a) the general document identity (Authors, Title, Year, Source Title, Publication Type, Geographical Area); (b) the research design (Research Area, Educational Level, Type of learning, Aim of the study, Type of study design, Type of Data Collected, Data Analysis Method, Sample); (c) the benefits and challenges of pedagogical application of 360 video (Learning gains, Benefits, Technical challenges). Underlying Theories, Methodological Approach, Research Applications). The data collected were analysed with descriptive statistics in order to summarize the variables studied.

### **Results**

In this section, we present the results according to the main categories and criteria of analysis explained in the previous sections, combining the data in order to gain a better understanding of the findings.

As a first step, we analysed the publications considering basic information about the documents such as year of publication, geographic area and document type. As shown in Graphs 1 and 2, it emerges that Europe is the geographical area with the highest number of publications (14), while it stands out South America and Africa have no one. As for number of publications, it has increased in the past three years (2017 to 2019), both for conference proceedings (18) and for journal papers (10). This trend highlights and confirms that the interest and use of 360 video is on the rise.

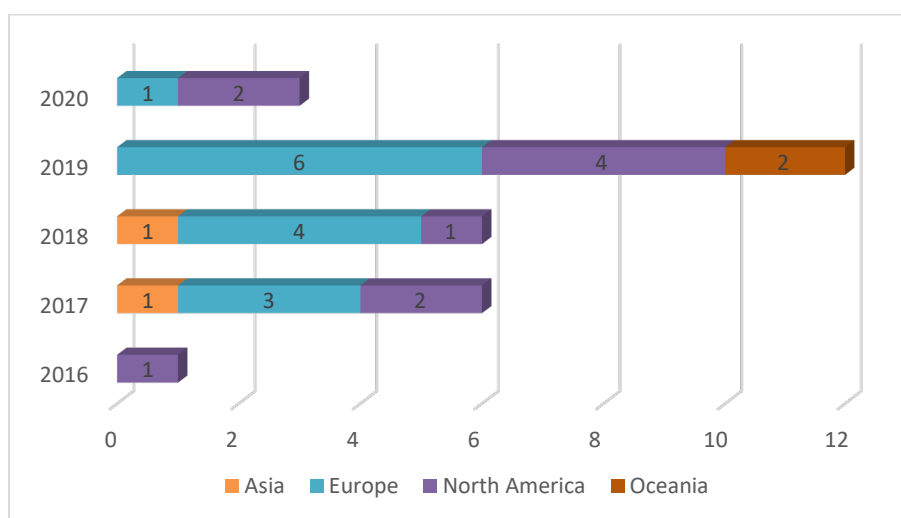


Figure 1. Number of publications per year divided by geographical area. The colour shows the details of the geographical area.

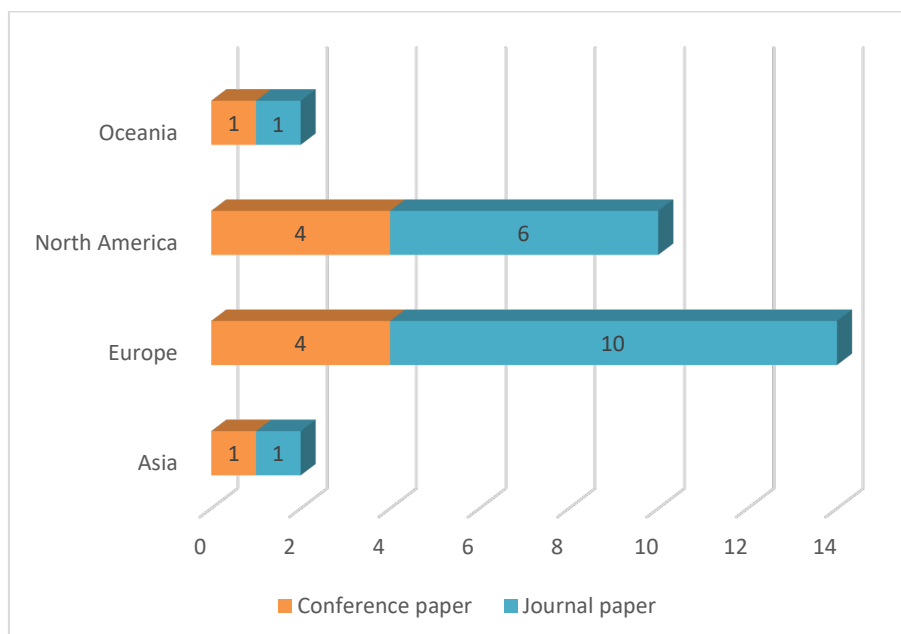


Figure 2. Number of publications per geographical area divided by document type. The colour shows the details of the document type.

Secondly, we analysed the publications according to the categories referred to the research design and results (Table 1). As for the educational context, most publications refer to

Higher education (24) and formal settings (27). Continuing the observation of the context, it is confirmed that the research area that denotes the greatest interest is the Scientific research area (Health Science, Science and Engineering) (11) followed by Education and Teacher Education (8). In these areas the 360 video is used in a profitable way to simulate operative procedures, laboratory experiments, physical environment, check which are the best technologies and the optimal workflow to make 360 video, and record the teacher in the classroom while conducting the lesson and analysing his work for understanding all the aspect of teaching. Unlike traditional video recordings, which usually provide a very restrictive perspective of an object, person or environment, 360 videos provide users with full spherical view, in order to enhanced realism, and make the experience more immersive and engaging.

Indeed, due to the greater interaction with content and environment, another area in which the interest in the use of 360 video is growing is Sport and Physical education (2) in adult learning and Higher education. The situated learning approaches with 360 videos evoke student to explore new learning behaviours and experience and make proactive adjustments on them.

Focusing on the students, learning gains and some problems emerge in the use of 360 video. The greatest benefits are obtained in terms of engagement (9) and, therefore, of learning, as thanks to the 360 video, compared to the 2D video, it is possible to keep students more involved, improve their attentiveness (6) and provide them with an enjoyable experience (13). The 360 video enable new viewing angles and learning scenarios that would not be possible without 360 video-techniques. A further benefit in the use of the 360 videos compared to the simulations made with VR, is the reduction in costs (4) necessary for their realization.

Table 1: Context, Benefits and problems as for learners or institutions

		Year	2016	2017	2018	2019	2020
Context	Research area	Arts & Humanities			3	1	
		Business		1			
		Commerce			1		
		Education	1	2		1	
		Engineering				1	
		Health Sciences		1	2	3	1
		Teacher Education				3	1
		Science				3	
		Social Science					1
		Sport/Physical Education		2			
	Educational Level	Adult Learning		1	1		
		Higher Education	1	4	5	11	3
		Primary School		1		2	
		Secondary School		2			
	Type of learning	Formal	1	6	5	12	3
		Informal			1		
		Non-Formal					

**Introducing 360-Degree Video in Higher Education: An Overview of the Literature**

Focus on learners	Learning gains	Attentiveness	1	1	3	1
		Cognitive skill			1	1
		Engagement	3	2	4	
		Information retention	1	3	1	1
		New learning behaviours		1		
		Reflective activities		1	1	
		Technical skill		1		
		Transfer of knowledge	1	2	3	
		Not specified	2	1	1	1
	Learners reactions / problems	Enjoyable experience	3	2	6	2
		Experienced technical hindrances			1	1
		Physical discomfort	1	3	5	1
		Not specified	2	3	5	
Focus on institutions	Benefits	Cost	1	3		
		Scalability	1	3	2	
		Not Specified	1	4	2	3

In spite of what one might commonly think, only seven publications reported problems in using the 360 video, detecting cases of uncomfortable feelings while using viewer headset: some students suffered from dizziness, nausea, anxiety about interaction or double vision. One publication conclude that it is harder to watch an immersive video as a class in a coordinated way, and it suggests that it is preferable to use it primarily for homework. Two other publications have mainly studied motion sickness and the results show that none of the students highlighted that physical discomfort.

## Conclusion

The results of the systematic literature review showed that research on 360-degree video has grown in the last three years still but it is still at his infancy: the topic is usually overlapping with different immersive solutions such as virtual or augmented reality that have been already fully experimented in educational contexts. Another limitation of current literature refers to the type of researches carried out: papers mostly describe application experiences, without providing affordable data on learning outcomes. Nevertheless, 360-degree video shows possible benefits in terms of students' involvement and satisfaction, even if the use of headset viewer can produce some physical or psychological reaction.

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## **DIGICULTURE – THE DEVELOPMENT OF OPEN EDUCATION LEARNING FOR DIGITAL SKILLS TRAINING**

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### **Abstract**

UniCampus, online learning environment started in 2014, as an attempt to provide the first Romanian language MOOC-like Massive Open Online Courses. For the development of the DigiCulture project we decided to extend the existing UniCampus platform with a new DigiCulture theme. This paper presents the technical development, based on the Moodle framework, with new user interactions. The DigiCulture project develops free, online short courses dedicated to adults with low digital skills. The shortage of digital skills in Europe reported in 2016 in “European Digital Progress Report EDPR” of the European Commission: 45% of Europeans have insufficient or no digital skills. As there are big differences between the countries that are partners in DigiCulture, we propose an integrated approach for course development, but with national personalization as language, study cases. These implementation and personalization are presented in this paper.

### **Introduction**

The shortage of digital skills in Europe reported in 2016 in “European Digital Progress Report EDPR” (ECDL, 2016) of the European Commission: 45% of Europeans have insufficient or no digital skills. Based on the Digital Economy and Society Index (DESI) (European Commission, 2016b) index of 2017 there are big differences between the countries that are partners in this project. Denmark has one of the most advanced digital economies in the EU, while Lithuania and Austria are in the middle, but Romania and Italy have the lowest scores on the DESI. Studies performed by authors in the cultural and creative industries (Ginsburg, Sabatini, & Wagner, 2000), in the last 3 years in different countries showed a large majority scoring lower or basic level for the 21 digital competences (Vorikari et al., 2016). The usage of web, mobile, social and analytical tools is permeating the length and breadth of the culture, creative industries, areas which until recently have been reluctant to embrace the use of the new technologies. Eurostat 2017 (European Commission, 2016a) identifies young adults from the creative industries as the

most at risk for unemployment from the 22-36 years old, and lack of entrepreneurial and digital skills.

We aim to create a sustainable and efficient open education program – DigiCulture – dedicated to adult learners with low digital skills and low-qualified adults involved in the creative industries sector. This paper analyses the need for such an educational program and presents the instructional modelling for an open, online and blended learning, training program based on a Massive Open Online Course model and the UniCampus virtual environment (Andone, Vasiu, & Ternauciuc, 2017). The modelling takes into consideration the existing UniCampus, which is further developed in order to integrate the requirements of low digital skills adults, Open Education, e-assessment and a mobile environment. The DigiCulture educational program is fully integrated in the UniCampus as an online component, a blended learning model and easy-to-access features in the mobile app.

## **Methodology**

The main research question of this paper is: how can we best adapt an existing Learning Management System (LMS), namely Moodle, to the specific requirements of non-technical learners, with the purpose of increasing the platform's effectiveness and level of adoption.

In order to answer this question, a qualitative approach was considered best suited. An exploratory analysis of the features considered essential for the adoption of the platform by low-skilled learners was based on the authors' multi-year experience in designing the necessary tools and the courses themselves, as well as in tutoring said courses.

The vast array of tools made available the open-source LMS Moodle was trimmed to the necessary minimum, and a large emphasis was placed on the functional usability of the platform from the point of view of the target audience. Starting with the building of a custom graphical interface, and continuing with testing and validating a suite of third-party extensions which provide – in part – the stated objective, we designed a simplified version of Moodle, aimed at non-technical learners, with limited digital skills as a whole, and e-Learning experience in particular.

## **Results**

The UniCampus platform started as an attempt to provide the first Romanian language MOOC-like courses. Development began in 2014, and by 2016 three courses were completed and piloted, with an additional two in advanced planning stages (Andone, Vasiu, & Ternauciuc, 2017).



The platform was based on Moodle, the popular open-source learning management system, which was completed with third-party extensions aimed at complementing and facilitating the learning process, all the while providing course participants with social media connections in line with the constructivist philosophy that Moodle promotes (Jordan, 2013).

Since its launch, UniCampus was constantly adapted to the needs of the users (course participants, course tutors, managers, etc.) and many extensions were functionally tested and uninstalled if found to be insufficiently useful. Moodle itself was affected by multiple updates, which were tested and validated inside the development environment, then applied to the production environment. Currently (January 2020), the UniCampus platform uses the latest Moodle 3.8 stable version, as well as the latest versions of the handful of extensions that were deemed useful for the aim of the platform.

Some of the plugins were not adapted by their developers once the newer Moodle versions were released, which led to broken functionalities. If those features were considered crucial to the platform, they were sometimes replicated by the developer team behind UniCampus.

One such extension is the graphical interface itself, which for the latest Moodle version required a complete rewrite. The current UniCampus theme was therefore entirely developed in-house, with the obvious advantages of complete control over the user interface and experience, as well as the possibility of functional optimizations, which are crucial for any MOOC-like platform catering to multiple concurrent users (Figure 1).

The starting point of the current interface was represented by the Classic theme, which was extended with the appropriate colours and graphical elements of the platform's visual identity.

Aside from simplicity, another directive of the graphical design philosophy was based on redundancy: controls we considered essential were duplicated in a top menu, via graphical icons leading users to a handful of critical aspects, such as the events calendar, the file repository, or the control preferences interface. The regular way of accessing these settings is also present, allowing users familiar with Moodle to continue to use the platform efficiently.

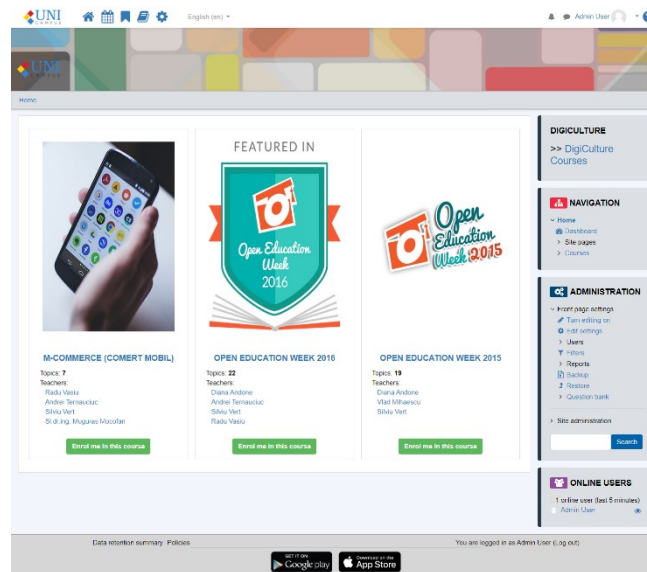


Figure 1. The UniCampus platform main interface

Most of the graphical elements were replicated in the new version of the theme, including the presentation cards for the featured courses on the frontpage of the platform. These cards were designed to provide at a glance all the relevant information for each featured course, including the cover image, the title, number of topics, list of tutors, as well as the direct link to the course for easy enrolment.

The same information is provided on the presentation website for the UniCampus courses, which is actually a completely different application than the Moodle-based UniCampus platform (Figure 2). The purpose of this interface was to provide an external perspective on the main platform's content, which suffers from most of the content management systems' shortcomings: adherence to strict mechanisms due to the Moodle framework, unnecessary complex handling of access controls, vulnerability to potential errors in the LMS's source code, etc. A simple presentation website, which reads the information directly from the database, provides unauthenticated visitors with all the necessary information needed before committing to the creation of an account with which to enrol in existing courses.

All of these considerations were based on the UniCampus stated objective of hosting MOOCs in the Romanian language. And since the intended users of such a platform include those with limited digital skills, the design of the application was directed from the start towards a user-friendly, optimized and efficient user-interface, available on a wide variety of devices.

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Figure 2. UniCampus presentation website

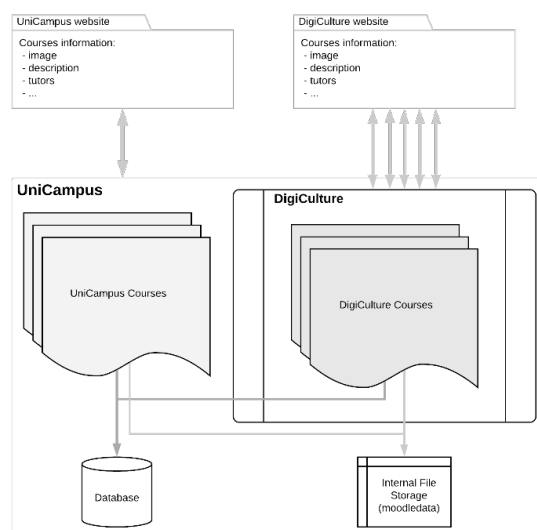


Figure 3. Integration of the DigiCulture application inside the UniCampus platform

This is the reason why for the development of the DigiCulture application aimed at hosting instructional courses, we decided to extend the existing UniCampus platform by creating

a separate section inside the course structure, in order to benefit from all of the facilities that the platform already provided (Figure 2). With a few improvements, we were able to seamlessly integrate the two applications which look and feel differently, but share the same underlying Moodle code. This greatly reduces the cost of maintaining multiple instances of almost identical platforms.

The most obvious difference is the graphical interface. The DigiCulture platform needed to follow the visual identity guides provided by the project, but still adhere to the restrictions of a Moodle theme.

The DigiCulture theme was therefore designed using the Moodle framework as the basis on which all the graphical elements and user interactions were built. And using Moodle's feature of allowing category themes (the possibility to use a different interface on all of the courses which are part of a certain category of courses, instead of the default template), we were able to switch the current theme by simply accessing the list of courses (or any individual such course) in the DigiCulture section of the platform. Also, in order to improve the appeal of the interface, the list of courses was replaced by a "card deck" of courses for each sub-category, similarly to the UniCampus featured courses display (Figure 3).

Another difference between the two platforms was the need for more interface languages. While UniCampus was aimed at Romanian users (and therefore provided only Romanian and English language packs), the DigiCulture project has partners from 6 different countries, which prompted the need for four additional language packs; these, luckily, were provided officially by Moodle via the administration interface.

One of the biggest changes that needed to be done was one in perspective. While UniCampus caters to users somewhat fluent in IT, the target group for DigiCulture consists of users with limited IT skills, mainly artists who are just beginning to grasp the fundamental concepts of the Digital World.

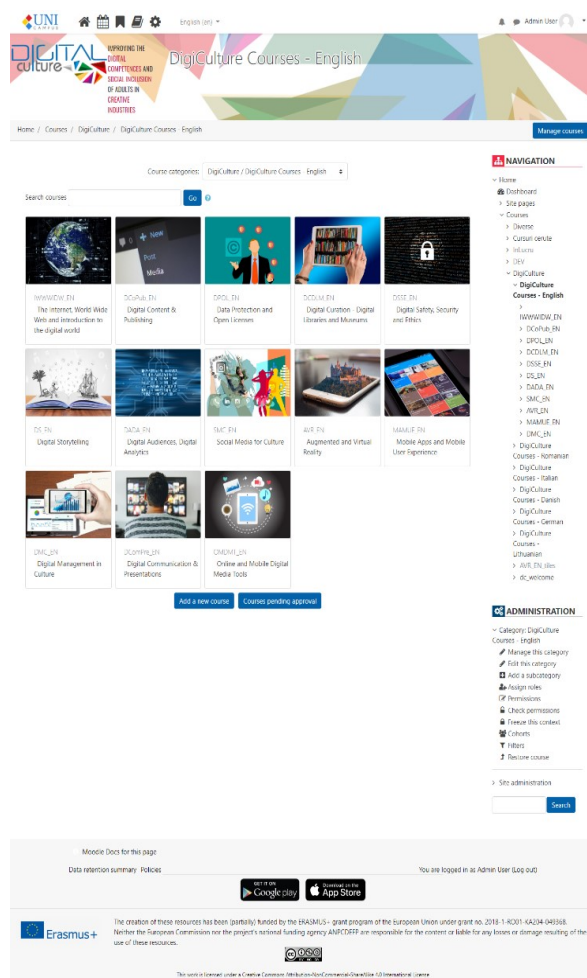


Figure 4. List of courses inside the DigiCulture category

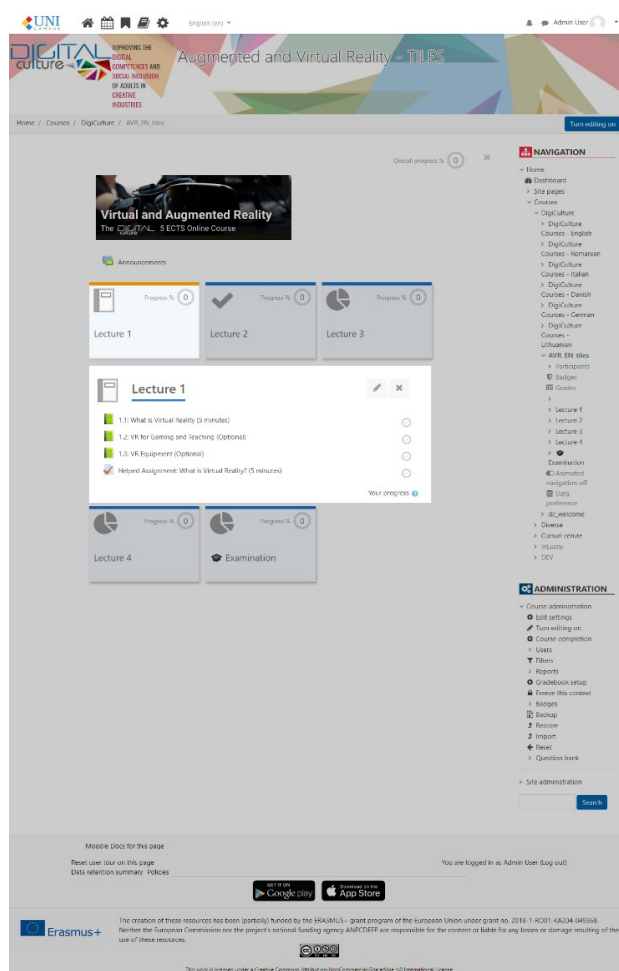


Figure 5. Course using the Tiles format

As such, we tested and ultimately chose an improved version of the standard course format (the way course activities and resources are organized), called the Tiles Format. This extension allows to efficiently access only parts of a course at a time, while providing relevant information like the number of resources/activities, the degree of completion, all in a visually pleasing package (Figure 4).

Of special interest is the ability to quickly visualize the current status of the course completion, since this course format can display the global course completion ratio, as well as a per-topic percentage of activities completed, according to the course completion criteria which were set-up by the course creators. This provides all learners with at-a-glance status report of their learning achievements.

In order to better promote the courses that were developed as part of the DigiCulture project, an API was developed aimed at easily bringing essential information pertaining to the courses to the project website (Figure 5). The information which is sent includes:

- The course title;
- The course cover image;

- A direct link to access the course on the DigiCulture platform.

This information is the one provided in the course description on the Moodle-based DigiCulture platform, and any change reflects automatically on the presentation website. This greatly reduces to complexity of the operations needed to update course information (such as the course image, the title, the description, etc.) since one only needs to modify it inside the platform.

Another objective of this mechanism is to provide any interested parties with easy access to the enrolment process. Many other improvements were also made, with the main purpose of providing a cleaner, more friendly and intuitive interface through which anyone, regardless of their level of competence in ICT, could access the content and experiences provided by the developed courses.

## **Interpretation and Conclusions**

The DigiCulture Virtual Learning Hub is an innovative multilingual ICT-based environment to promote collaborative learning using connectivist social networking as an instructional method, OERs as the main content, and open digital credentials as recognition and validation of digital skills which can be applied to all ages, genders, cultural backgrounds and levels of digital education in order to promote social inclusion at a digital level. The next step of our project implies usability evaluations of the environment as to seek if the proposed the user-friendly interface and the mobile interface will encourage all users to access it, engage in a variety of open learning activities, connect with other cultural actors and develop their own digital skills.

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## **ARE STUDENTS READING THEIR TEACHERS' COMMENTS? THE IMPACT OF DIGITAL FEEDBACK IN ADULT LEARNING SECONDARY EDUCATION**

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### **Abstract**

This paper shows the results of an ongoing research which explores the impact of digital feedback in adult learning at the Institut Obert de Catalunya (IOC), an online public school (Department of Education of Catalonia, Spain). The students are adults who did not obtain a degree in compulsory secondary education at the time. The objective of these studies is twofold: to teach students basic life skills they should know to survive and thrive in nowadays society and to manage lifelong learning. Within this context, feedback plays an important role as it has a huge influence on students' learning gain. However, are students taking advantage of the teachers' feedback to improve their tasks? The research is based on the assessments made by students of their teachers' feedback comments and the improvement those meant in the students' task completions. Our intention was to prove from the statements made by the students two facts: if the students received feedback effectively and if that resulted in an improvement in their task completions. Seven closed-ended multiple choice questions together with an open-ended one were used to carry out this survey. The first set of questions were used to gather insight about the students' opinions on the effectivity of the feedback regarding content value, extension and clarity of message. With the open question, we tested how much information the students had retained from their teachers' feedback messages, and what aspects of it they considered more relevant. These first findings provide new insight into the relation between digital feedback and its impact on academic results.

### **Introduction**

The widespread use of ICT in recent years has played a meaningful role in the way online adult learning education is conceived. It is an educational context that allows the student to access a virtual classroom at any time and from where he can interact with the teacher and with other students through various devices, even from the mobile phone.

This online educational context is characterized by flexibility and interactivity. It is flexible because it adapts to both the schedules and the geographical area of each student as well as the different learning rhythms, making individualized attention more possible and facilitating access to people who were excluded from the traditional educational system. It is an interactive modality since it focuses on interaction as a key element for learning. That is, the student must have an active role: he must interact with the teacher, classmates and make use of the activities and resources he has at his disposal. This implies a higher degree of autonomy and student commitment, because he is responsible for his own learning. On the other hand, it involves more careful and personalized guidance from the teacher, an accompaniment that must be planned in the design of the course (Durán & Manresa, 2016).

One of the key elements of this learning process is the way feedback is performed: the teacher can guide and help regulate the learning process, taking into account the formative assessment (Sanmartí, 2010) that develops the awareness of the student's learning (Allal, 2016). Many studies show that feedback can be one of the most powerful influences on student learning (Hattie & Timperley 2007; Jonsson, 2012; Jonsson & Panadero, 2018; Zimbardi et al., 2017) as well as reinforce a positive attitude towards studies (Heppelstone et al., 2011; Knauff, 2015; Hilliard et al., 2019). Recent research focuses on the way students take advantage of feedback in order to improve their tasks (Zimbardi et al., 2017). Feedback is effective only if the learner becomes "proactive recipient", that is, if the student tries to improve from it. (Jonsson & Panadero, 2018).

But how can teachers engage students with feedback? There is evidence feedback is not always productive despite it is well received by students. Some students do not read it and some others do not do anything about it (Jonsson & Panadero, 2018). Other research has shown that feedback is more effective in intermediate tasks rather than in final tasks, especially when the tasks are designed so that the student must read the teacher's feedback to improve the final products (Zimbardi et al., 2017).

## **Study context**

This study explores the impact of digital feedback in the adult learning secondary educational context of GES at the Institut Obert de Catalunya (IOC), an online state school operated by The Generalitat de Catalunya Department of Education. This institution, with more than 23,000 enrolled students in September 2019, integrates all kinds of online non-compulsory education: GES (Graduate of Secondary Education), VET Vocational training, Upper secondary education and modern languages. Its students are adults who did not obtain the certificate in Compulsory Secondary Education on time (16 years of age). These former school dropouts note their educational failure, and teachers must ensure these students rebuild trust in their academic capabilities of achievement. The objective of this

educational stage is twofold: to teach students basic life skills, which should be known to survive and progress in today's modern society, and to manage lifelong learning.

The pedagogical and methodological principles that rule the formative proposal of GES studies at the IOC stem from the teachers' wish to guide the students through their learning process. For this reason, the syllabus is based on didactic sequences whose main objective is to reword the students' post-drafting phase productions in order to achieve a successful monitoring learning process (Camps, 2003). Making a mistake is seen as the starting point of the learning process (Guash, 1997) and it is in this context that feedback plays an outstanding role. Moderating an attitude towards academic achievement as the ultimate result of the learning process is not the objective of the GES teachers, but promoting educational interaction between educators and students to achieve pre-established learning goals. In virtual educational contexts, this objective presents its own particularities as feedback is mainly written. Under these circumstances, the attention to instructions and the reading of the teachers' inputs become part of the teaching-learning process and not a conclude assessment qualification closed to further amendments.

## **Purpose and Research Questions**

This research focuses on the impact of digital feedback in the students' learning processes. Some questions need to be considered to understand the connections between assignment feedback and the effect this exerts on the students' learning gains.

- How do GES students act on feedback? Do they actually read it?
- Does it really have a significant impact on the students' learning process? What aspects of feedback do students find more relevant?

## **Method**

In order to meet the needs, a system, which was implemented at GES (IOC) ( $n = 1046$ ) during the fall term 2019 to 1046 students from 9 courses (from 46 to 181 students) and that is related to the feedback given by the teacher in an assignment from the second unit, has been designed. It is necessary to say that GES studies have a total of 34 courses and each course has a planned time dedication of 35 hours during a trimester, divided into four units. Each unit includes, at least, one activity with a personal feedback from the teacher.

The sample subjects were selected as follows:

- All areas and levels are represented (3 courses from communication, 3 from social and 3 from science).
- Compulsory and elective course.

To have a confirmation that the student read the teacher's feedback, a survey which was linked to the commentary was designed so that it could only be accessed through the feedback. We are assuming that it is difficult to know how many students read the teacher's feedback, and it is even more complicate to know if the reading has been attentive or superficial. However, we may assume that those students who have clicked on the survey link have read it.

The survey included seven multiple-choice questions and an open-ended one. The first ones were intended to take the students' opinions towards the usefulness of the feedback according to their content, their extension, or clarity of the information; the relationships between students who answer the survey and the obtained mark, and the impact of the feedback in the student post-draft production. The last question asked to students about the device from which they check the teacher's commentary. The aim of the open-ended question was to recover the student's memories about the content of the feedback to note which aspects they considered more relevant.

This data has been compared with Moodle logs and the students' qualifications. In total, more than 50 variables (date and time, Boolean, integer, float, percentage, text).

Finally, a text discursive analysis of the open-ended questions has been done and four resulting categories were established: (a) learning content related to the assignment; (b) acquisition of cross-curricular learning strategies; (c) emotional personal aspects, and (d) the assessment of the teaching work.

The research instrument was validated in a pilot test conducted during the spring of 2019 ( $n = 1200$ ).

## **Results and discussion**

In this paper we are only presenting those results that allow us to answer two of the initial research questions. Data relating to each are presented in summary form, and analysis of each key theme is then reported and discussed.

### ***RQ1 Are students reading the teacher's feedback?***

Of the active 1046 participants that received teacher feedback, 84% consulted the gradebook during the following month where they were able to see their mark, 70% checked the feedback for the task, 51% did something with teacher feedback (either clicking on the link to the questionnaire or repeating the task), 43% clicked on the link to the questionnaire and only 17% of the students actually filled it in. In other words, we cannot know for certain the number of students who read the feedback given, but we consider it is more than 51% and less than 70%. This implies that at least 30% of students,

that is to say, almost one in three active students, did not check the teacher's comments and, therefore, will not be able to use this feedback to improve their performance on the task or said feedback will have little or no impact on their learning.

Our initial hypothesis was that this might be related to the mark that the students got in the task (very high marks or very low ones would probably render the comments for improvement as only minimally useful). However, the figures do not show any relationship between the two variables (mark received and checking the feedback) (Figure 1).

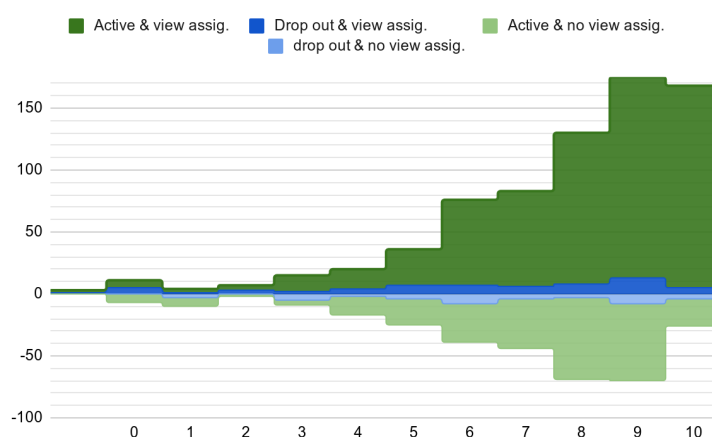


Figure 1. Number of students grouped by their activity, access to the assignment and marks

We can observe that between 30% and 40% fail to check the feedback for the task no matter what the mark awarded was (final grade for the task), except in the case of the students who obtain a 10, of whom only 13% do not check their feedback. In other words, those who are awarded the maximum mark read their feedback more often than students who obtain lower marks. It doesn't seem to be connected [neither] to students' dropping out.

Table 1: Relation between students' activity and access to the feedback

	View feedback	No view feedback	% no view
Active	666	277	29%
Drop out	62	41	40%
% drop out	9%	13%	

Among drop-out students, the percentage who do not read feedback (40%) is slightly higher than among those who continue as active students (29%). The dropout rate for those who check the task and for those who don't are similar (9% and 13%).

On the other hand, logs show some relevant information. Most students who check their feedback do so within a few hours after the task has been corrected by the teacher. That is because once a submission has been marked and moderated by teacher, students receive an email notification that feedback is available.

## Are Students Reading their Teachers' Comments? The Impact of Digital Feedback in Adult Learning Secondary Education

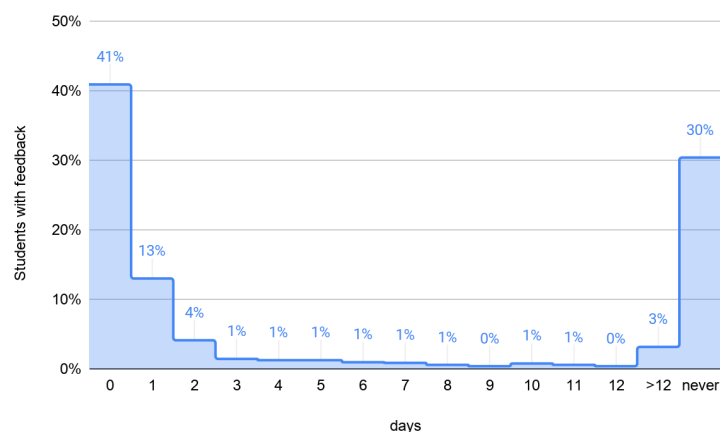


Figure 2. Proportion of students who looked at their feedback in days after receiving it

41% of students see the task the same day they are assessed (less than 12 hours), and 13% the next day.

In the questionnaire, when asked about how did they get into the feedback in a multiple choice query, 83 students answered that they got into it by email, 4 via notification, 69 saw it in the assignment and 79 in the gradebook. In this sense, the message they get when a task is assessed seems to have a motivating effect for students to read their feedback.

In all the courses analysed, the percentages are similar (between 64% and 75%) except in the case of SO2, one Social Sciences course. In SO2 we analysed 49 students and it was the only course in which the main activity was a quiz with open-ended questions whereas in all the other courses students handed in assignments.

### **RQ2 What type of feedback do students turn their attention to?**

When analysing the answers that the students gave to the open question of how had the teacher assessed the tasks they had submitted, we noted that their answers could be classified into four different categories of analysis: (a) things that they had learned which were related to the task; (b) acquisition of transversal learning strategies; (c) emotional personal aspects; (d) assessment of the teaching work.

Generally speaking, we can see a great impact in the emotional aspects and improvement of their self-esteem. For example:

*"I like to see how my teacher values other tasks that I have done during the course and how she encourages me to continue my studies of Catalan Literature." (Catalan Language).*

Besides, students value the cross curricular learning strategies. For example:

*"[She told me] that I have to revise the procedure and the final result of the tasks before submitting them" (Joan P., Maths).*

There are as well a lot of comments related to the teacher's assessment. For example:

*"I think he is a good teacher, and whenever I had an issue or made a contribution, he responded and solved it immediately". (Catalan Language)*

There are less comments in relation to specific contents than related to the aforementioned categories, even though, in some cases, they were more detailed. For example:

*"[She told me] that I could have explained the question of the causes of WWI with more detail. Also, that in another question, the reason is archduke Franz Ferdinand's assassination in Sarajevo and that the answer to the fifth question should be that women came across with problems such as not being allowed to vote: suffrage." (Anna, Social Science)*

## **Conclusion**

The research has allowed us to draw some conclusions on three different aspects: (a) feedback reading, (b) the students' perception of the impact of the feedback in their learning, and (c) the teaching in a virtual learning environment.

As for the first aspect, the results show that a high percentage of students (one in every three) do not check the submitted tasks again and, therefore, it is obvious that they do not read the teacher's comments. This is especially worrying in a learning context whose virtual learning support is based on the improvement of the students' self-regulation tools and gives a key role to the teacher's feedback as a tool for the formative assessment (Hattie & Timperley, 2007). The profile of the students who do not read the feedback is not related to the task of the quality or to the education level, as there is a similar percentage of students who do not read the feedback independently of their marks. However, there seems to be a relationship between the type of activity and the feedback reading, as the percentage of the students who read their feedback is much lower when feedback is not related to a Moodle task, but to an open-answer quiz. On the other hand, most students who check their feedback do so immediately after the teacher's submission, which shows the motivating effect of the warning sent to the students' emails.

Relating to the impact of the teacher's feedback on the students' task, the results show that the students greatly appreciate positive feedback and point out the motivating function of feedback. In this sense, the results of previous research (Heppelstone et al., 2011; Knauff,

2015), which shows that the teacher's positive comments reinforce the students' positive attitude towards their studies. This is especially important in second-opportunity contexts like that of the IOC. Students also appreciate the comments related to cross curricular learning strategies and to procedural support which might serve them to carry out both one specific task and the tasks of other courses or subjects. Such support is very important in distance education, where the student must have a certain degree of autonomy and, for this reason, must adopt some self-regulation strategies. However, the results also show that the teacher's comments do not have much influence on the specific learning strategies needed for the task.

In relation to the third aspect, the teaching in a virtual learning environment, the results show the need to rethink the students' actions as soon as they receive the teacher's feedback. If the feedback is part of the students' learning process, we must design activities in which the students necessarily have to resort to their feedback. This leads us to think about the need to design activities that require the students' more active use of feedback (Jonsson & Panadero, 2018).

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## THE STUDENT STUDY EXPERIENCE – ANALYSING STUDENT STUDY CHOICES

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### Abstract

As higher education institutions increasingly teach online and offer greater levels of choice to students (over which modules to study, in which order to study, and how long to extend study before qualification) new challenges are introduced. One of these challenges is how to maintain an understanding of the student experience. This understanding is necessary to provide feedback to both students and faculty, and institutionally for the continued enhancement of quality. This paper is the first attempt at providing a narrative describing one approach to this challenge and the experience within a large distance learning University. It demonstrates a new approach to data is key to enabling the analysis of student study pathways. For many years, this University has offered great flexibility of study and as wide a study choice as it is possible to offer with conventional modules. By design, the Institution holds high levels of data for all student study. However, whilst it is possible to create bespoke queries, we found that this has been insufficient to readily enable analysis of the student experience. By moving from a traditional relational database structure to a multi-model database, many of the difficulties are resolved. In this paper, we report on this approach and describe next steps, including the potential to apply machine learning algorithms and test other data theories like that of Markov Chains.

### The need for a different approach

Colleagues within the Institution have for years asked questions relating to student study paths because they recognise this is central to understanding whether there are any issues with particular paths, or recommendations that could be made to students to aid them in their choices. Whilst some of the simpler questions have been taken up the level of resource required has meant that mostly these questions have remained unanswered. Within the last decade there has been one major change in the way higher education operates within England. The loss of government funding resulted in the introduction of student loans and forced universities to increase fees. This change also had the effect of increasing students' expectations of universities. To qualify for a loan, students are required to register on a

degree course: an entire programme of study rather than an individual module. Together these changes greatly increased the need to improve our understanding of student study choices. However, after several years of attempts, there had been little progress. The problem was proving to be intractable. The authors postulated that the issue was not to do with the expertise within staff but much more likely to be to do with the way data was organised. The University had developed its datasets gradually over many years, and these are held in traditional relational databases. It should be said that these fully support the day to day running of the Institution but are inefficient at supporting queries relating to student study paths. Recent advances in database technology have produced so-called 'graph' databases that are tuned to manage linked data.

### ***Fragmentation of cohort***

When considering student performance on almost any of the University's modules, it is clear that the cohort is fragmented. Yet, we have struggled to find a way of dealing with this fragmentation in our analyses. This is actually the same challenge of analysing study pathway but from the module rather than student perspective. This fragmentation is created by several factors:

- The programme of study leading to a qualification offers choice at least at one point; where students can opt to study either module A or module B and still complete the qualification. One of the most constrained programmes of study, because of the requirements of professional bodies is Psychology. However, by the time a student reaches their final module they could have taken one of sixty-four different study paths. The Modern Languages degree has rather more options for study and a student completing just the first of three study stages will select from some 1436 study paths.
- Students can choose how long they take to complete a degree. This usually ranges from three years, the equivalent of full-time study, to a maximum of 16 years. Therefore, a cohort of new students embarking on the first module of a programme of study will soon find themselves split up, even if there is no optional study choice within the programme. This is simply because some will study three modules per year and others will choose to take either one a year, or to take a study gap between modules.
- There is also fragmentation due to study outcome. Ideally, we would like all students to be successful at their first attempt but we know this does not always work out. The most obvious reason is that some students complete their study but do not pass the module. Others may realise part way through that they need to halt their study and return to it at a later date. These defer their study. Still, others

withdraw from one module, perhaps because they realise it was the wrong choice for them, and move on to a different one.

- Many modules serve a number of qualifications. So, at any one time, Module A will be studied by students on different study paths to Qualification A and Qualification B, and so on.

Any consideration of the effectiveness of a module or programme of study therefore, needs to be able to recognise these fragmentations and be able to separate them out as necessary for a fuller understanding to be gained. If we do not do this, we are not using the available data to the full and missing potentially important lessons.

### **The student pathway data model**

We selected a multi-model database, ArangoDB. This is a flexible technology that fully supports graph database structures and queries, whilst also allowing other approaches to be used without impacting on the data. Having made this selection, the next steps were around determining how the data should be structured to facilitate pathway queries. The only requirement we set was for the model to support pathway analysis. However, the choice of database should also futureproof the model, allowing it to be readily adapted to any future needs. At the outset it was important to define what we have called the *smallest creditable element*. For our institution, at this moment in time, this element is the combination of student, module, and module presentation date: student-module-presentation. A student could choose to study Module A in 2020. There are usually several potential outcomes for this study attempt: pass, fail, defer, and withdraw. If the student passes, they may go on to study Module B in 2021, creating a new data element. If they fail, they may re-attempt, and this new study attempt would create another data element.

### **Hypothesis**

We hypothesised (Edwards, 2017) that within this database, two complementary pairs of data structures would essentially provide all that was needed to construct student pathways and analyse them in terms of qualification programmes of study. The four data structures are shown in Figure 1 below. They comprise a set of vertices containing all student study attempts; a set of edges linking one study attempt with the next; another set of vertices containing all modules; a set of edges linking the modules into qualification programmes of study.

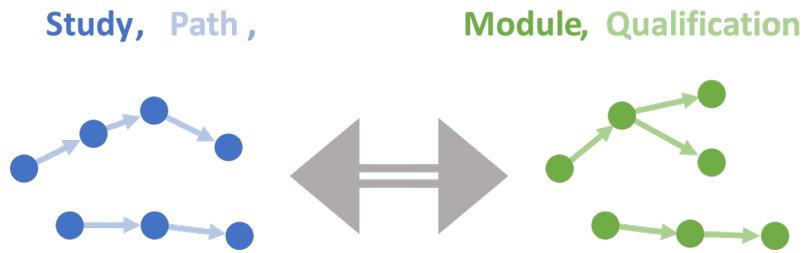


Figure 1. The four data structures within the model

### **The model in practice**

Early results from using this model are very encouraging. For example, an analysis of the actual study paths followed by a single starting cohort of students is shown in Figure 2 below. Some of the data in this figure has been deleted in order to anonymise the figure. The figure was produced by selecting all the new students beginning their study with a defined module and building all their individual study paths from that point. The query then aggregates the data and outputs it in a form the database interprets as a graph. This graph could be designed to be interactive, not just with the ability to move the vertices around to improve visibility but also in enabling the expansion of individual vertices to explore the data in greater detail. The query can be readily modified to focus on a different module, or group of students. This kind of analysis was presented in both Ullmann et al. (2018) and Clow et al. (2019).

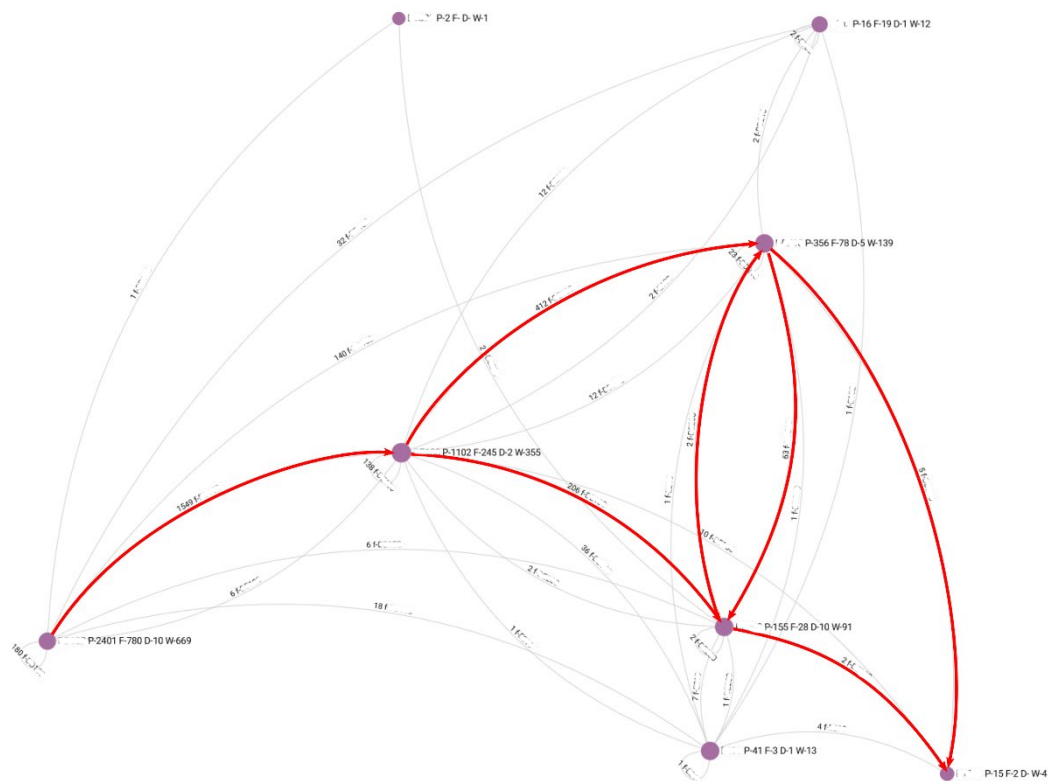


Figure 2. The study paths followed by an initial cohort of new students studying an undergraduate degree programme. The figure shows numbers of pass, fail, defer and withdraw for each study step. The most populace paths are highlighted in red. Note, the diagram has been anonymised through the deletion of some data.

Another example of the model in use is the simple representation of study paths. For this a simple standardised form of representation was created. It is as follows, an arrow,  $\rightarrow$ , is used to signify that study of one module was started after that of another module. Brackets are used to indicate that two or more modules are studied concurrently. These modules are always listed in alphabetical order. Therefore, the study path of a student studying Module A, followed by Module B and Module C studied concurrently, and finally, Module D, would be written as:

Module A  $\rightarrow$  (Module B, Module C)  $\rightarrow$  Module D

Data queries were developed that build the study path for a defined group of students and then aggregate the results for further analysis. This could be readily carried out within any spreadsheet programme. The queries are readily updated to select any student group and the standardised output. Table 1 below contains anonymised data from one real query in the faculty of Science, Technology, Engineering and Mathematics, STEM. By developing this standardised representation, colleagues without knowledge of the database or query language can be provided with data that they can readily work with, using tools with which they are very familiar.

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Table 1: An anonymised sample of output of a study path analysis, presented in standardised form. M, indicates module; Y, year; P, Pass; Ppath, Pass path; Ps, Passes. The entries have been abbreviated and the column showing module attempts removed, in order to fit on the page.

Fullpath	Ppath	Ps(a-to-z)	credit	freq
(M1-Y1-P,M2-Y1-P)->(M3-Y2-P)->(M4-Y3-P)	(M1,M2)->(M3)->(M4)	M1,M2,M4,M3	120	57
(M1-Y1-P,M2-Y1-P,M3-Y1-P)->(M4-Y3-P)	(M1,M2,M3)->(M4)	M1,M2,M4,M3	120	19
(M2-Y1-P,M3-Y1-P)->(M1-Y2-P)->(M4-Y3-P)	(M2,M3)->(M1)->(M4)	M1,M2,M4,M3	120	18

The data model readily supports investigations into the health of a qualification through two different methods. One of these methods is through analysing the success of those students who have attempted to study the required modules, in the correct order: if there is one. This can be done, both in terms of overall outcome and in terms of grade for those passing. The other method that we have tested, is that of taking a snapshot of the qualification. This method considers all students anywhere on the programme of study for the qualification at a certain point in time, considers their study journeys to that point and their ongoing study. Each of these methods has its own strengths and when used together they can complement each other to build a rich picture of the qualification and the student experience. To date, both these methods have been trialled on one qualification in the Social Sciences.

## Next steps

As described, this approach to the data has shown much promise and is beginning to allow longstanding questions to finally be answered within the institution. We are embarking on a University project to use this technology to drive a qualification dashboard providing standardised information for colleagues. The database also has some built-in machine learning queries which we intend on applying to the data. This may yield some patterns that are not readily seen through the usual analyses that we undertake. We are finalising a sub-project that took a first step towards exploring whether the probability theory of Markov Chains, has any relevance to University study, after finding a paper that had attempted something similar (Ikonen, 2009). The theory is used in a number of fields, including voice recognition. Whilst this fact may not immediately suggest any value for universities, it seems that from our initial efforts it may well be relevant to, at least, some groups of students. This is currently being checked.

## Conclusion

By responding to the long standing challenge of analysing student study paths within one institution through structuring data in a different way using database technologies that are still relatively new, we are finding that many questions that have long gone unanswered are finally yielding. We have also found that the model developed has potential to serve the Institution more widely through the development of a qualification dashboard. In addition,

this restructuring of data will enable machine learning algorithms to work with the potential to reveal new insights. Other theories, like that of Markov Chains can also be tested against the data. These developments amount to a significant step forward for our Institution and its potential to support students. As noted in the abstract, many institutions are moving more of their teaching online and this data model may also therefore offer benefits more widely.

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## THE STUDENT-INQUIRER IDENTITY DURING THE MASTER THESIS IN AN ONLINE UNIVERSITY

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### Abstract

When students are conducting their research project as part of their studies, they can be better prepared for the societal and professional challenges of the future. This study contributes to the research of the inquirer identity by elaborating a model for the assessment of student-inquirer identity skills in light of the development of a master thesis in an education-related field in an online university. The model presents student-inquirer identity as a dynamic multiplicity of ten skills related to the five phases of the practice of inquiry (search and focus, understand and explore, design and implement, interpret/evaluate and reflect, write and present). Based on the model, a questionnaire that measures students' inquiry skills during the development of the master thesis was constructed. The questionnaire is comprised of ten sub-scales with 42 Likert-type items in total. 154 students of the Universitat Oberta de Catalunya responded to the questionnaire. Findings revealed that, overall, online students develop inquiry skills to a moderate extent while conducting their master thesis.

### Introduction

The last decade we have witnessed many tech-related trends that both increased the saturation of technologies in our daily life and raised several concerns as regards their (mis)use (Auxier et al., 2019). While more than half of the population owns a smartphone and has internet access even in the developing world (Poushter et al., 2018), a growing number of people are becoming ambivalent about the impact of digital connectivity on society as a whole (Smith, 2018). In this period of crisis, professionals upon graduating from the university must have the skills, attitudes, and stances that will enable them to address the challenges of the digital world.

Whereas there is no magic therapy that alleviates the problems of digitisation, developing an inquirer identity to students and teachers has been recognised fundamental for the society and school of the future (Alvunger & Wahlström, 2017; Meijer et al., 2016; Taylor, 2017). Nevertheless, although inquiry as a concept and practice in education is nearly one

century old dating back to the work of John Dewey, there is lack of a clear and empirically grounded definition of inquiry-based attitude (Meijer et al., 2016), while the research on inquirer identity is scarce, to say at least (Badia et al., 2020; Konstantinidis & Badia, 2019; Taylor, 2017). More research on the inquirer identity would benefit the design and development of professional development courses aiming at nurturing and promoting inquiry attitudes and competencies (Badia et al., 2020).

This study aims to contribute to the research towards the development of a well-structured definition of the notion of inquirer identity, applied to both students and teachers. In line with Oyserman et al. (2012) we perceive that identities include the personal traits and characteristics as well as one's social relations, roles, and memberships. Accordingly, the inquirer identity encompasses components related to the competencies, knowledge, actions, beliefs, and roles regarding inquiry (Badia et al., 2020).

This study is part of a larger research project entitled "The inquirer identity of teachers and student-teachers", and its overarching aim is to identify and characterise the identity components related to inquiry when teachers are involved in pedagogical innovations, as well as to categorise clusters of teachers which show different ways of positioning in light of pedagogical innovations. In particular, this study focuses on one component of the student-inquirer identity, the skills that students develop while doing their master thesis and elaborates a model and a questionnaire for assessing this component.

## **Methodology**

### ***Construction of the student-inquirer identity model***

The structure of the student-inquirer model is primarily based on the teacher-inquirer identity model by Konstantinidis and Badia (2019). The teacher-inquirer identity consists of ten teacher skills which are related with the five phases of the inquiry process: scan and focus, understand and explore, plan and implement, evaluate and reflect, and write and present.

In order to adapt the teacher-inquirer identity model to the ways students conduct inquiry during their master thesis, we reviewed bibliography related to researching in social sciences (Bell & Waters, 2014; Booth et al., 2016; Cohen et al., 2000). Although each author approaches the process of researching from a different angle and with a different audience in mind, we could see the five phases of the inquiry process emerging from the topics of each book, even if not in the same order necessarily. Therefore, we decided to maintain the five main phases and make only some changes. The resulted model is presented in Table 1.

Table 1: The inquiry phases and the skills that comprise the student-inquirer identity

Inquiry Phase	Skills
Search and Focus	Search for potential topics to develop the thesis Focus on a particular topic to develop the thesis
Understand and Explore	Build knowledge and understanding on the topic (i.e. through reading resources) Explore what other people know about the topic
Design and Implement	Design a thesis on the topic Implement the research project/collect and analyse data
Interpret/Evaluate and Reflect	Interpret the results and evaluate the research project Reflect on the process and outcomes
Write and Present	Write the thesis Present the thesis to the committee

### ***Construction of a questionnaire for measuring students' inquiry skills***

Based on the model, we constructed a questionnaire that intends to measure the inquiry skills that students develop while they are conducting their master thesis. The questionnaire was constructed and refined through three stages. Initially, the first author crafted several question items for each one of the sub-identities related to the process of inquiry. Next, the second author reviewed the question items and added a few question items as well. Lastly, the final list of items was reviewed by both authors and any ambiguous item was discussed and subsequently rewritten or deleted.

The final questionnaire is comprised of ten sub-scales, with 42 Likert-type items in total and can be seen in Table 2. Each subscale corresponds to a specific skill of the student-inquirer identity. The response scale ranged from 1 to 5 (*not at all, to a small extent, to some extent, to a moderate extent, to a great extent*).

### ***Sample***

The questionnaire was sent to six cohorts of students (in total 1239 students) of three postgraduate programmes (education and ICT, psychopedagogy, and learning difficulties) who attended the TFM (master thesis project) at the Universitat Oberta de Catalunya (UOC) during academic years 2019-2020. The questionnaire was emailed a few days after the deadline for the presentation of their thesis to the committee and a reminder was sent a few weeks after the first email. In total 154 students responded to the questionnaire (response rate 12.4%). Approximately four out of ten of the respondents are aged between 21-30 (N = 59; 38.3%) and another four out of ten 31-40 (N = 61; 39.6%). Nearly half of the respondents (N = 70; 45.5%) were working in formal education as primary or secondary school teachers, nursery and kindergarten teachers, special education teachers, and secondary school teachers. The vast majority of the respondents (N = 144; 93.5%) have working experience and/or they are currently working, while, on average, respondents have nearly ten years of working experience. Over four out of ten of the respondents (N = 66; 44.7%) reported advanced or higher English language level, four out of ten

intermediate ( $N = 62$ ; 40.3%), and less than one-fifth elementary or lower ( $N = 26$ ; 16.9%). As regards their experience in doing work related to a master thesis, nearly half of the respondents ( $N = 69$ ; 44.8%) had completed an undergraduate thesis and another one out of five a graduate thesis ( $N = 28$ ; 18.2%), while less than one-fifth of the respondents ( $N = 23$ ; 14.9%) reported having no previous experience in doing activities similar to those requested in a TFM. Lastly, as regards the type of the thesis, half of the respondents conducted empirical research or intervention research ( $N = 80$ ; 51.9%) and more than four out of ten of the respondents ( $N = 66$ ; 42.9%) conducted an educational intervention related to their profession.

## **Results**

### ***Students' inquiry skills while conducting the master thesis***

Respondents' answers to the questionnaire show that online students develop inquiry skills to a moderate extent while conducting their postgraduate thesis. In the following subsections respondents' answers to the questionnaire will be analysed in greater detail while Table 2 reports the mean and SD of responses for each question item and each subscale.

#### *Searching*

Students reported the development of searching skills to a moderate extent before actually start working on their research project (mean: 4.16; SD: .67). They seem a bit more inclined to search for potential topics through browsing related websites (mean: 4.32) and the literature (mean: 4.30) rather than asking the opinion of others (mean: 4.03) or making a list of their interests (mean: 4.00).

#### *Focusing*

Students reported that they develop skills related with focusing on a topic they recognised during the searching process to a moderate extent (mean: 4.07; SD: .69). Although the difference among the means of the particular set of skills is low overall, it seems that respondents are more inclined to develop skills related with identifying the purpose of their thesis (mean: 4.23), next formulating relevant research questions (mean: 4.11), following that reducing the list of topics (mean: 4.00), and to a lesser extent evaluating the viability of the thesis on the chosen topic (mean: 3.94).

#### *Understanding*

Students reported that they develop skills related with building knowledge and understanding of the topic at hand to a moderate extent (mean: 4.17; SD: .68). The difference among the means of the particular set of skills is low overall. However, respondents engage with skills related with reading the literature to a greater extent (mean:

4.28), next conducting an organised search to find key literature on the topic (mean: 4.19) and recording and organising the information related to the topic (mean: 4.18), and lastly evaluating the literature found for quality and relevance (mean: 4.01).

### *Exploring*

Students reported that they develop skills related with exploration about a topic to some extent (mean: 2.99; SD: 1.13). To a considerably greater extent, they are asking more knowledgeable others about the topic (mean: 3.49) and they are discussing their topics with their colleagues (mean: 3.28). Conversely, they are engaged to a lesser extent with attending learning events about the topic (mean: 2.65) or posting questions about the topic on the internet (mean: 2.55).

### *Designing*

Students reported that they develop skills related with the designing of their master thesis to a moderate extent (mean: 4.00; SD: .83). Writing the theoretical part of the thesis was the skill that students developed more (mean: 4.29) followed by the consideration of the ethical issues (mean: 4.18). Following that, they are engaged to a similar extent with selecting the research methodology (mean: 4.05) and selecting or designing the data collection methods and instruments (mean: 3.99). To a lesser extent they are engaged with the specification in an operational way of the aims (mean: 3.82) and utilisation of the data analysis methods (mean: 3.67).

### *Implementing*

Students reported that they develop skills related with the implementation of their thesis to a moderate extent (mean: 3.97; SD: .96). There is little variation among the means of the specific skills: analysing collected data (4.03), collecting data (4.01), presenting the results in different ways (3.96), and planning the fieldwork (3.89).

### *Interpreting and Evaluating*

Students reported that they develop skills related with the interpretation of the results and evaluation of the outcomes to a moderate extent (mean: 4.17; SD: .70). There is almost no variation among the means in this set of skills: evaluating the results and reaching conclusions (4.23), evaluating the extent to which the thesis has achieved its initial purpose (4.18), interpreting and discussing the results (4.11).

### *Reflecting*

Students reported that they develop skills related with reflection to a moderate extent (mean: 3.97; SD: .82). The responses reveal that students are a bit more inclined to reflect on the adequacy of the research methodology and the relevance of the results (mean: 4.02) and to a lesser extent to reflect on the implementation of the project (mean: 3.88).

*Writing*

Students reported that they develop skills related to writing their thesis to a moderate extent (mean: 4.22; SD: .76). When looking more closely the means of this set of skills, it becomes clear that students' engagement with writing skills is in general well above moderate: writing all the necessary parts of the thesis (4.54), structuring the thesis (4.41), using a citation style consistently throughout the thesis (4.37), and self-evaluating the thesis before submission (4.34). However, when it comes to sending the final document to others for feedback, then respondents indicated that they develop this skill only to some extent (mean: 3.43).

*Presenting*

Students reported that they develop skills related to presenting their thesis to a moderate extent (mean: 4.32; SD: .79). Overall, there is little variation among the means of the specific set of skills, yet it seems that respondents worked more on skills related with the development of the presentation document (mean: 4.43) as well as with the presentation and recording (mean: 4.38) and answering board's questions about the presentation (mean: 4.40). To a bit lower extent, they were engaged with rehearsing and revising the presentation (mean: 4.28) and reflecting on the process of presenting the TFM (mean: 4.13).

Table 2: The questionnaire for measuring students' inquiry skills while conducting their master thesis and the mean and standard deviation of responses for each question item and each subscale.

	M	SD
<b>Searching</b>	4.16	.67
1. Listing relevant topics/interests to your profession or listing topics that you would like to research	4.00	.68
2. Asking the opinion of others (e.g. tutors, colleagues, peers, friends) about your initial ideas	4.03	.83
3. Browsing literature related to your field and/or your interests	4.30	.57
4. Browsing websites related to your field and/or your interests	4.32	.60
<b>Focusing</b>	4.07	.69
5. Reducing the list of topics to a choice of 2-3 topics	4.00	.83
6. Identifying the purpose of your TFM	4.23	.61
7. Formulating research questions or professional intervention questions about the chosen topic	4.11	.59
8. Evaluating the viability of the TFM on the chosen topic	3.94	.74
<b>Understanding</b>	4.17	.68
9. Conducting an organised search to find key literature related to the topic	4.19	.71
10. Evaluating literature found for quality and relevance with the topic	4.01	.76
11. Reading literature to increase your knowledge on the topic	4.28	.62
12. Recording and organising the information related to the topic	4.18	.64
<b>Exploring</b>	2.99	1.13
13. Discussing with your colleagues about the topic (e.g. with your classmates)	3.28	1.14
14. Posting questions about the topic on websites/social media	2.55	1.07

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15. Asking more knowledgeable others (e.g. academics, mentors/professionals) about the topic	3.49	1.13
16. Attending face-to-face or online learning events (e.g. conferences) to learn about the topic	2.65	1.18
Designing	4.00	.83
17. Specifying in an operational way the research aims or the aims of the professional intervention	3.82	.87
18. Considering the ethical issues	4.18	.87
19. Selecting the research methodology or the methodology of the professional intervention	4.05	.80
20. Designing and/or selecting the data collection methods and instruments	3.99	.84
21. Utilising the data analysis methods	3.67	1.03
22. Writing the theoretical part of the TFM	4.29	.59
Implementing	3.97	.96
23. Planning the fieldwork (e.g. scheduling interviews, conducting a pilot, selecting participants)	3.89	1.03
24. Collecting data of the research or the professional intervention	4.01	.93
25. Analysing collected data	4.03	.86
26. Presenting the results of the TFM in different ways (e.g. tables, graphs)	3.96	1.00
Interpreting & evaluating	4.17	.70
27. Interpreting and discussing the results	4.11	.76
28. Evaluating the results and reaching conclusions	4.23	.66
29. Evaluating the extent to which the TFM has achieved its initial purpose	4.18	.67
Reflecting	3.97	.82
30. Reflecting on the adequacy of the design of the research/professional intervention methodology	4.02	.78
31. Reflecting on the implementation of the research project or professional intervention project	3.88	.89
32. Reflecting on the relevance of the results of the research or professional intervention project	4.02	.80
Writing	4.22	.76
33. Structuring the TFM according to the guidelines	4.41	.62
34. Writing all the required parts of the TFM	4.54	.57
35. Using a citation style throughout the TFM and verifying that the reference list is correct	4.37	.70
36. Sending the TFM document before submission to others (e.g. peers) and asking for feedback	3.43	1.20
37. Self-evaluating the TFM before submission (e.g. revising and proofreading)	4.34	.69
Presenting	4.32	.79
38. Developing a specific document (e.g. a PowerPoint) to present the TFM	4.43	.70
39. Rehearsing and revising the presentation	4.28	.82
40. Presenting and recording the presentation of the TFM	4.38	.77
41. Answering the board's questions about the presentation	4.40	.71
42. Reflecting on the process of presenting the TFM to the board	4.13	.95

**Conclusions*****The design of the student-inquirer identity model and the questionnaire***

This study built on the teacher-inquirer identity model to construct a model for the student identity as an inquirer. The model presents the student-inquirer identity as a dynamic

multiplicity of ten skills related to the five phases of the practice of inquiry. The results of the questionnaire corroborate to a considerable extent the validity of our model.

Based on the student-inquirer identity model, we constructed a quantitative questionnaire that seeks to measure the development of students' inquiry skills while they are conducting their master thesis. Admittedly, the questionnaire adopts a quite narrow perspective in identifying the inquiry skills both due to its nature (quantitative), but also because in our efforts to present a short and as simple as possible questionnaire we included only issues related with the process of inquiry during the master thesis. As a result, the questionnaire in its current form largely ignores the inquiry context (i.e. students' interests or work) as well as students' personal characteristics (i.e. beliefs about inquiry, relationships, agency, etc.). This limitation should be taken into account for the interpretation of the results. Nevertheless, the results show that the question items are highly relevant to the inquiry skills that it intends to measure.

### ***Students' inquiry skills while conducting the master thesis***

The results show that, in general, when students develop their master thesis as part of their studies in an education-related field in an online university, they develop inquiry skills. More specifically, they develop searching, focusing, understanding, designing, implementing, interpreting and evaluating, reflecting, writing, and presenting skills to a moderate extent and exploring skills to some extent. While it is difficult based only on these quantitative data to explain the small differences observed among the calculated means, it seems that students develop and work more on some skills than others. Whether this is a necessity (i.e. some skills are needed more or are more relevant for conducting the thesis), personal choice (i.e. they might feel that they need to advance their skills in some areas more compared to others), or whether there are other underlying reasons needs to be further investigated through qualitative studies. What is more important, however, is that the proposed student-inquirer identity model, which identifies five phases of inquiry is affirmed to a considerable extent by the results of the questionnaire.

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## **FOSTERING RETENTION IN ONLINE HIGHER EDUCATION: STUDENTS' PERCEPTIONS OF AN INTERVENTION ADDRESSING THEIR FIRST-YEAR EXPERIENCE**

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### **Abstract**

Dropout represents one of the greatest challenges faced by online higher education. This paper presents an institutional intervention aimed at fostering retention and success of first-year undergraduate students at the Universitat Oberta de Catalunya (UOC), an online and open University, through measures addressing learning design and academic support. Secondly, through analysing in-depth interviews with first-year students, the paper explores their perception of intervention measures and their possible advantages or risks. Results indicate that time-related factors represent the major issue for persistence and continuance. Intervention measures such as personalized course packages which prevent overlapping of submission deadlines; flexibility in continuous assessment; and personalized support and academic advising were valued highly by most students. Future retention interventions in open universities are also discussed.

### **Introduction**

#### ***Dropout and Retention in Online Higher Education***

Dropout represents one of the greatest challenges faced by online educators and administrators (Lee & Choi, 2011), as online higher education (OHE) tends to present higher dropout and lower retention rates than traditional face-to-face education (Muljana & Luo, 2019). Early dropout is typical of OHE programs, sometimes reaching 50% of first-year students (Simpson, 2010). Many studies have investigated the factors that influence dropout and retention. Reviewing key dropout factors, Lee and Choi (2011) found that among the most important ones were student factors such as academic background and skills, self-efficacy, and motivation; course and program factors like course design and institutional support; and environmental factors such as work situation, family and job support, and life circumstances.

However, more broadly speaking, lack of time and time-related conflicts seem to be the main factors that lead to dropout (McNeill, 2010; Xavier & Meneses, 2018). That seems to be due to two key issues (Korstange, Hall, Holcomb, & Jackson, 2020). On the one hand, students' *misconceptions* or unrealistic expectations regarding the workload, time, effort, discipline, and involvement required by OHE (Bawa, 2016), and *overestimation* of their own readiness, available time, and capacities. On the other hand, *time-related issues* such as time management to deal effectively with OHE demands and job and family commitments are essential for success and persistence (Michinov, Brunot, Le Bohec, Juhel, & Delaval, 2011) while procrastination, lack of time, and conflicting work-study-life demands are key factors for dropout (Ashby, 2004; Youkselturk & Inan, 2006).

In that sense, first- and second-semester enrolments play a crucial role. Slim, Heileman, Al-Doroubi, and Abdallah (2016) found that course enrolment has a profound impact on student achievement and engagement at both course and semester levels. Many students overestimate their capacities and time-availability and underestimate what is required by OHE; thus, they often enrol in too many or too difficult courses, sometimes with overlapping schedules, and end up dropping out in their first semester or year – sometimes from their courses but also from the degree.

## **Context of Intervention and Research**

Both the intervention and the research reported herein were carried out at the Universitat Oberta de Catalunya (UOC). As an open, fully university, UOC is characterized by *flexibility*: there are no permanence requirements and very few enrolment requirements, and access is very open. Although flexibility is seen as the main attraction of OHE (Soffer, Kahan, & Nachmias, 2019), especially for busy, time-poor adult students, it also increases individual responsibility, for eLearning is mostly self-directed and self-regulated. UOC's typical students are non-traditional learners: mature-aged or adult, with full- or part-time jobs and/or family responsibilities. Statistically, 40.5% of students are 30 or over, and 81.5% study and work; dropout rate at UOC is 57.6%, with first semester drop-outs accounting for nearly half of this total (Grau-Valldosera, Minguillón, & Blasco-Moreno, 2018). The combination of paid work alongside studies is related to dropout (Hovdhaugen, 2015), as it may create conflicting commitments and time constraints.

Regarding enrolment, at UOC students choose freely which courses they want to take each semester, guided by an academic advisor who offers recommendations. Learning design at UOC is characterized by the employment of continuous assessment (CA), of a diagnostic, formative, and summative character. To pass a course (completion), students are usually required to pass all the evaluation activities plus a synthesis test at the end of the semester. That implies that successfully adhering to CA is the best predictor for re-enrolment. Hence,

students who withdraw from the CA process (i.e. not submitting activities) are most likely to drop out of a course (González, Minguillón, Martínez-Aceituno, & Meneses, 2018).

Therefore, in order to foster retention, persistence, and satisfaction, institutional support must address students' first and second enrolments (i.e. their selection of courses and academic pathways), balancing through academic advising their expectations and goals with their time availability and previous academic results, as well as providing students with *flexibility* in the CA process during their first academic year so as to be able to face unexpected situations (González et al., 2018).

Thus, the aim of this paper is, firstly, to present an institutional intervention that seeks to address these issues, and secondly to characterize the participant students and explore their perception of its measures and their possible advantages or risks.

### **The ESPRIA Intervention**

UOC's ongoing institutional project *First-year Students (ESPRIA)*, for its initials in Catalan) seeks to minimize the impact of such course/program dropout factors (Lee & Choi, 2011): course design and institutional support. Based on the employment of institutional learning analytics, it revised pathways and course design together with tenured professors (responsible for learning design) and part-time adjunct professors, providing also flexibility measures in the CA process (Meneses, Minguillón, González, & Martínez-Aceituno, 2019). Enhancing tutorial quality, ESPRIA-trained advisory staff offers personalized support during the application and enrolment processes, helping first-year students to set realistic and achievable goals and to match their needs with their chosen course of study (Tresman, 2002), paying particular attention to student workload issues, capabilities, and time availability, while also detecting early risk situations so as to manage open entry. Such measures seek to avoid excessive student workload and help students achieve their goals in their first and second semesters, so they can be motivated to re-enrol in the following ones. However, ESPRIA's main goal is to help students adhere to and be successful in the CA process, especially in their first semester. Table 1 shows the numbers of academic staff and students involved in ESPRIA since its inception. A total of 16,479 students have participated in ESPRIA thus far.

Table 1: ESPRIA Intervention – Participants

	Spring 2017	Fall 2018	Spring 2018	Fall 2019
Programs	6	8	9	10
Courses	51	69	78	78
Tenured Professors	46	63	73	76
Academic advisors	145	267	243	312
Adjunct professors	217	350	327	445
Students	1,449	5,619	2,603	6,808

Besides personalized support, ESPRIA offered first-year students two other measures. First, flexible enrolment *packages*, containing three courses that have non-overlapping calendars (i.e. submission deadlines) and with adjusted syllabus and workload so as to prevent work overload. Packages were designed taking into account learning analytics (enrolment patterns and course pass rates) and students' interests. Each degree offers three packages, each presenting a possible learning pathway, and students, guided by academic advisors, are free to choose between them and the number of courses they want to take. Second, *flexibilizing the CA process* with some rescue alternatives: making up for a failed or non-submitted CA activity; creating a first, not graded CA activity to induce a smoother entry in the course; allowing delayed submission of assessments; among others.

In what follows we present the students' perceptions of such measures, their adequacy or risks, difficulties, and suggestions. This is part of an institutional evaluation of the project, focusing on its qualitative aspects from the students' perspective (professors and academic advisors will also be interviewed as part of such assessment), in order to inform this intervention and possible future ones, including in other open universities facing the same retention issues.

## **Method**

Participants included eight first-year, fully online undergraduate UOC students who started their studies at UOC in September 2017 and were *persisters* (students who enrol for three consecutive semesters). Students were chosen according to the following criteria: age - non-traditional ( $\geq 25$  years old) or traditional; full-time (enrolled in more than 18 credits ECTS) or part-time, and gender (male or female). The study employed a qualitative, exploratory method, collecting data through semi-structured in-depth interviews (duration: one hour) following an interview protocol that explored the students' perceptions about ESPRIA measures. Students did not know that the measures were part of an institutional intervention. Interviews were transcribed and analysed following content analysis guidelines (Elo & Kyngäs, 2008).

## **Preliminary Results**

The preliminary results presented herein focus on the students' characteristics, depending on profiles, and their perceptions about ESPRIA measures. As here we have focused only on persistent students, results should be taken with caution. In this small sample, there were usually no significant gender differences.

Young (traditional) part-time students usually have a 30h work week, or else study two degrees at the same time; enrol in two or three courses per semester; have good time

management skills; value the UOC system and its flexibility; and report some time conflict, especially during their first semester (when they are not familiar with the online system). They value especially the following intervention measures: course workload adjustment (“Yes, that would be good. So you can plan ahead and organize yourself” [Participant 1 – P1]); and flexibilizing submission deadlines, particularly in the beginning of the semester, when they return from holidays and need more time to get accustomed to the routine again [P2].

Young full-time students do not work and enrol in 30 credits per semester; their underestimation of workload expectation leads to procrastination problems (especially for women), creating stress at the end of the semester (conflict with other commitments), but nevertheless they succeed. They would like more personal support (from advisors but especially from professors), and like the measure of flexibilizing submission deadlines – but not for themselves, for they fear it would increase their procrastination: “I don’t work, but for the people who do, or have kids, or unexpected situations, that would be great. Because in the end there’s people who don’t want high grades, they just want to complete the course” [P3]. “For a person like me, that would be no good. It’d probably feed my procrastination issues” [P4]. As they typically enrol in five courses per semester, they would like to have ESPRIA packages of five courses as well: “Yes, a package with five courses that have submission dates every two weeks, if they could provide me a leeway of two, at most three days between submissions, that would be great for me ... especially because it gives you time for your [personal] things” [P3]. One student valued course workload adjustment (“That’s what you seek, right?, to adjust that. Then you can plan your activities better” [P3]), but the other perceived it negatively: “To adjust all the courses would perhaps make them more boring. I don’t know” [P4]. They would like more information on the degree and online system before starting their studies; and not having group assignments (which take away the independence to which they are used).

Older, non-traditional part-time students typically enrol in 12 credits per semester and have full-time jobs; when they start their studies, it takes them a whole semester to get used to the open, online system. Their expectations are realistic, but when they enrol in more than two or three courses, they end up facing (time-related) problems. They value the flexibility and self-regulation of OHE and are very happy with academic advising (especially because of their lack of experience with OHE and the fast replies of advisors to their doubts or demands). Flexibilizing submission deadlines is perceived as having both positive and negative sides: “If you increase flexibility, sure, you will have lower grades and the student will be more relaxed, and will let work aside a bit more, and if he thinks he will get a low grade, then ‘well, I’ll submit it soon’. It feeds procrastination” [P5]. Regarding workload adjustment, students would like more details and more adjustment: “How much

it'd cost, in terms of time and dedication, to take such course" [P5]. "Yes, because then you can have an estimation, so you can be bold and think, 'I'll enroll in three courses'" (instead of two) [P6]. They like the non-overlapping submission measure in ESPRIA packages: "Yes, because then it's smoother, you can plan yourself" [P6]. They also demand measures to give them a sense of community, something that changes their perception of cold online interactions: Skype videoconferences, or similar. "A face-to-face meeting with my advisor, like 'so explain to me your doubts', or... Because it is indeed a distance university. But in the end, we who are behind a computer screen, we're people" [P5].

Non-traditional full-time students live with parents or partner, do not work, and enrol in 30 credits per semester. They have very good time management skills and are adapted to the OHE system, valuing a lot its flexibility. They expected to work more than what was required of them, and do not present procrastination nor stress regarding time. They would like more personalized support as voicemail or similar measures. Regarding ESPRIA measures, they think the possibility of making up for failed submissions would be beneficial, but for other students: "Normally you have enough time to submit a graded activity. But it's true that, anything happens, like getting sick, or having to travel for a week, something like that, if you don't submit by the deadline you've lost it, and so that possibility of making up for submissions would be good" [P7]. Non-overlapping of submissions is also seen as a good measure, but mostly not for themselves (only in special cases). "There's enough time to submit the activities... But there are also people who indeed prefers more than a week [of time available to submit], so... it would be good. That will depend on the user [student]" [P7]. "There are some hard moments, when you have many submissions at the same time, and you're tired, you know?, and you are not in the same rhythm you were at the beginning of the semester, so it becomes a bit heavy. So I prefer submission dates [for different courses] to be in the same week, for example, Mondays, Wednesdays, and Fridays. One day at least between them. So I can dedicate myself to the other two [submissions]. If I had one submission per week, I wouldn't like it, because then I'd go crazy, every week you have this tension" [P8]. They think flexibilizing deadlines is a good measure. "It wouldn't induce myself to procrastinate, no, because I always try to get the highest grades" [P8].

## **Conclusions**

As seen, each student profile experiences time in different manners, and has dissimilar time management skills, demands, and perceptions of needed support measures. Thus, treating the different profiles in the same way is not adequate, for they display different behaviours, demands, experiences, and strategies to succeed. However, for most students, time-related factors represent the major issue for persistence and continuance. The ideal

would be to design and implement forms of support tailored to each profile, according to their specific demands. Almost all participants value online flexibility, but for some it also represents conflicting demands, especially the profiles who present more time-related problems (e.g. procrastination in full-time students). In this sense, for some profiles some measures (e.g. flexibilizing submission deadlines) would be good; but for other profiles (procrastinators, or the ones with very high expectations of personal performance), they would be counterproductive. The intervention measures described here should ideally be extended to full-time students – which is particularly difficult, given the difficulties inherent to flexibilizing submission dates and making them non-overlapping in five different courses.

Some common demands, which ESPRIA tries to fulfil, were seen in almost all profiles: more personalized feedback and mentorship and the possibility of making up for CA graded activities. Some demands are hardly feasible in an open University model: face-to-face mentorship, synchronous advising, and so on. Misconceptions and unreal expectations may be diminished or transformed through providing more information on the reality of online studies before the first enrolment.

Therefore, future retention interventions in open universities should focus on the first academic year, especially the first semester (which presents the highest attrition rates), and be embedded in ampler interventions addressing situational, institutional, and personal factors: flexibility in continuous assessment; identifying and providing personalized support especially for at-risk students early on; targeted advice and orientation; and personalized course plans, especially for their first enrolment.

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## **BUILDING NEW SPACES FOR EDUCATION THROUGHOUT LIFE, APRENDO+ COURSES**

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### **Abstract**

In this paper the study case of the Aprendo+ courses is presented as a proposal of the so-called lifelong learning, which the UNAM offers to the Spanish-speaking community, seeking to return the knowledge generated within the university to society. The Aprendo+ courses are self-learning and are supported by the use of ICT.

### **Introduction**

Times are constantly changing, so people that makeup societies must be prepared to face them appropriately. Lifelong learning is a valuable tool to achieve this preparation. To meet these individual and collective needs of modern communities, universities can actively participate by articulating strategies and particular initiatives or through partnerships to promote lifelong learning. In this way, universities will continue being the leading depositories of the knowledge society. To attain such goal, it is vital the support of Information and Communication Technologies (ICT), which provides resources to promote new ways to teach and learn. Furthermore, open and self-learning courses can be offered as a return on investment in the university to society. Considering all the previous aspects, the Coordination of Open University and Distance Education (CUAED) developed a lifelong learning project called Aprendo+ Courses.

### **Lifelong Learning Initiative**

The origin of the term lifelong learning came from the '70s when it was called Lifelong Education. It intended to seek a more human development for people and communities to face the vertiginous social changes. Later on, in the '90s, the term was transformed into lifelong learning linked to the training and knowledge of new skills that allowed people to face changing work demands. (Medel-Añonuevo et al, 2001)

As well, lifelong learning seeks to provide knowledge, experience, skills, abilities, and attitudes to achieve personal enrichment, development, social inclusion, democratic

citizenship, and employment. Lifelong learning includes “learn to know,” “learn to be,” “learn to do,” “learn to live together,” “learn to change,” and “learn to transform,” to achieve all of them, it is necessary to develop the ability to “learn to learn.”(Badat, 2013)

Lifelong education should be paramount in developing countries that seek to solve problems such as the gaps between urban and rural societies, low schooling, violence, democratic participation and corruption. Taking this into consideration, in these regions, lifelong education could address the following aspects:

- “Resilience and self-esteem, so that people are capable of responding positively to change;
- Team work and cooperation, so that people can work together on issues;
- Creativity and problem solving, so that people can pioneer new solutions;
- Independence of mind and critical thinking, so that they can analyse issues and persist despite scepticism or opposition from conventional thinking;
- Learning to learn, so that people are able to continue learning effectively throughout life;
- Public speaking, presentation and communication skills, so that people can get engaged with a wider public more effectively;
- Political and citizenship skills, so that people can take part in decision-making effectively;
- Global power structures and processes;
- Core concepts and knowledge of sustainable development and global interdependence;
- Appropriate values and attitudes” (Alexander, 2002).

Thus, to develop education projects throughout life, the following challenges must be considered:

- Lifelong learning should seek the optimization of individual differences in learning, as they are the key to solving our past experiences, to diminish the effect of negative hereditary factors that influence learning;
- Lifelong learning must provide continuous learning experiences to allow people to achieve self-growth, self-realization, skill development, knowledge acquisition, and creativity development;
- Promote a lifelong learning culture, placing it above every individual culture (Medel-Añonuevo et al., 2001).

### ***Support Provided by Self-Learning***

Self-learning is a crucial component of the skills of this century as linked to lifelong learning. It is a demand of modern society, as pointed by various international

organizations such as UNESCO (United Nations Educational, Scientific and Cultural Organization) and the OECD (Organisation for Economic Co-operation and Development). By self-learning, we mean any increase in knowledge, skills, achievements, or personal development that an individual selects and achieves by their efforts, using any method, in any circumstance or moment. (Chee et al., 2011).

Self-learning should consider the following three aspects:

- Possession of learning shown when the learner can identify, determine and articulate their own learning goals, identify learning activities to achieve the meeting goals, visualize their progress in learning, and challenge themselves by establishing their indicators of achievement of learning goals;
- Management and monitoring of their learning. The learner must ask questions and generate relevant research, explore their range of possibilities and make decisions, self-plan and self-manage their time, be critical of their learning, and be able to seek support from others to achieve their learning goals;
- Extension of their learning. The learner applies what he has learned in new contexts and uses the skills he or she has acquired to learn beyond formal content (Chee et al., 2011).

### ***Lifelong Education from the University Perspective***

Universities must fulfil a prominent role within the dynamics of the so-called knowledge society. In this society, the dominant institutions seek that people meet the requirements of the new knowledge-based industries. Although not all universities have recognized this new world and adapted to it. Thus, universities now face new actors competing with them in the quest to educate people. (Alexander, 2002)

In this regard, the European Association of Universities (Smidt & Sursock, 2011) organized a working group for lifelong education that agreed to point out that if universities adopt lifelong learning strategies they can generate benefits for their societies in the following aspects:

- Economic aspect: by promoting an increase in productivity, economic growth, wealth creation, improvement of the knowledge base, and increase in employment opportunities and social policy;
- Social aspect: by improving people's health and quality of life, stimulating new approaches to social problems, changing community attitudes, informing public policies and promoting public debate;
- Environmental aspect: by improving the environment and lifestyle, optimizing waste management, reducing pollution, improving the management of natural

resources, reducing the consumption of fossil fuels and achieving adaptation to climate change;

- Cultural aspect: by improving society's understanding regarding who we are and where we come from as a nation and as a society, preserving and enriching culture, and bringing new ideas and forms of a nation.

Likewise, the aforementioned group discovered a series of aspects in which universities must commit to develop and implement lifelong learning initiatives, which are:

- Incorporate the concepts of extending coverage and lifelong learning into institutional strategies;
- Provide education and learning to a diversified population;
- Adapt the study programs to ensure that they are designed to achieve wider participation and attract more adult learners;
- Provide appropriate guidance and counselling services;
- Recognize previous learning;
- Incorporate lifelong learning into the institution's quality culture;
- Strengthen the relationship between research, teaching and innovation from the perspective of lifelong learning;
- Consolidate reforms that promote a creative and flexible learning environment for all students;
- Develop alliances at local, regional, national and international levels in order to offer attractive and relevant programs;
- Be a reference for institutions that promote lifelong learning (Smidt & Sursock, 2011).

### **Social aspect: by improving people's health and quality of life, stimulating new approaches to social Education and ICT**

Information and communication technologies have been the fundamental element for the growth of various educational forms, mainly in the open and online modalities, which have provided new opportunities for lifelong learning in many countries.

Kanwar and others (2011) claim that some of the main tendencies in the use of ICT in education are: the significant expansion of the organizations' potential for spreading their scope of operations and influence beyond their traditional geographical boundaries; and the increase in collaborative exchange and the generation of visible knowledge in the so-called collective intelligence and training of the masses, which break the school boundaries, while the creation of dynamic knowledge and social computing tools and processes are more widespread and accepted.

Nowadays, ICTs are one of the essential means to support informal learning and self-learning, which are the most important mechanisms for gaining and improving skills and competencies, primarily through electronic networks of interests and professions. These electronic networks of interests and occupations are constituted as important spaces to access and share information, and to collaborate in the development of skills and competencies collectively.

## **Open Educational Resources**

Open Educational Resources (OER) are teaching, learning, and researching materials in any medium that reside in the public domain and released under a free license that allows access, use, reuse, and redistribution by others, with limited restrictions or without restrictions. (Atkins, Brown, & Hammond, 2007)

A relevant aspect regarding these resources is its quality to be open. In this sense, three independent areas distinguished where the concept of openness manifested, they are: the social, the technical, and the nature of the resource itself. The term open, in the social area, is based primarily on the expected social benefits and ethical considerations related to the freedom to be used, contributed, and shared. In the technical field, open means that the resource is operable at both the technological and functional level. The nature of the resource itself is that any individual can enjoy it as others can, and the resources are not contrary but public goods.

As well, open educational resources have the enormous potential to improve the quality and effectiveness of education by permitting some situations: greater availability of relevant and high quality learning resources, cost reduction of accessing educational materials; easy adaptation favoured by permissive license use encouraging the development of new ways for students to be more active participants in their own learning processes; design of the necessary capacities to create open educational resources so as to reduce their production costs, favouring teacher participation in the development of more content.

## **The CUAED proposal for lifelong learning: Aprendo+ Courses**

The Aprendo+ Courses are a CUAED initiative to bring education to various sectors of the population, promote educational equity, provide a useful educational offer and applicable in everyday life (personal, family, professional), and expand the cultural baggage of the general population.

The scheme established that Aprendo+ Courses should have the following characteristics:

- Self-managed;
- Aimed at the general public;
- Addressing specific topics;
- Using a close or colloquial language;
- A minimum duration of 6 hours and a maximum one of 20 hours.

The basic structure of the Aprendo + courses considers the level of general components, which includes relevant aspects to the entire course. Within this level, we find the following elements:

- Introduction. It refers to a short text indicating: the content in the course, the organization, the relevance of the content, and what the general objective to achieve is;
- Way of working. This element should include the structure of the course, the materials and available resources, the types of activities, the way to monitor the progress, and the estimated time of studying.

Subsequently, experts develop the units that contain the following elements:

- Introduction – small text to contextualize the unit in the course structure;
- Content – the development of knowledge, skill, or attitude achieved and structured in such a way that the user manages to incorporate and develop it through self-studying;
- Individual and self-assessing learning activities with clear and complete instructions regarding the product carries out, the characteristics it must have, and how to assess it. Besides, instruments that support self-assessment provided in the form of checklists, rubrics, etc.;
- Self-evaluation, reflected through activities that show the progress of the participants, will be individual and with closed response questions, maintaining congruence with the contents and the learning objective;
- Sources of consultation, listing the bibliographic and hemerographic resources both physical and digital, to which the student can go to learn more about the subject.

## **Results**

Based on those considerations the Open University and Distance Education Coordination (CUAED) has developed 69 Aprendo+ Courses, like:

- “Feeding: the key to diabetes control”, course that recognizes the importance of following a proper diet to prevent and maintain proper control of diabetes mellitus,



distinguishing the most convenient foods to consume and promote a better quality of life;

- “Learning to say no”, course that allows building the necessary skills to say no to everyday situations, without feeling guilty about it;
- “Healthy heart and food”, course that recognizes the importance of following a healthy lifestyle to prevent or control cardiovascular diseases and improve your quality of life;
- “Discovering myself in sexuality”, course that identifies the aspects that favour self-esteem and allow to express sexuality, the type of erotic-affective relationships that can be built, as well as self-care and protection behaviours for the responsible and satisfactory exercise of sexuality;
- “Economy for everybody: responsible consumption”, course that identifies the best process of choice and purchase, both of products and services in present-day Mexico, in order to obtain an improvement in the popular culture of product consumption;
- “When love ends divorce begins”, course that identifies the most important basic legal elements of divorce and its processing: the steps to follow from the application to the registration in the marriage certificate; In addition to the institutions where it is requested;
- “The history of art”, course that allows you to identify the different eras, styles and names of the creators of the vast world of art history – understood from the art of prehistoric peoples to the offer of contemporary art of our days - in an easy and pleasant way, recognizing the historical, cultural and social context in which they developed;
- “Knowledge plays with no violence”, course that recognizes the tools of education for peace and human rights, to address school violence in educational communities;
- “Oral presentations”, course that allows you to build oral presentation skills using presentations;
- “Orthography for beginners”, course that identifies some of the main spelling rules in Spanish.

The platform launched on social networks in May 2019. At the end of January 2020, it has more than 1,800,000 visits, and more than 460,000 users from more than 110 countries being Mexico, where there is more demand, followed by Latin American countries.

The most demanded course turned out to be “Orthography for beginners” with around 189,000 users. The second one was the “Basic Tools of Microsoft Office 2010, Excel” with approximately 99,000 users, and the third one was “The History of Art” with more than 47,000 users.

## **Conclusion**

Lifelong learning is an essential aspect for current and future generations because of the changing environment, and the people need to update themselves to participate in the knowledge society actively.

Universities, as knowledge management institutions, are ideal actors to develop and deliver resources that promote lifelong learning of people with difficulties to access to formal education.

The open educational resources, for their broad characteristics so valued in this knowledge society, are the ideal products that universities can develop, and make available so as to promote lifelong learning of all individuals in society by enabling them with the knowledge, skills and attitudes necessary to function in society.

Considering the information above mentioned, the CUAED has developed the Aprendo+ Courses “to bring education to various sectors of the population, favouring educational equity; providing a useful educational offer, applicable in everyday life like personal, family, labour, professional, and expanding the cultural background of the general population. This initiative added to the social function, which means that the university makes education a common good for all society members.

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## **DEVELOPING AN INNOVATIVE PROGRAM FOR FIRST YEAR ENGINEERING STATISTICS STUDENTS AT AN OPEN DISTANCE UNIVERSITY**

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### **Abstract**

A study was performed on a first year industrial engineering statistics course to improve the statistics pass rate. Statistics is a requisite for other engineering courses. The pass rate for the statistic course was below 50%. The primary purpose is to enable learners to build a capacity to comprehend module content and establish a deeper level of learning that will enable learners to achieve goals and objectives of T&L lessons. An intervention program was instructionally designed to develop a personalized and differentiated learning process that breaks down lessons into lower and basic cognitive components, for struggling learners. The program improves e-learning lessons to a complex higher cognitive level and advances challenging activities for excelling students. Forty students were considered for the study. Moore's theory of transactional distance was used as a theoretical framework. A quantitative method was used to analyse the data. The data consisted of assignment scores. Hypothesis testing at a 95% level of significance suggests that the intervention program made an impact. The overall pass rates improved by 25%.

### **Introduction**

The first year statistics course in the engineering department at an ODL university produces pass rates below 50%.

Pinker (2002) suggests students beliefs might help or hinder learning depending on their consistency or discrepancy with what is lectured. From the perspectives, ODL lecturers have been interested in student's preconceptions and misconceptions so that content design and content instructional design can be effected. Fisher (1985) believes misconceptions emanate from strong word association, confusion, conflict, or lack of knowledge. The categories of misconceptions are describes as follows:

- students are at variance with normative conceptions held by statistics experts;
- students tend to be pervasive (shared by many different individuals);
- students are often highly resistant to change.

Consequently, statistical lecturing methods and models have to be developed. Lawrenz (1986) and Smith and Anderson (1984) suggest statistics lecturers engage with numerous examples of how to identify misconceptions by students and strategies to change them. A common view is to begin the lectures with students' ideas and then design engagement lectures notes (Engel Clough & Wood-Robinson, 1985).

Peters et al. (2014) suggest there is evidence that blended classroom models can be effective only when the online elements are active rather than passive. Undergraduate students in blended classroom settings had better assessment outcomes than purely online or face-to-face classes. The reason being that blended courses in which the students are spending their time online solving problems, learning at their own pace. Half-teaching time was on eLearning. It has a more positive learning impact than both face-to-face do only and purely online only (Peters et al. 2014) do.

A study of previous courses suggests content comprehension was a challenge for first year module students. It necessitated a program that student needed a differentiated approach and different learning techniques and offering the best from both components of a blended learning course. It is apparent that for engineering students pacing is needed and learning must be possible on more platforms than just on the LMS (Learning Management System). Therefore, a T&L approach that provides a better control to the learner and is supported with online resources is indispensable (Peters, 1994). Thus, an active technology integrated T&L approach is critical for throughput improvement.

Learning may mean acquisition of knowledge and deepening of understanding of concepts. Learning includes acquisition and improvement of both technical and interpersonal skills and/or development of desired attitudes and values. Understanding, skills, attitudes and values are all highly subjective constructs. Studies have shown that the more students work in cooperative learning groups the more they learn, the better they understand what they are learning, the easier it is for them to remember what they learn (Johnson et al., 1998a; 1998b; 1998c). Springer et al. (1999) meta-analysed the research for college-level science, engineering and technology and found significant effects on students' persistence and achievement in these fields and positive attitudes toward their education.

Therefore, a system with the ability to adapt intelligently to goal, tasks, interests and other features of individuals and groups of users, is an ideal engineering technology education medium. In an ODeL (Open distance eLearning) institution, access is given to all potential

students with varying school mathematics grade 12 scores and therefore different competencies of the basic engineering modules such as mathematics and science. Some student have poor grades, while others have very good grades. This in the teaching and learning process, it is not possible to treat all students in the proliferating range of e-learning users with very different prior knowledge of the domain, backgrounds, learning styles, interests and preferences, with the “one size fits all” approach. Therefore, adaptation of the learning process and assessment is indispensable.

The power of this innovation is in matching the educational content and the complexity or simplicity of the material, with the learning style of the learners and considering the underlying pedagogical principles. The effect of the combination of strategies is observed and comprehended by analysing the assignment scores of learners and therefore, making a decision to adapt learning content by increasing the complexity of the problems or simplifying content. Since the learning styles are not static (Siadaty & Taghiyareh, 2007), assessment, alignment and adaptation is done continuously throughout the learning period i.e. semester or year.

Connected to Learning Styles is Statistical Cognition. Ruth Beyth-Marom et al. (2008) defined statistical cognition as the processes, representations, and activities involved in acquiring and using statistical knowledge. The issues of statistical cognition can be described as follows:

- Descriptive: students acquire and use statistical knowledge and how they think about statistical concepts.
- Normative: how students should think about statistical concepts and a standard to which our performance is usually compared.
- Prescriptive: How to close the gap between the descriptive (the “is”) and the normative (the “should”).

The study is guided by the learning styles and Statistical cognition as defined by Beyth-Marom et al. (2008).

## **Theoretical Framework**

Introduced in the early 1970s, is the theory of transactional distance by Michael Moore. Moore recognized the limitation of the structure of the independent learning package by including dialogue as a second variable. Moore’s theory of transactional distance is intuitively appealing and moves the field toward the realization of a pedagogical theory. According to Moore (1991), transactional distance is pedagogical and necessitates “special organizations and teaching procedures” composed of two variables (clusters, dimensions?), i.e. structure and dialogue (Moore, 1991; Moore & Kearsley, 1996). Structure

reflects the course's design and is largely a function of the teaching organization and communications media employed.

On the other hand, dialogue is also associated with the medium of communication and may include either real two-way communication or Holmberg's internal didactic conversation. In Moore's theory, the most distant program has low dialogue and low structure while the least distant has high dialogue and high structure (Moore, 1993). The innovation program applied Moore's pedagogical variables of transactional distance. The innovation works on structure as it relates to course design and communication media employed. It is also deals with dialogue, for the engagement between student and instructor is bound to increase.

## **Methodology**

The study is focused on first year engineering student, who have taken engineering statistics for the semester. Analysis was performed on the results of the first assignment to measure the impact of the innovation on student performance. Adequate supports was provided for students with different learning styles. Fahy and Ally (2002) found that students with different learning styles have different preferences for support. The difficulty level of the material is set to match the cognitive level of the learner, so that the learner can both attend to and relate to the material.

Cognitive description is applied on the pre-test scores and student are grouped according to their performance. Poor performing students are placed on a pacing and an instructional scaffolding-teaching program and excelling students are placed on an adaptive learning and gradual release of responsibility program. (See Figure 1).

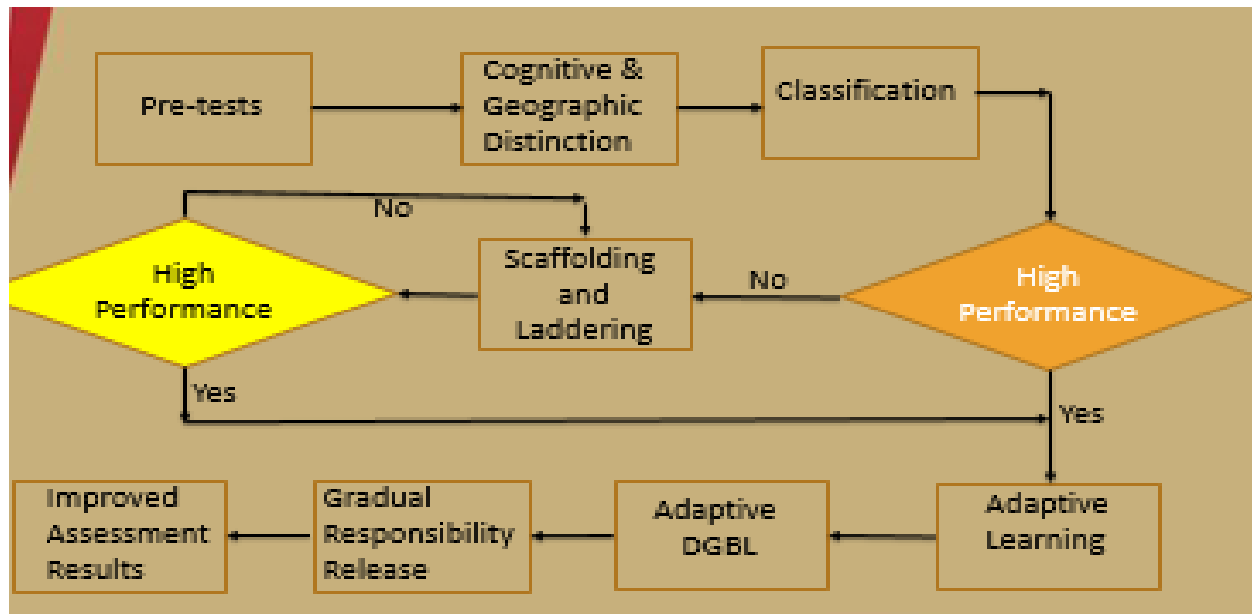


Figure 1. Intervention model

Applied techniques for mapping this approach into practice are providing a pre-test, breaking off the learning material into small pieces, sequencing the material from easy to more difficult and providing links for further exploration to fulfil this characteristic of sensation seeking learners. This approach is implemented by applying methods such as providing the summary and outline of the content, chunking the educational material into meaningful groups and giving the learners the opportunity to revisit topics to strengthen their retention. In order to evaluate the proposed program the instructors matched the educational contents with the learning style of the learners along with considering the underlying pedagogical principles.

Table 1: A summary of the questions and objectives

Research Question	Hypothesis	Prediction
Does, the matching of Educational contents with learning styles of learners and underlying pedagogical principles, affect learners performance outcomes?	Matching the educational Contents with the learning style of the learners along with considering the underlying pedagogical principles, affects the performance of the students in terms of learning outcomes.	If I match module contents With the learning style of the learners along with considering the underlying pedagogical principles, learner's performance outcomes will improve.

The experimental group were provided with the personalized contents based on their learning styles whilst the control group was given the non-matched contents, originally designed for that course. The limitations of the study are that:



- Learning styles are not static, initiating the T&L framework once (per group) when learners first use the system, might not be adequate.
- It is possible that learners are not assessed as effectively.

Application of teaching technologies, learning objects and instructional support media tools to enable learning possibilities, whenever, where ever and on whatever device student have access to at a point in time, is key to the innovation employed. This strategy consists of a representation of learning materials that the learner can engage and includes a set of domain concepts such as facts, lessons and activities organized to form a kind of a semantic network as stipulated by Siadaty and Taghiyareh (2007). At this stage numerous instructional support material such as OERs, LO, MOOCs from other institutions, were used.

## Results

Results of the impact of the innovation on student's performance are displayed below. S1 and S2 represent semester one and semester two assignment scores. There is a general increase in pass rate for the years 2015 to 2018. These results imply that the innovation has a positive impact on the combined learner's performance. Note that these results represent both excellent students and students who were struggling in the beginning of the semester.

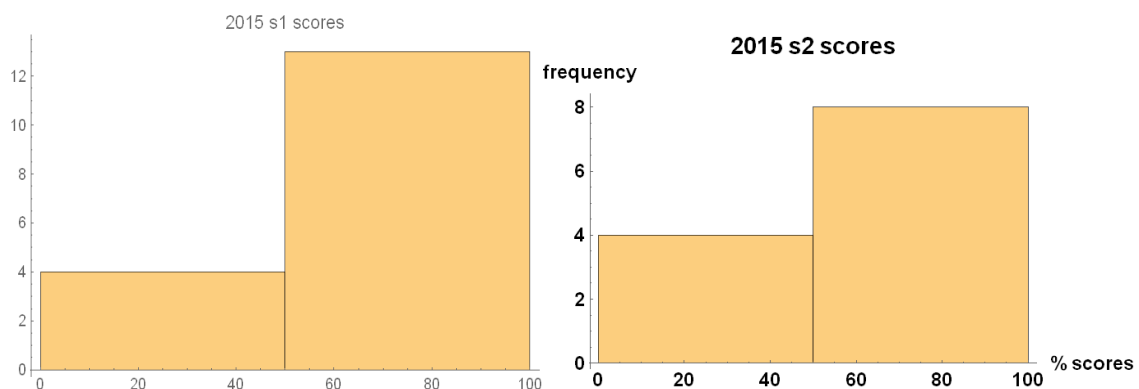


Figure 2. Assignment scores for S1 and S2 in 2015

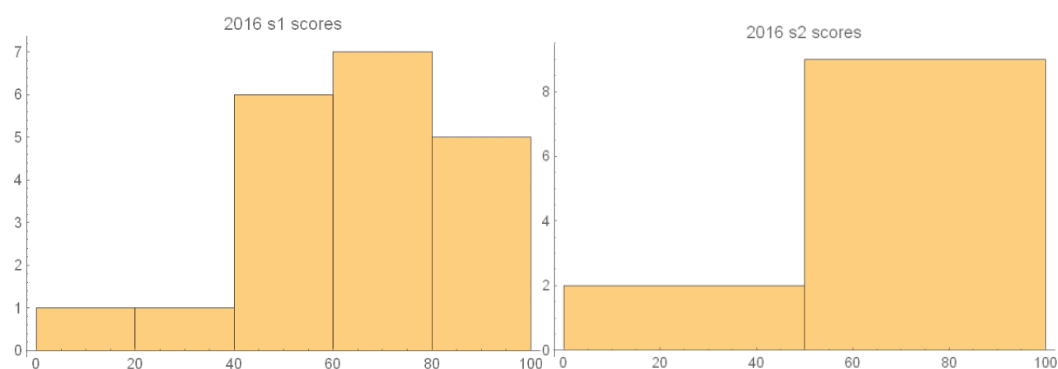


Figure 3. Assignment scores for S1 and S2 in 2016

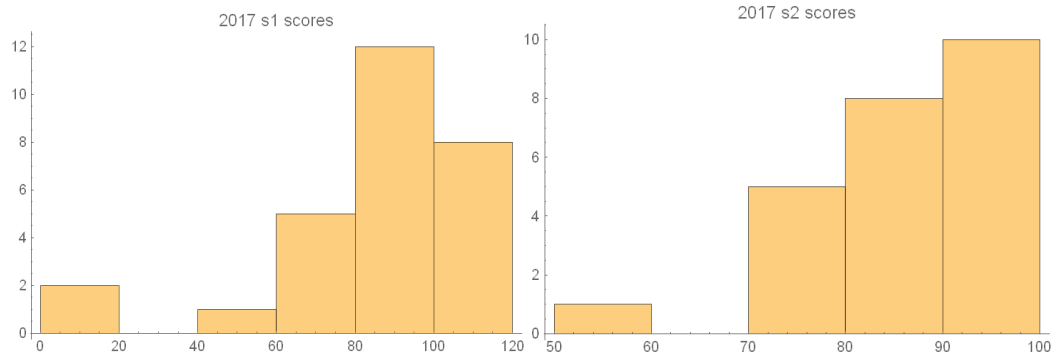


Figure 4. Assignment scores for S1 and S2 in 2017

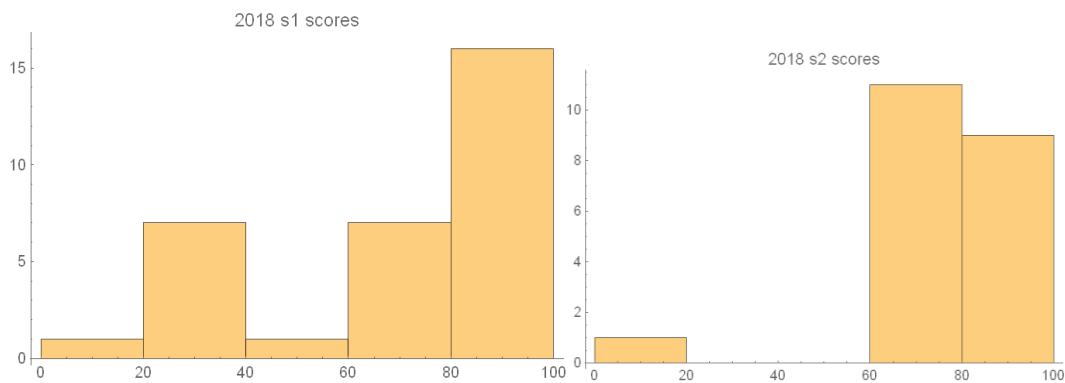


Figure 5. Assignment scores for S1 and S2 in 2018

In the beginning of the program, there are clearly two homogenous groups of student, i.e. a big group of struggling students and another big group of good performance students. In the subsequent years, student performance began to stratify, and there are new groups formed, i.e. a small group of utterly struggling students and numerous groups of students with improved performance and a sizeable group of excelling students. Hypothesis testing at the 95% probability indicates that during the years 2015 to 2018 students were performing better after the intervention. The students were performing better during the second semester assignments than the first semester assignments. The intervention was instituted during the first semester and during the first assignments stage.

## Discussion

An intervention of a teaching program which was instructionally designed to develop personalized and differentiated learning process for students, through breaking down lessons into lower and basic components, for struggling learners, and improves lessons to a complex high level and challenging activities for excelling students, proved to have produced positive results. First, the struggling students group is reduced gradually and the excelling student's group size is increased. Second, the two homogenous groups of good performance and struggling learners gradually disappears and they are replaced by numerous and smaller groups of learners performing above 50%.

Towards the end of the study, i.e. 2017/2018, it becomes apparent that the group of excelling students increased and that of struggling students decreased significantly. It is also clear that more learners have improved their performance above 50% and a large group is in the category of excellent performing students was noted. The innovation introduced has improved student performance gradually and increased the number of excelling students. In general, the student success rates has been increased and performance improved for a large number of learners approximately 25%.

## **Conclusion**

It is evident that this innovation model integrates Moore's pedagogical variables, i.e. structure and dialogue, and builds a new conception for the four component of the intelligent tutor system (ITS), as inspired by Bloom's learning theory (Springer et al., 1999).

The model content design included Beyth-Marom et al. (2008) categories of cognition and descriptive, normative and prescriptive.

The resultant is that student have an integrated view of the instructor's responsibilities (Petocz & Reid, 2003). They expect lecturers to be a catalyst for their learning and help them to change their view of the world of teaching and learning statistical content. Therefore, lecturers are seen to open student's minds to new possibilities and better performance.

This conception of teaching and learning is different from the common and general method, because it focuses on helping students to develop a higher level of comprehension of subject matter content. Therefore, the innovation model implemented confirms that it is no more possible to treat all students in the proliferating range of e- learning users with very different prior knowledge, backgrounds, learning styles, interests and preferences, with the one-size-fits-all approach. It is thus, confirmed that when module contents is matched with the learning style of the students and the cognitive categories ,along with considering the underlying pedagogical principles, learner's performance outcomes will improve, and therefore the hypothesis is confirmed.

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## OPEN EDUCATIONAL PRACTICES IN ROMANIAN UNIVERSITIES DURING THE EDUCATIONAL DISRUPTION

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### Abstract

The Covid-19 pandemic led to an unprecedented situation, when education worldwide moved online, leading to what is called Emergency Remote Teaching. Completed three months after the suspension of face-to-face activities in schools and universities, this paper aims to capture the actions taken in three Romanian universities, for the continuity of education in online environment. How prepared were the higher institutions in terms of infrastructure, teacher training, digital competences of teachers and students, open education strategy? What educational technologies have been used, what is the role of Open Educational practices, the integration of Open Educational Resources and Massive Open Online Courses? How were accessed, adopted and adapted the many international initiatives, projects and resources? What are the results of the studies already carried out on the efficiency of the actions taken? What can be done better until the return to the face-to-face activities, what are the lessons learned and how this knowledge will be applied for a better future? What current practices will have an impact on the teaching-learning activity, on the opening of education?

### Introduction

While people were shutting the doors to their homes and countries were closing their borders, the virtual realm was opening up. The necessary social isolation measures have led to the disruption of school-based education for several months in most countries around the world. According to UNESCO, the maximum number of affected learners were at the beginning of April, almost 1.6 billion from 194 countries, representing 91.3% of total enrolled learners. In the second part of June, after a number of schools were reopen in a few countries, there are more than 1.1 billion learners, from 144 countries, meaning 67.7% of the total (UNESCO, 2020a).

In March, just in a few days, pupils, students, teachers and all the other educational actors were forced to make a quick transition towards online learning and teaching. In fact, what we have experienced is an “emergency remote teaching” (ERT), which means an adjustment for a temporary period of time, that involves alternative ways of delivering instruction, fully remote teaching solutions “that would otherwise be delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated” (Hodges et al., 2020).

Without an effective strategy to protect the opportunity to learn during this period, this disruption will cause severe learning losses for students. The continuity of the learning process for students, respectively support for students who lack the skills of independent learning should be ensured with priority (Reimers & Schleicher, 2020).

### **Romanian universities response**

On March 11, 2020, the Romanian Ministry of Education and Research (MER) has suspended the courses in all the schools, encouraging and supporting the continuation of the educational activities for 2.8 million pupils in online environment. Having autonomy, the same day, universities have stopped their face-to-face courses, the activity being continued as online courses on virtual learning platforms, for more than 500 thousand learners. Since then, there has been a high mobilization and collaboration between teachers, students, parents, ministry and the whole society in supporting this Emergency Remote Education process (Holotescu et al., 2020).

Romania was not found unprepared, having a good infrastructure, teacher training, Open Educational Resources (OER) repositories created in previous projects and an active Open Education movement, but with problems related to Internet connection in rural areas, to the level of teachers’ digital skills, and also to software platforms available in schools (Grosseck, Holotescu, & Andone, 2020).

For most universities, the educational programs continue on their online learning platforms. Below there are the initiatives undertaken by three of the most active universities in the area of Open Education, which implemented open and blended learning approaches, and continuous teachers training during the past years (Holotescu, Andone, & Grosseck, 2016). To overcome the challenges of moving online the whole process of teaching and learning, to keep students motivated and engaged, effective pedagogical approaches were applied, using Open Educational Practices (OEP) and Resources (OER), also integrating Massive Open Courses (Wiley & Hilton, 2018; Huang et al., 2020).

### ***Politehnica University of Timisoara***

All the courses of Politehnica University of Timisoara (UPT) are run online on the Virtual Campus platform (<http://cv.upt.ro>), implemented on Moodle, and accompanied by a mobile application (Holotescu, VasIU, & Andone, 2018). UPT has also a MOOC platform (<http://unicampus.ro>) with open courses which are used for training or integration in traditional courses (Vasiu & Andone, 2014).

The university has developed a specific methodology for this period, since the first week of the lockdown. Most of the teachers acquired already skills and knowledge for online/blended learning during the national DidaTec project (Training in blended-learning and new educational technologies for university academic staff) or in the continuous training program offered by the eLearning Center (CeL) (<http://elearning.upt.ro>). In this period, CeL runs daily live sessions for teachers, in order to support them and to improve their skills for online courses developing and facilitation, and for OERs and MOOCs integration, in a process consisting in the phases of identification, validation, integration and assessment (Andone et al., 2015). The webinars are registered and uploaded with CC licenses on the CeL's YouTube channel for future reuse. At the beginning with April, the university started to organize online exams for all study programs and the admission will be held online too.

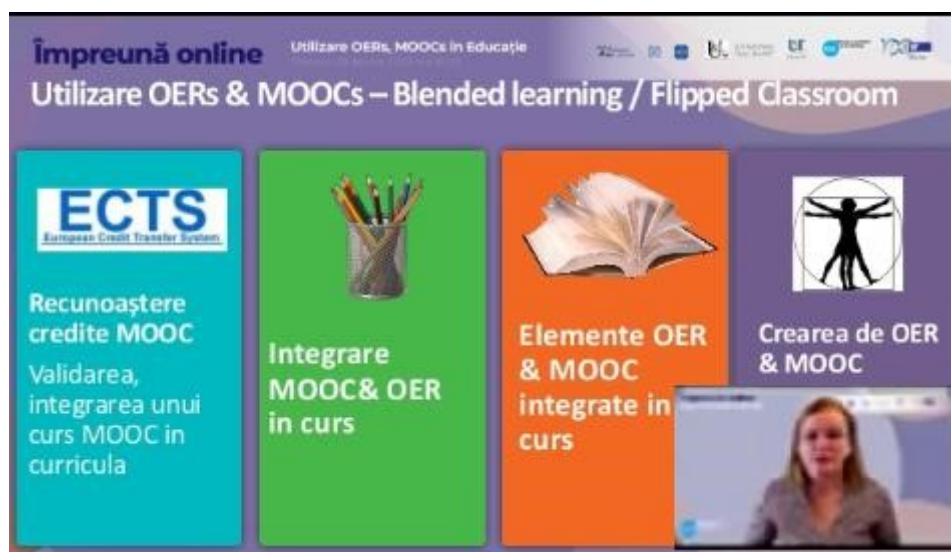


Figure 1. #togetheronline workshop related to OER and MOOC integration

CeL runs also weekly national webinars for teachers and students, in the series “From Campus to Online Learning” #togetheronline (<https://elearning.upt.ro/ro/impreuna-online/>), the first one being organized on April 15: “We aim to succeed in getting out of the individualistic paradigm and to collaborate as much as possible, between us, those in the Romanian educational environment, to find out ideas, experiences and solutions that each of us has tried to apply together”. Therefore, there are shared valuable experiences about

organizing the educational process at the level of universities and departments, about strategies, open practices, applications and platforms for teaching, assessment, evaluation, collaboration, the insights being brought by teachers, students and managers (Figure 1). The presentations and videos are published on Slideshare, Facebook, Youtube and IGTV, with open licenses, while the participants receive open badges.

### ***West University of Timisoara***

West University of Timisoara (WUT, <http://www.uvt.ro>) is well equipped with the technology needed for online learning, thus all the courses are run online using G-Suite and Moodle. WUT created a special digital repository (<https://resurse.e-uvt.ro/>) with a variety of educational resources, including textbooks, course materials, video training. On the other hand, teachers and students use Google Shared Drive, to list the Open Textbooks and OERs they use. The academic community members use Meet, Zoom or Webex for online classes. The sessions are recorded and uploaded for use and reuse by students and teachers. Students also have the opportunity to participate in training sessions organized by the Center for Counselling and Career Orientation (CCCO) to acquire knowledge about online learning.

In order to engage and motivate students, the MOOC-based teaching method has been successfully used during the past three years (<https://west-university-timisoara.teachable.com>) (Figure 2). Since 2015, WUT has supported open education (<http://novamooc.uvt.ro>) and has included MOOCs in the program of complementary disciplines, which generate transversal competencies (TCD – <http://dct.uvt.ro>). They are accessible to all students, from all majors. For example, “Learning English with Technology” was first created as a pilot SPOC (Small Private Online Course) and included for the first time in the TCD program during the second semester of the 2017/2018 academic year, the course being active since then (Bran & Grosseck, 2019). Another initiative set up four years ago regards the integration of OERs and MOOCs in particular courses. The students who participate in different MOOCs, with topics related to the curricula, receive credits for their activities in such courses (Holotescu & Grosseck, 2018). For example, in the transversal discipline “Digital Storytelling”, the teacher includes parts of the course “Pixar in a Box” from Khan Academy (<https://www.khanacademy.org/partner-content/pixar/storytelling>) in some of the learning units.





Figure 2. MOOCs offered by WUT

For the purpose to find the best ways to interact with students and provide quality online education, WUT has consistently applied questionnaires to both students and teachers. Moreover, WUT is the first higher education institution that organizes an online postgraduate program for training and continuous professional development of pre-university teachers, focused on digital and online teaching, learning and assessment activities.

In order to encourage students, WUT posts inspirational messages and photos on social media, Facebook pages and Instagram (social emotional campaigns, #uvt happywall and #stamAcasa). WUT also has developed some specific solutions for managing anxiety: a site that lists prevention methods (<http://masuridepreventie.uvt.ro>) and webinars offered by the CCCO. Simultaneously, the Department of Psychology has started a weekly publication, “Pastila de psihologie” (The psychological tablet), which is distributed to entire academic community and the general public through Facebook and the department’s blog (<https://www.psihologietm.ro/#blog>).

### ***“Ioan Slavici” University of Timisoara***

The teachers of “Ioan Slavici” University of Timisoara run the courses using the university platform (<http://islavici.ro/softstudenti>) and different free online learning applications (Chirila & Chirila, 2020; Maris et al., 2018), being supported by the Center for Open Education and Blockchain (<http://www.islavici.ro>), and also by their colleagues by adopting co-teaching or peer-mentoring practices.

The university platform has features for multimedia content, synchronous and asynchronous interaction between students, teachers and invited lecturers, and also an open repository of OERs produced by students and teachers, for future reuse in university, but also by the larger academic community.

Following an initiative started seven years ago, teachers have participated in international MOOCs for improving their knowledge in their own area of expertise and for improving their competencies and skills for adopting new models of open educational practices (Holotescu, Andone, & Grosseck, 2016).

Thus, especially during the pandemic crises, many of the university courses have followed open educational practices for OERs and MOOCs integration (Holotescu et al., 2014). Therefore, the students consult part of the content of a number of MOOCs and also participate in their social activities (assignments, discussions, peer evaluation). The complex task of the teacher is to synchronize the activities of his or her own course with those of MOOCs, proving support, feedback, additional OERs, moderating and nurturing the local learning community (Figure 3).



Figure 3. Video lecture in an online course with MOOC integration

Students have a high autonomy in assessing their own learning needs for choosing the MOOCs in which to participate in order to deepen the course topics, are exposed to high quality materials created with top educational technologies, to collaboration in global learning communities and to a broader range of experiences than those to which they otherwise might have access.

## Discussions

In these three months of lockdown, teachers have learned and applied many new things about open and blended education, tools and applications, have improved their digital skills, acquiring maybe more than in previous formal face-to-face training sessions. They have self-assessed their training needs, participated in efficient and active communities, learning together with their peers, making important steps towards becoming Open Scholars.

Students found a favourable ground to become more creative, more active, more collaborative, their ideas of organizing the learning being taken into consideration to a greater extent by teachers, thus becoming their real partners in the teaching-learning process.

Both students and teachers should be more aware and use the large number of valuable digital resources and participate in the MOOCs about online learning, made now freely accessible worldwide by companies, publishers, libraries, universities, museums, and international and European organizations (WHO, UNESCO, OECD, OERu, Google, Europa.eu, FutureLearn, Coursera, etc.). Under these circumstances, everyone could become a long-life learning and informed learner.

Nobody knows when this crisis will end, when we'll be able to return to normal, and what the new normal means.

The open strategies adopted by the three universities and presented in the article were recognized as successful use-cases for Open Education and were quoted in the UNESCO Guidance about OEPs, already translated and published in Romanian, to facilitate the adoption of open educational practices by other teachers and institutions (Huang et al., 2020). Having open education strategies implemented during the past years, these universities could have a smooth transition to online teaching and learning, and could contribute with studies, events, OEPs, new developed OERs to the larger academic community of practice.

We believe that a real strategy for the improvement of the educational system is needed, following the experience and lessons learnt during this still ongoing crisis: online learning recognition, better infrastructure ensuring the access to quality education, a national online learning platform, MOOC and OER integration in formal learning, digital credentials on Blockchain for students and teachers' participation in MOOCs on different platforms (Miclea, 2020; Holotescu & Grosseck, 2018; Holotescu & Vasiu, 2020).

Education has to be more centred on students, has to use more the technology, in a correct, flexible and efficient way. More quality and effective training programs for teachers to be organized online or in a blended manner. Also education should become more open, should use, integrate, produce quality OERs and MOOCs, should use the blended and flipped approaches, and collaboration between teachers and institutions should become more global.

Thus, we should rethink the role of a resilient and quality Education at all levels:

- Institutional level
  - motivate teachers to learn continuously - in (in)formal programs, MOOCs;
  - adopt open educational practices/blended learning, integrate OERs and MOOCs – National Level;
  - implement programs for infrastructure, connectivity;
  - promote Open Education principles, OER repositories, as reservoirs of resilience (Kanwar & Daniel, 2020);
  - establish transparent public-private partnerships – European level;
  - recovery instrument NextGenerationEU (EC, 2020): supporting distance learning and digital skills development;
  - projects for opening up education, micro-credentials for formal recognition of different learning paths (MOOCs);
- International level
  - collaboration for sharing best practices, for communities of practice of teachers and policy makers;
  - collaboration for adopting UNESCO Recommendations for OER/Dynamic Coalition of OER (UNESCO, 2020b).

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## ABC LD – A NEW TOOLKIT FOR RAPID LEARNING DESIGN

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### Abstract

ABC Learning Design (ABC LD) is a high-energy, hands-on curriculum development workshop from University College London (UCL). In just 90 minutes teaching teams work together to create a visual “storyboard”. The storyboard is made up of pre-printed cards representing the type and sequence of learning activities (both online and offline) required to meet the module or programme learning outcomes. All the resources have been released under Creative Commons licenses and are free to download, adapt and use.

ABC LD is now popular across European tertiary education and beyond. Participants have found the workshop-based “sprint” approach to be quick, engaging and productive. The original UCL or “base” ABC LD is built around a collaborative and intensive 90’ workshop in which module teams work together to produce a paper-based storyboard describing the student journey.

Over the last two years UCL has led an Erasmus+ project to develop and evaluate the ABC LD method with 12 partners (<https://abc-ld.org>). We have focused on localisation to institutional contexts and have explored the important link between storyboard designs and the Virtual Learning Environment. The main output is a freely downloadable Toolkit of resources and guides, enabling any college or university to adapt and adopt the method.

Although developed to promote blended learning, during the COVID emergency, some institutions have now modified ABC LD to be facilitated remotely to support their need for a rapid transition to online learning. ABC LD is proving an effective method in this new format, too

### What is the ABC LD Toolkit?

Since being launched in 2015, UCL’s ABC learning design method (Young & Perović, 2016) has been widely adopted across universities in Europe and beyond. It is also being used in training, secondary education and other education -related sectors. The core of ABC LD is a highly successful sprint workshop format that engages academic teams in programme and module (re)design. Rapid institutional transition towards online learning due the

Covid 19 pandemic has, if anything, reinforced the value of ABC LD's sprint approach. The suspension of live group work has disallowed the original format but the community of ABC LD enthusiasts has responded with energy and imagination to produce online ABC LD approaches that capture the essence of the method.

The Toolkit (2020) is a series of seven guides with accompanying resources that was co-produced in 2020 as the main output of the Erasmus+ project "ABC to VLE". The project was led by UCL and brought together 12 other universities to further develop, localise and evaluate the ABC LD learning design method. The partners were; University College Absalon, University of Amsterdam, Dublin City University, University of Helsinki, KU Leuven, University of Milan, University of Oxford (associate partner), Sorbonne University, Tallinn University, Polytechnic University of Timișoara, VIVES University of Applied Sciences, University College London (lead), and SRCE University of Zagreb. Some were already using the method and others were keen to try it. The project was focused on institutional adoptions of ABC LD, user experiences and how the designs could link to the local technical environment, and particularly their virtual learning environment (VLE) such as Moodle, Canvas or Blackboard. The project was still underway when the pandemic struck, so we were able to respond to the crisis by developing extra material, with input from the wider community. The main part of the Toolkit focuses on the original or "base" format and its variants. We are confident that we will be able to facilitate live workshops again soon. In the meantime, the core principles of co-design by teaching teams, apply to online as much as face-to-face activities and we are excited by the possibilities of the new online adaptations.

## **The seven Toolkit guides**

The guides (G1 to G7) are not intended to be read in sequence, as many users will already be familiar with ABC LD method. Some knowledge from earlier guides may be assumed, though, in later ones. The titles are as follows.

- G1 – Introducing ABC learning design – an overview of the principles.
- G2 – Base ABC LD and translations – how the live workshops run.
- G3 – Localising ABC – integrating ABC LD in local initiatives and policies.
- G4 – ABC LD and the VLE – moving from designs to technical implementation.
- G5 – Does ABC LD work? – the evaluation of ABC LD method.
- G6 – Online ABC LD (Covid versions) – different approaches to replacing the live workshops
- G7 – The future of ABC LD – building the community and sharing practice.

The seven short guides, presented as an online resource, provide a cohesive narrative thread linking the various components of ABC LD method. The real value in the Toolkit



however is the resource collection; tools, examples, variations and evaluations produced during the project and via the wider ABC LD community. These resources are linked from the Guides to enable those interested in the method to “dive deeper” at any point into specific resources, examples and ideas.

## **How the Toolkit is intended to be used**

The guides address five user scenarios.

- If you are new to ABC LD, we’d suggest you start with G1. This guide introduces the underpinning theory, derived from Professor Diana Laurillard’s “Conversational Framework” (2002; 2012) and her concept of “learning types”. Videos from the live workshop give an impression of its dynamics, and the recorded explanations by Dr Clive Young and Nataša Perović (the co-creators of the ABC LD method) expand on how this version works and why.
- If you are interested in running ABC LD workshop, G2 breaks down the workflow of the original UCL version and introduces some variations from the Erasmus+ project partners and others. Part of the ethos of ABC LD method is to encourage and enable localisation. All ABC LD resources are downloadable and released under Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) license. You can adapt them to your needs, providing you keep the original attribution (and ideally share with the community). G2 provides ideas on how to do this.
- If you want to run an online ABC LD workshop, G6 offers some alternatives from the project and the community. Again, developers have been generous in providing resources. It is still probably best to look at G2 to see what the intended outcomes are and you will want to look at G4 and the technology support model. Look for the ABC LD “tool wheel” (or “app wheel”) for an interesting way to link pedagogical approaches to the tools available.
- If you want to adopt ABC LD method in your institution then G3 will provide some inspiration, and if you need evidence (for your management) or convincing (for you), G5 and the evaluation of ABC LD provides an interesting and positive story.
- If you want to join the ABC LD community, and/or create a local network, then G7 lists some ideas we have used in the project and beyond.

## **Components of the Toolkit**

### ***G1 – Introducing ABC learning design***

How can we engage and enable our time-pressured academics to design rich blended and online courses? Even before the Covid epidemic of early 2020, most leading universities already had ambitious strategies to develop digitally rich blended and fully online courses.

Progress was patchy in most institutions, as only a few pioneering academics had the design skills, technology knowledge and above all time to remodel their programmes. Covid was, on top of everything else, a challenge to current learning designs and has forced even traditionally-minded universities to “pivot” rapidly to online learning provision, a cultural transformation that is unlikely to be completely reversed. Many universities with experience of ABC LD are now looking to integrate the method into their response. The “Base” version of ABC LD is a high-energy hands-on workshop. In just 90 minutes teaching teams work together to create a visual “storyboard”. The storyboard is made up of pre-printed cards representing the type and sequence of learning activities (both online and offline) required to meet the module or programme learning outcomes. Assessment methods, cross-programme themes and institutional policies can all be integrated into the process. The key to this approach is pace, engagement and collaboration. The ABC LD method was found particularly useful for new programmes or those changing to an online or more blended format. The approach generates high levels of engagement, creative informed dialogue and group reflection about curriculum design among even time-poor academics. The workshops have an immediate impact in terms of stimulating a level of collaborative “educational design thinking” in a range of academic contexts. An early form of the Toolkit was released in 2018. G1 discusses the underlying pedagogy of ABC LD, namely Professor Diana Laurillard’s concept of “learning types”, itself derived from her “Conversational Framework” model of adult learning (Laurillard, 2002). This has proved a remarkably robust and accessible route into teaching and learning discussion and reflection. The six learning types are: Acquisition (i.e. to read/watch/listen), Investigation, Practice, Discussion, Collaboration and Production. For teachers with limited experience of (and sometimes enthusiasm for) educational theory, the learning types approach is easy to grasp, resonates with practice, and stimulates rich pedagogical conversation. The six learning types were converted into the ABC LD cards, (Figure 1) used to create the storyboard.



Figure 1. ABC LD Learning Types cards (front)

## G2 – Base ABC and translations

This part of the toolkit explains how the Base (i.e. UCL) version of ABC LD workshop is structured, with detailed step-by-step advice on how to run it in that format, why the event is structured that way and potential questions the organisers (and participants) might have. The workshop is organised in a very planned and time-conscious manner (Figure 2). Most of the 90 minutes is spent on group activity, but it starts with a brief presentation introducing the toolkit elements and their pedagogical background.

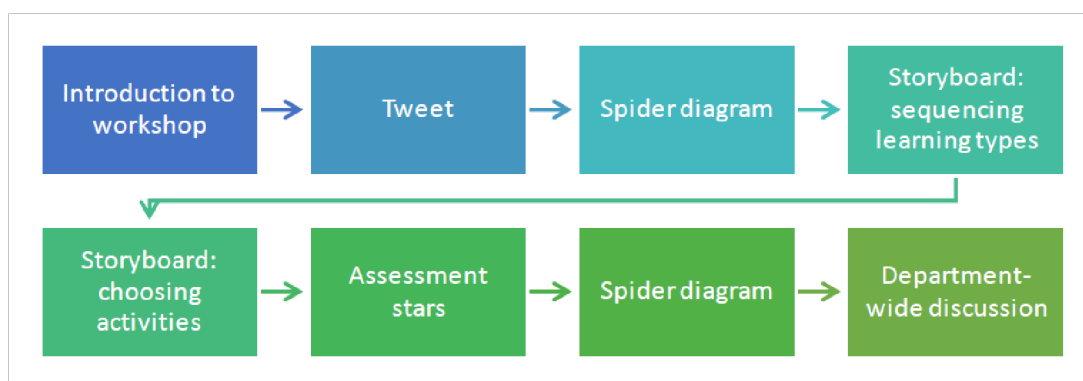


Figure 2. ABC workshop activities as a flow chart (Pieroni, 2019)



Figure 3. Facilitating the ABC LD workshop

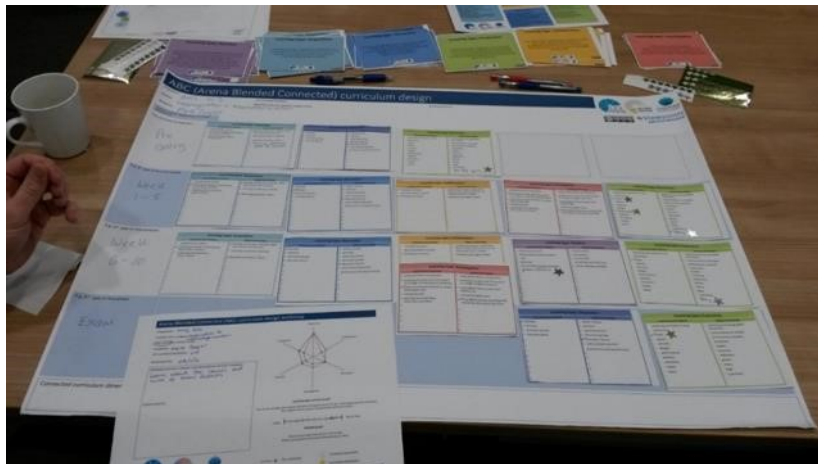


Figure 4. A completed ABC LD storyboard

The Toolkit includes ABC LD resources translated into 14 languages by members of the Erasmus+ project and the ABC LD community.

### ***G3 – Localising ABC***

While retaining the core principles, the “Base” workshop format is sometimes localised to specific institutional, teaching and discipline contexts. These variants are also described in the Toolkit. The examples of the local adaptations are given explaining why and how the changes have been made as well as the outcome of the changes. Apart from translation of the resources are translated, the timings may be changed (often extended), and the content, activities, card sets and storyboarding have all been adapted by different partners to fit with their institutional and national educational priorities. The ABC LD workshop is often supplemented by pre- and post-workshop events and activities and “extensions” included, such as mapping learning outcomes, competencies and so on.

## **ABC LD – A new Toolkit for Rapid Learning Design**

The ABC LD workshop can be supplemented by pre- and post-workshop events and activities and “extensions” included, such as mapping onto graduate attributes, assessment policy, learning analytics and other local priorities. It became clear during the project that although the UCL vision of ABC LD had focused on learning design, with some strategic components, the method was often applied in other areas, too. These areas can be summarised as follows:

- Learning Design – blended courses, programmes, MOOCs, CPD, training;
- Strategic Development – Research based learning, digital capabilities, employability, assessment and feedback review, student input;
- Academic Development – identification of skills, share practice, terminology, part of courses, practical development exercises, certification, case studies;
- Review of technical and support environment – VLE review, gap analysis, service provision, “app wheel”;
- Quality Assurance – documented part of new module/programme design and review;
- Analytics – identification of data points for “in-flight” feedback and post hoc review (with JISC, EUNIS);
- Digital capabilities for staff and students.

The Toolkit includes institutional narratives from the Erasmus+ partners.

### **G4 – ABC LD and the VLE**

As colleagues from Dublin City University note, “It is clear that academic staff require further support to integrate technology within their teaching and specifically in their VLE and technology-enhanced practice”. The hands-on team-based format of the classic ABC LD workshops is motivating and enjoyable and there is ample evidence of engagement and staff learning as a result. Early evaluation at UCL had shown however where there was a lack of direct follow-up support, participants were often unable fully realise the plans they made during workshops. Direct support by digital education technologists may be hard to scale so is invariably supplemented or replaced by online resources. Universities generally have extensive guidance supporting the tools in the VLE but the link to learning design is not always clear. Although not part of the Base workshop, the “Tool Wheel”, where the tools available to teachers – in the VLE and beyond – are mapped to the learning types, has proved a critical part of institutional implementation (see Figure 5).

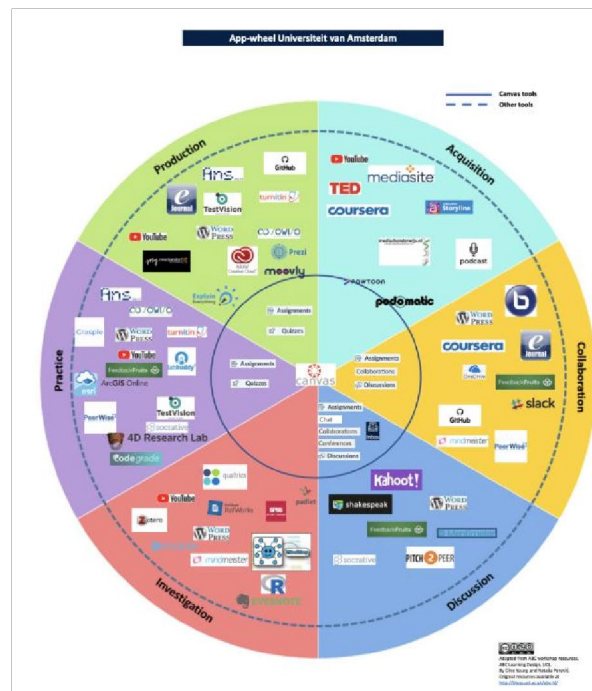


Figure 5. Example Tool Wheel from the University of Amsterdam

The Erasmus+ project explored several different implementations of the Tool Wheel concept. Four approaches were taken. Dublin City University produced an interactive online version using the web-based development environment HP5, Absalon developed a selection tool in WordPress, and UCL developed a worksheet. The deepest integration was from Vives, who had already been using ABC LD for several years when the project started. The Toolkit provides explanations of, and links to, each of these implementations. The H5P tool includes instructions how to localise the interactive tool to the institutional VLE and other supported tools.

### **G5 – Does ABC LD work?**

At first, ABC LD can seem a challenging methodology. The dynamic, group based, rapid development format may feel quite different to existing methods of curriculum design, and even “normal” academic development events. The questions from people unfamiliar with the method are obvious. How will our academic colleagues react? Can such an apparently simple method achieve any useful results? Does it work for all disciplines? Won’t sceptical and resistant colleagues disrupt the workshop? What if I can’t answer the questions that come up? These, and others, are all perfectly valid concerns, and not easy to answer without experiencing the workshop directly. Since launching ABC LD in 2015, the UCL team have therefore made a considerable effort to facilitate “train the trainer” ABC LD workshops in many different institutions, and indeed that was a central component of the Erasmus+ project. The belief remains that by seeing how the format works by participating, attendees can judge for themselves whether it was relevant and useful for themselves and their institutions. In parallel, ABC LD has progressed through several



stages of more structured evaluation, from initial ad hoc feedback through qualitative evaluation during a project funded by the Higher Education Funding Council England (HEFCE, 2018) to a more quantitative, survey-based approach as part of the Erasmus+ project (references). A few representative participant responses of the HEFCE research are as follows.

*“We haven’t had such level of detailed discussion as a team. I think the structure and the materials are facilitated well.”*

*“It makes you think about: OK, we are going to use this technique, but where, how, for what and how does it fit with everything else? And this is the way into that, I think.”*

*“It was an eye opener. I found it really useful to think about categorising how the learning objectives will be delivered and assessed, and examining the variety of ways that these can be achieved. It made me think more deeply about what skills the students can develop by making them responsible for their learning journey and not simply the content that needs to be delivered to them”.*

For the ABC to VLE project evaluation, a questionnaire was agreed by the partners who ran 84 ABC Learning Design workshops in 11 countries, with more than 1035 participants. Feedback was sought from over 60 of the workshops and the project team received 344 participant responses and a further 42 follow up responses about whether they had implemented their plans. The full report is available (<https://abc-ld.org/evaluation/>) but Figure 6 encapsulates the main message.

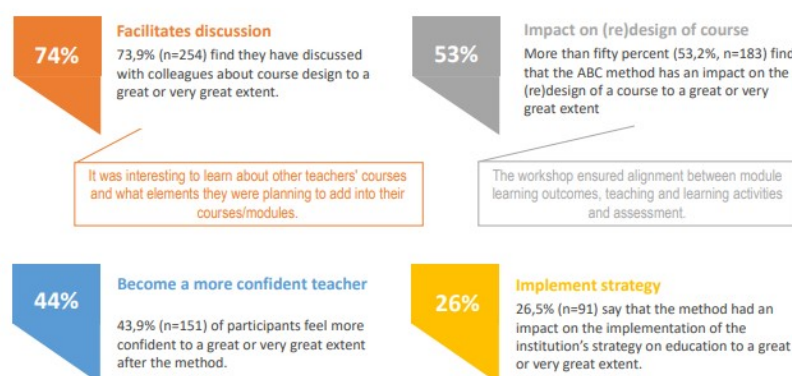


Figure 6. To what extent did you reach the following outcomes by the end of the workshop?

The opportunity, perhaps “permission” to discuss how to design the student journey in a non-judgmental, collegiate atmosphere is always much appreciated. Although only small majority found it had an immediate impact on course redesign, it should be remembered

ABC LD is a short-form intervention with academic teams with little or no preparation. Moreover, “redesign” of the course in terms of changes may not be the only desirable outcome. The examination and overt justification of the current course may itself be valuable and this relates to the next point. The finding that participants feel more confident teachers after ABC LD is as unexpected as it is pleasing. We have often seen that the openness of ABC LD can help validate current practices and designs among peers. Teachers can be quite self-critical of their own methods but may find, when discussing with colleagues, that the underlying rationale is quite robust and may require only minor adjustments. Thus, even if few changes are made to the design, the outcome can be satisfying. Not all workshops (at least prior to Covid) focus on implementing educational strategy or policy, so it was almost surprising that over a quarter of respondents recognised a strategic component.

### **G6 – Online ABC LD (Covid versions)**

Due to social distancing demands, the community cannot run the popular face-to-face ABC LD workshops at the time of writing. However, many institutions wish to continue to use the method. The community has been very active in sharing their experiences. There are three components of ABC LD that are often repurposed for online delivery. The first is the concept of the learning types. As mentioned above, the learning types framework types has proved a rapid, robust and engaging route into pedagogical discussion and reflection. Even without the complete ABC LD workshop, learning types act as a focus for consideration of existing (face-to-face or blended) teaching and learning activities and what fully online alternatives might be. One example is to use a simple worksheet categorising the six types in terms of “conventional” and digital practices, how they might be implemented in the VLE and some ideas for engaging activities using these tools. The App Wheel as in Figure 5 provides another approach to linking pedagogy and technology, providing a clear visual representation of the toolset available and where it can be used. Although drawing from ABC LD, these are essentially staff development activities. The most challenging component of ABC LD to replicate online is also the one that participants usually find the most rewarding: the collaborative storyboarding. While there is no single tool or approach that meets this requirement, several approaches have been tried by the community. One is to use a shared Microsoft PowerPoint space, as the base version tools (primarily the cards and storyboard) are already in this format. The participants work synchronously in the shared online worksheet and “drag and drop” cards along the timeline. Popular shared “whiteboard” tools such as Padlet, Miro and Microsoft Planner have also been used to provide some of the dynamic interaction of the live workshop. Trello is a card-based online organiser that also shows some promise. UCL is experimenting with Learning Designer (<https://www.ucl.ac.uk/learning-designer/9> a session planning tool from UCL aimed at secondary school teachers but based on the same learning types pedagogical model as ABC



LD. While not designed for course-level planning, it produces a useful list of actions. Various members of the ABC LD community, including UCL, have produced Microsoft Excel sheets that can be used to track decisions in ABC LD workshop and produce an action list. It may be that no single software tool will emerge, but institutions will adopt a variety of tools and workflows according to local licensing availability, context and needs. Although the ABC to VLE project is now complete, the project partners continue to evaluate online alternatives and will add these to the Toolkit as they emerge (<https://abclld.org/online-abc-ld/>).

### **G7 – The future of ABC LD**

During the final (online) meeting of the Erasmus+ project in June 2020, one partner remarked that the “Toolkit” was more than simply a set of downloadable guides, resources, tools and videos. Although we know of universities that have adopted ABC LD and have not contacted UCL or any other current user, the Toolkit artefacts themselves take on more value if they are placed in the context of shared professional practice. New users are recommended to discuss with UCL or other partners to form a better understanding of ABC LD and the ethos behind it. In the next stage of ABC LD, the partnership hopes to develop a structure of national information “hubs”, local online communities, and an international conference to share ideas and resources. A method of “badging” facilitators to recognise their skills and experience has already been planned. Above all we anticipate that users of the Toolkit will wish to join the wider community, not only to gain ideas and updates, but to contribute to it themselves. The underpinning pedagogy of ABC LD is the “Conversational Framework” and the workshop in both live and online formats is also essentially a conversation. We hope the international ABC LD community will evolve into a global conversation, not only about ABC LD, which is just one method, but about the importance of learning design to build effective and engaging educational experiences.

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