Video-based collaborative learning

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PREFACE

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EAPRIL is the European Association for Practitioner Research on Improving Learning. The association promotes practice-based and practitioner research on learning issues in the context of formal, informal, non-formal, lifelong learning and professional development with the aim to professionally develop and train educators and, as a result, to enhance practice. Its focus entails learning of individuals (from kindergarten over students in higher education to workers at the workplace), teams, organisations and networks.
More specifically

- Promotion and development of learning and instruction practice within Europe, by means of practice-based research.
- To promote the development and distribution of knowledge and methods for practice-based research and the distribution of research results on learning and instruction in specific contexts.
- To promote the exchange of information on learning and instruction practice, obtained by means of practice-based research, among the members of the association and among other associations, by means of an international network for exchange of knowledge and experience in relation to learning and instruction practice.
- To establish an international network and communication forum for practitioners working in the field of learning and instruction in education and corporate contexts and develop knowledge on this issue by means of practically-oriented research methods.
- To encourage collaboration and exchange of expertise between educational practitioners, trainers, policy makers and academic researchers with the intent to support and improve the practice of learning and instruction in education and professional contexts.
- By the aforementioned goals the professional development and traning of practitioners, trainers, educational policy makers, developers, educational researchers and all involved in education and learning in its broad context are stimulated.

Practice based and Practitioner research

Practice-based and practitioner research focuses on research for, with and by professional practice, starting from a need expressed by practice. Academic and practitioner researchers play an equally important role in the process of sharing, constructing and creating knowledge to develop practice and theory. Actors in learning need to be engaged in the multidisciplinary and sometimes trans-disciplinary research process as problem-definers, researchers, data gatherers, interpreters, and implementers.

Practice-based and Practitioner research results in actionable knowledge that leads to evidence-informed practice and knowledge-in-use. Not only the utility of the research for and its impact on practice is a quality standard, but also its contribution to existing theory on what works in practice, its validity and transparency are of utmost importance.

European Association for Practitioner Research on Improving Learning

Context

EAPRIL encompasses all contexts where people learn, e.g. schools of various educational levels, general, vocational and professional education; organisations and corporations, and this across fields, such as teacher education, engineering, medicine, nursing, food, agriculture, nature, business, languages, … All levels, i.e. individual, group, organisation and context, are taken into account.

For whom

Practitioner researchers, academic researchers, teachers, teachers educators, professional trainers, educational technologists, curriculum developers, educational policy makers, school leaders, staff developers, learning consultants, people involved in organisational change and innovation, L&D managers, corporate learning directors, academics in the field of professional learning and all who are interested in improving the learning and development of praxis.

How

Via organising the annual EAPRIL conference where people meet, exchange research, ideas, projects, and experiences, learn and co-create, for example via workshops, training, educational activities, interactive sessions, school or company visits, transformational labs, and other opportunities for cooperation and discussion. Via supporting thematic sub communities 'Clouds', where people find each other because they share the same thematic curiosity. Cloud coordinators facilitate and stimulate activities at the conference and during the year. Activities such as organizing symposia, writing joined projects, speed dating, inviting keynotes and keeping up interest/expertise list of members are organised for cloud participants in order to promote collaboration among European organisations in the field of education or research, including companies, national and international authorities. Via newsletters, access to the EAPRIL conference presentations and papers on the conference website, conference proceedings, regular updates on cloud meetings and activities throughout the year, access to Frontline Learning Research journal, and a discount for EAPRIL members to the annual conference.

More information on the upcoming 2022 Conference as well as some afterglow moments of the 2021 Conference can be found on our conference website http://www.eapril.org.

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APPLYING LEARNING ANALYTICS AND LEARNING DESIGN TO SUPPORT STUDY PROGRESS IN ONLINE COURSE – A CASE STUDY

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ABSTRACT

Universities of Applied Sciences (UAS) in Finland have invested extensively on providing online courses and digitalisation will continue to expand. Students are required to be increasingly self-directed. Development of learning analytics (LA) provides opportunities to support students study progress, however the starting point of implementing learning analytics (LA) has not traditionally originated from learning but from organisational or teacher perspectives. This case study applies LA in an online course aiming to boost students' self-directed learning (SDL) while completing learning tasks, within the Moodle environment. The effect of student progress visualisation and automated process-oriented feedback was explored. In addition, the changes in students' satisfaction towards the course (NPS) was explored. The preliminary results suggest that LA significantly enhances timely returns of learning tasks and might even increase course satisfaction. The results were emphasized among those students who had problems in timely returns of the tasks. The present results indicate that even easily applied LA can have a positive effect on task returns and possibly even on increased self-direction.

THEORETICAL BACKGROUND

In the last five years, universities of applied sciences (UAS) in Finland have invested extensively in providing online courses (e.g. Scheinin et al., 2018). According to the European University Association digitalisation in learning will continue to expand (Gaebel, 2021), which has partially increased the need for students' self-directedness (Song & Hill, 2007). Self-directed learners take more responsibility for their own learning, are proven to be and feel more confident and successful as learners compared to teacher-directed learners (Garrison, 1975; Knowles, 1975). In recent years, particular attention has been paid to the use of technology and on design of digital environments to support processes of self-regulated learning (SRL) and self-

directed learning (SDL) (Durall & Gros, 2014; Song & Hill, 2007). These concepts are often considered synonymous and overlapping (Loeng, 2020). In this study the concept of SDL is used, since its origin the concept has been often used in the context of higher education and adult learning in non-formal learning environments, such as online learning (Durall & Gros, 2014).

Research highlights the significance of adult learner academic SDL in open-distance and e-learning contexts (Botha 2021, Zhao & Chen, 2016,1). Need for understanding and fostering SDL exists particularly in higher education online learning contexts which typically allow high levels of autonomy (Song & Hill, 2007). There has been growing interest in higher education in exploring how learning analytics (LA) could be used to support student engagement and to provide actionable feedback with LA for students (Silvola et al., 2021). However, comprehensive understanding is lacking in these learning processes and their support in online-environments with LA (Ifenthaler & Yau, 2020), even though case studies and empirical evidence exist in varying contexts and applications (Matcha et al, 2020).

LA has been defined as 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, 2013). Previously, the development of LA has focused on providing information for teachers rarely have students been considered as main receivers of LA (Dural & Gros, 2014), also implementation is often approached in a data-driven way and from the perspectives of organisations, not learners. Therefore, we lack knowledge on the effects of LA on student activities and learning. In UAS, LA is expected to support students' SDL as well as teachers' pedagogical practices (e.g. Viberg et al., 2018; Sclater et al., 2016). Analysing and supporting SDL with LA offers exciting opportunities, such as time management, self-monitoring or self-reflection for competence building (Roll & Winne, 2015) e.g. raising students awareness of their own learning process. One of the main values of LA for higher education students is that it can provide insights into their learning habits and offer recommendations (Siemens & Long, 2011).

According to Pardo (2014) designing the utilisation of LA can be divided into five chronological stages: collect, analyse, predict, act, and refine. The successful use of LA is based on careful consideration, e.g., designing the first 'collect stage' in a way that digital traces (footprints) of student activity enable supporting SDL. A digital footprint is data that users have left behind, e.g., traces of a student's activity in digital environment (e.g. Pozdeeva et al., 2021; Wang & Han, 2021). Virtual learning systems are diverse information technology-based environments, in which the learner interacts, e.g., with materials, teachers or peer students through technology. Typically, virtual learning systems conduct real-time LA exploring and processing learner behaviour and performance data and display the feedback as visualizations in dashboards (Wan & Han, 2021). For example, a student learning process, such as assignment completion progress can be visualised in a dashboard. Dashboards can

be tailored, e.g., to promote awareness, self-reflection and sense-making (Verbert et al., 2013). Although visualizing the learning process has been recognized as an important issue (Deric et al., 2013), the content and visualized appearance of LA dashboards has not yet reached a consensus (Wan & Han, 2021) and research on the effects of various dashboard on students' behaviour, skills development and performance are contradictory (Bodily & Verbert, 2017). Often dashboards information has not originated from the pedagogical considerations or theory basis (Jivet et al., 2017) and therefore accumulated data can be completely insignificant to the student. In addition, it is also argued by Park & Jo (2015) that students are not used to interpret visualized data as part of their learning process. It would be assumed that students also need support in using LA to empower students' agency in using analytic tools as part of their learning (Ochoa & Wise, 2021).

Learning Management systems (LMS) such as Moodle, Blackboard etc. are platforms designed to manage online learning, typically including features such as individualized dashboards or tailored messaging systems applied as assisting tools for students' metacognitive process (e.g. Durall & Gros 2014; Verbert et al., 2013). Generally, LMSs offer the possibility of automated, process-oriented feedback. Furthermore, Moodle offers functionality (Completion Progress Block) for teachers and students to overview activities to be completed and the reengagement plugin (Reengagement activity) for teachers to use automatization to remind students or offer personalised up to date feedback (Moodle, 2022).

Satisfaction experienced in learning is beneficial for the students and furthers their self-directedness, thus it would be beneficial if students were actively involved in improving their online learning experiences. In order to utilize student-centred LA, it is important to involve them as feedback providers (Ochoa & Wise, 2021). Net Promoter Score (NPS) (see Grisaffe, 2007), a metric used in customer experience programmes, can be applied in business to measure customers' willingness to recommend a product or a service. NPS has also been applied in education, e.g., as a willingness to promote a course (e.g. Heilala et al., 2020; Aguilar et al., 2020). Since NPS is strongly influenced by scale structure, it is suggested to be used, interpreted, and compared with caution, something more like an indicator (Grisaffe 2007, p.50).

Our case study context is a blended course implementation in UAS, which had earlier received critical feedback from the students. The challenges emerged in both study progress within online phases of the course as well as in student satisfaction (low NPS score, see also Heilala et al., 2020). First, students were not progressing through the course in the expected manner and time, and second, the feedback received from the students remained poor, despite teachers' earlier attempts to improve the course content and structure. Intervention applying LA (approach by Lockyer et al., 2013) was launched 2020, aiming to boost students' SDL, help them to complete the course on schedule. Self-directedness appears as studies progress through completion of

learning tasks. We applied LA plugins to Moodle to collect data on the effect of the improvements of the re-formulated course, the students' satisfaction was explored by using NPS.

RESEARCH QUESTIONS

The study was targeted at visualization (Completion Progress block) and automated guidance messages (Reengagement activity) applied by the online platform (Moodle), to study their effects on the study progress, specifically their learning task return activity. In addition, the student satisfaction for the course was gathered and compared to previously implemented course without LA. The main research questions were i) whether applying learning analytics (LA) has an effect in supporting students' study progress, and ii) whether it has an effect of the student satisfaction. Thus, more specific research questions were set: 1) Are there differences in the shares of timely returns of the learning tasks between control group and test groups? 2) Are there differences in overall return activity between control group and test groups? And 3) Are the distributions of the willingness to promote a course similar before and after re-formulation of the course?

RESEARCH DESIGN, INSTRUMENTS AND METHODS

This case study initiates practice-based research on the use of Learning Analytics (LA) to develop data-driven learning design, to support teaching and learning in higher education. The institutional context is a UAS in which an increasing number of courses are delivered in a blended or online mode. Our case study is situated in the context of a blended learning process in autumn 2020. The i) data of the study progress was automatically traced in Moodle while student return learning (RQ 1-2) tasks and ii) student feedback data on course satisfaction was collected (RQ3).

Research design

The course is a mandatory part of the degree programs for first- and second-year students. The participating students, total of 473 undergraduate bachelor- UAS students represent multiple study programs A research permit was applied from the UAS. Students were provided information on the research at the beginning of the course both through video and written material.

To enable supporting students SDL through LA, the course needed to be re-designed. The overall structure of the course and the pedagogical approach and total workload (ECTS) remained the same. The number of learning tasks increased from 5 to 14.

The course structure consisted of 3-phases (see Fig. 1). Independent online Phases 1 and 3 of the blended learning course were selected for the study.

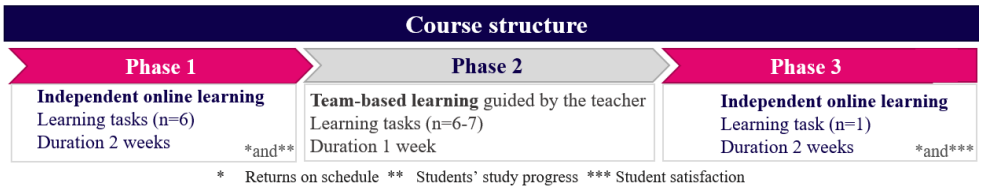

Figure 1: Re-designed course structure

The master Moodle course was created in which the learning process was visible to students through learning activities. Thereafter the course was copied to create 3 identical implementations, control course (Course 1) and test courses (Course 2-3). Varying types of LA, Moodle plugins, visualization of progress (Completion Progress block) and automated to process-oriented feedback (Reengagement activity) was added to the control courses according to learning design. Students were randomly divided into three courses (Fig. 2).

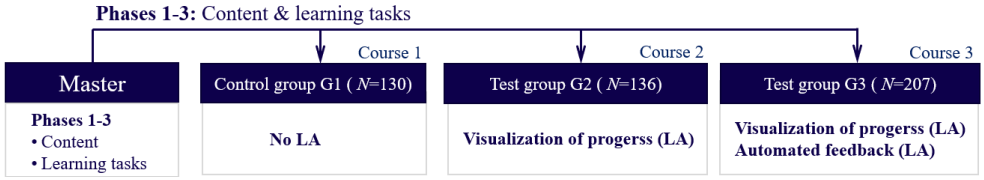

Figure 2: Experimental setup, courses and LA plugins.

NPS -score (Grisaffe, 2007) was utilised as an indicator of students' satisfaction with the changes made in the course and it was a question of willingness to promote a course on 0 (not at all likely) to 10 (extremely likely). To generate an NPS score, responses were sorted into one of 3 categories: Promoters (a score of 9 or 10), passives respond (a score of 7 or 8) and detractors (a score of 0 to 6). The NPS score is the difference between the percentages of promoters and detractors.

Research instruments and methods

The study focuses on the first and third, independent online phases of the course (see Fig. 1). The students' study progress was measured by data generated automatically by Moodle while completing a total of 7 learning tasks. Each learning tasks had predetermined return dates. The students' returns were classified: returned on schedule (2), returned late (1) and not returned (0). Additionally for each student and task, a new variable was created as an indicator of timely return (returned on schedule (1), returned late and not returned (0)).

First examination targeted the **return activity** of learning tasks, i.e., whether each had been returned on schedule. This preliminary review focused on comparing indicator, timely returns. For the analyses, each learning task was examined separately and the differences between the shares of timely returns in control and test groups were analyzed by using Pearson Chi-Square -test. Data analysis was performed with IBM SPSS (28.0).

Second, to examine students' **study progress** the return activity variable (RAV) was generated by calculating a sum variable from classified students returns [0,2]. This statistical examination was targeted at the first independent phase (Phase 1), as Phase 2, team-based learning that was guided by a teacher was expected to affect student study progress during Phase 3 also. All students who dropped out during Phase 1 (*N*=3) were excluded from the review.

RAV1 was employed to examine students' return activity response to varying LA. The RAV1 range was [0,12] for the six learning tasks in Phase 1. Thereafter, the students who had returned all their learning tasks on schedule were excluded. RAV2 indicates students' return activity, where RAV2 was [0,11]. As expected, RAVs were not normally distributed but of similar shape and range. The differences between the three groups were analysed with two-by-two comparisons by using the non-parametric Mann-Whitney U test (see Fig. 3).

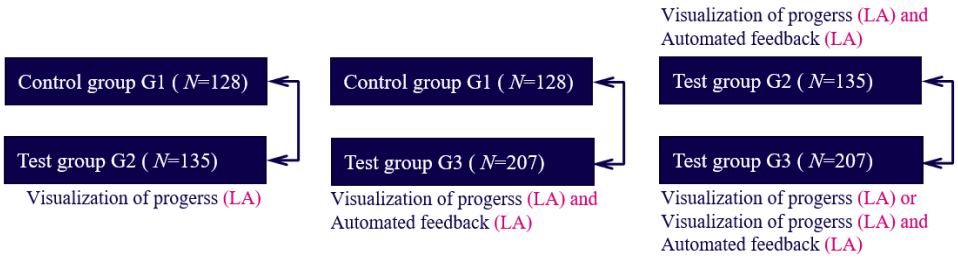

Figure 3: Comparison groups for Mann-Whitney U -test

Thirdly the student study satisfaction and willingness to promote the course was explored according NPS. The NPS score was compared respectively for both 2018 and 2020, and within 2020 groups. The scale used for 2020 was [1,11] and for 2018 [0,11]. The 2018 scale was modified [1,10] combining results for categories 0 and 1 to be able to compare NPSs before 2018 and after the learning design process autumn 2020. This combination weakens the comparison. Since the data was collected as part of the final learning task in the end of Phase 3 (see Fig. 1), the NPS score describes student study satisfaction of the entire course, not just the SDL Phases (Phases 1 & 3).

Results

The statistical examination of **returning each learning task on schedule** was examined. The results calculated with percentages indicate that learning task return activity was lowest in the group without learning analytics G1 and highest in the group with both visualization and automatic feedback G3 (see Table 1).

Table 1: Descriptive statistics (frequencies and percentages)

Learning task	G1 (*N*=130)		G2 (*N*=136)		G3 (*N*=207)	
	N	%	N	%	N	%
Returned on schedule						
Phase 1 -Task 1	121	93 %	131	96 %	202	98 %
Task 2	122	94 %	131	96 %	203	98 %
Task 3	115	89 %	127	93 %	198	96 %
Task 4	103	79 %	121	89 %	184	89 %
Task 5	99	76 %	108	79 %	175	85 %
Task 6	81	62 %	97	71 %	148	72 %
Phase 2 -Task 7	111	85 %	124	91 %	185	89 %
Returned late						
Phase 1 -Task 1	6	5 %	5	4 %	4	2 %
Task 2	6	5 %	5	4 %	4	2 %
Task 3	9	7 %	4	3 %	4	2 %
Task 4	4	3 %	3	2 %	5	2 %
Task 5	11	9 %	13	10 %	12	6 %
Task 6	21	16 %	30	22 %	51	25 %
Phase 2 -Task 7	2	2 %	1	1 %	1	1 %
Not returned						
Phase 1 -Task 1	3	2 %	0	0 %	1	1 %
Task 2	2	2 %	0	0 %	0	0 %
Task 3	6	5 %	5	4 %	5	2 %
Task 4	23	18 %	12	9 %	18	9 %
Task 5	20	15 %	15	11 %	20	10 %
Task 6	28	22 %	9	7 %	8	4 %
Phase 2 -Task 7	17	13 %	11	8 %	21	10 %

Figure 4 presents each learning task which were returned on schedule (left side) and which were not returned at all (right side) from all three groups (G1-3). In fact, the return rates trend was somewhat decreasing, but most in the control group excluding task 7, where no trend can be determined. The results are uniform in all first 6 learning tasks during Phase 1, however task 7 which students returned in Phase 3 gives a different result.

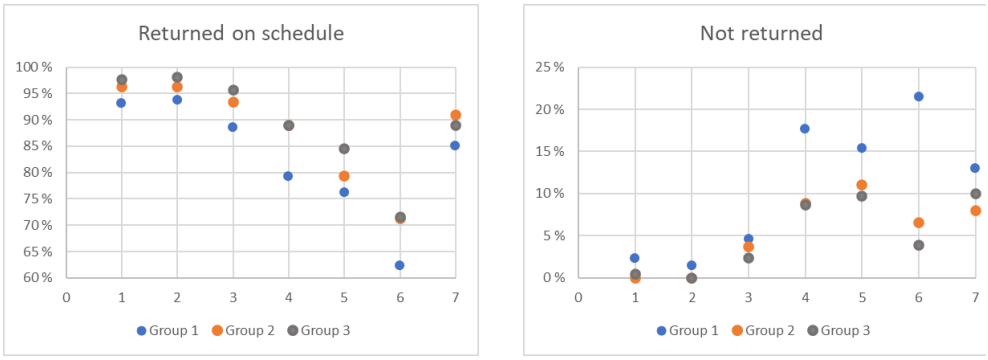

Figure 4: Learning tasks returned on schedule (left side) and not returned at all (right side) from all three groups (G1-3)

Pearson Chi-Square -test of independence was performed to examine the relation between groups and the timely returns of learning tasks. Statistically significant differences were found between the groups in returning learning tasks on schedule. Significant differences ($p < .05$) relating first four tasks were found when comparing control group G1 with test group G3 (see Table 2). However, the statistical differences were not found systematic relating all learning tasks between test group G1 and the control groups (G2, G3, G2&G3). Significant differences relating first four tasks were found when comparing control group G1 with test group G3.

Statistical differences between groups were not found in any later tasks during the course (tasks 5 and 6), but significant differences were found between control groups and test group G3 in the first 4 tasks. Differences in the first 4 tasks were largest and most systematic between G1 and G3.

Table 2 Groups comparisons of timely returns (Pearson Chi-Square –test)

Learning Task	G1 (N=130) and G2&3 (N=343)			G1 (N=130) and G2 (N=207)			G1 (N=130)and G3 (N=207)		
	Pearson Chi-Square	*df*	*p*	*Pearson Chi-Square*	*df*	*p*	*Pearson Chi-Square*	*df*	*p*
Task 1	3.927	1	**.048**	1.405	1	.236	4.075	1	**.044**
Task 2	3.390	1	.066	0.878	1	.349	4.144	1	**.042**
Task 3	5.748	1	**.017**	1.961	1	.161	6.242	1	**.012**
Task 4	7.468	1	**.006**	4.742	1	**.029**	5.895	1	**.015**
Task 5	2.449	1	.118	0.409	1	.523	3.696	1	.055
Task 6	3.661	1	.056	2.440	1	.118	3.097	1	.078

Examining students' **study progress according to overall return activity** (RAV) showed statistically significant difference between the groups. Differences between groups were analysed by using Mann-Whitney and the test was used to assess whether the distribution of mean ranks is statistically significant.

A Mann-Whitney test indicated that the RAV1 was greater for test group G2 than for control group G1 (U=7475.5, p = .034). Statistically even more significant difference was found between test group G1 and control group G3 (U=11355.0, p = .013). However, the statistically significant difference was not found between test groups G2 and G3 (U=13871.0, p = .895). In examining RAV2, results showed a further increase in significances of statistical differences (see Table 3).

Table 1 Group differences in study progress (RAV) by Mann-Whitney –test

Students' study progress	RAV1							RAV 2 (varible less 12)					
	G	*N*	Mean Rank	*Mdn (iqr)*	*U*	*Z*	*p*	*N*	Mean Rank	*Mdn (iqr)*	*U*	*Z*	*p*
(G1) Control group *compared to* (G2) Visualization of progerss (LA)	G1	128	122.90	12.0 (2)	7475.5	-2.119	**.034**	59	48.53	10.2 (2)	1093.0	-2.406	**.016**
	G2	135	140.63	12.0 (1)				50	62.64	10.2 (2)			
(G1) Control group *compared to* (G3) Visualization of progerss (LA) and automated feedback (LA)	G1	128	153.21	12.0 (2)	11355.0	-2.484	**.013**	59	56.97	10.2 (2)	1591.5	-2.984	**.003**
	G3	207	177.14	12.0 (1)				76	76.56	10.2 (2)			
(G2) Visualization of progerss (LA) *compared to* (G3) Visualization of progerss and automated feedback (LA)	G2	135	170.75	12.0 (1)	13871.0	- .132	.895	50	62.37	10.2 (2)	1843.5	- .294	.769
	G3	207	171.99	12.0 (1)				76	64.24	10.2 (2)			

Thirdly the **student satisfaction**, i.e., willingness to promote the course was explored according to NPS. Implementation 2018 included no LA. The NPS value was significantly increased compared with the scores from the earlier 2018 course implementation (See Fig. 5). However, when the 2018 group and control groups Autumn 2020 G1-3 were examined according to the NPS categorization (Detractors, Passives and Promoter), 77% of students were in the category of 6 or lower, in 2020, 55% students scored the course 6 or less.

Comparing the distributions in 2018 to Autumn 2020, there were almost twice as many students classified as passives (scored 7-8) in Autumn 2020, and more than 2 times classified as promoters (scored 9-10). It was also detected that the share of passive students in Autumn 2020-G1 had almost doubled but the share of Promoters had remained the same in relation to Spring 2018. It was also observed that the students' satisfaction in the control group by NPS is lower than in the test groups. It is also noted that the NPS is at its highest in Autumn 2020-G2 (see Fig. 5).

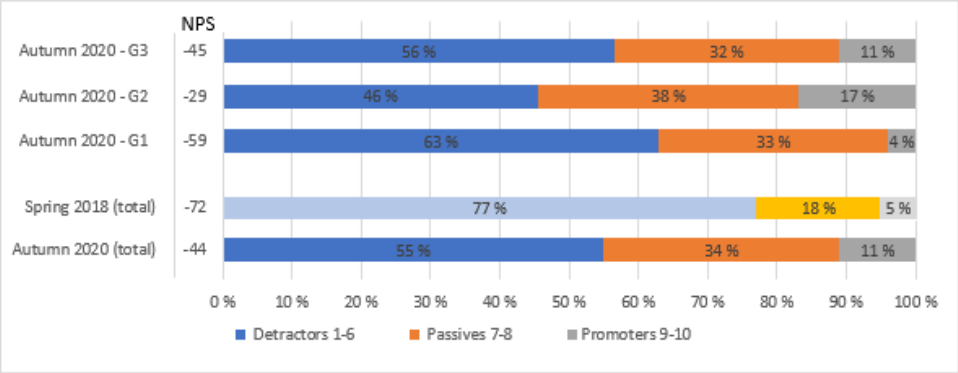

Figure 5: Satisfaction by after the learning design process (Autumn 2020) and before (Spring 2018)

DISCUSSION AND CONCLUSIONS

This study focused on UAS students' study progress in a Moodle environment. Varying LA-based support was applied for enhancing self-directed learning, i.e., returning their learning tasks. Student satisfaction, willingness to promote the course was explored using NPS. The main research questions focused on i) whether applying learning analytics (LA) has an effect on supporting students' study progress, and ii) whether it has an effect of student satisfaction.

First the statistical examination of timely returns of the learning tasks was explored. Task return would appear to vary rather expectedly depending on whether students had access to LA or not. Return activity was lowest in the control group G1 (without LA) and highest in the test group G3 (with visualization of progress and automated feedback). The percentages for each task timely returns were higher in both test groups G3 and G2 compared to control group G1. Statistical comparison showed some differences between the groups and tasks (see Table 1), but the differences were not systematic (see course structure Fig. 1).

When observing the study progress within test group G1 ask 6, more than 20% of the students had missed the return (see Fig 4). The task was a part of a summary, and might easily be overlooked. The students in both control groups G2 and G3 (with LA) had significantly higher rates of return in task 6, thus in this case LA could have had a guiding effect on students' study progress, meaning that non-completed task would be easier to notice. In higher education, there has recently been growing interest to explore how LA could be used to support student engagement and providing actionable feedback for students, which is also an emerging focus in research (Silvola et al., 2021, Lim et al., 2021), and the present results indicate that even simple/easily applied LA can have a positive effect on task returns and possibly

even on increased self-direction. This type of student-centred utilization of LA is a step towards MyData, data available and usable for students, e.g., for self-direction and competence development and reflection.

There was also a somewhat decreasing trend seen in the return rates of first six tasks, within study Phase 1, and the most declining trend was observed in the control group G1. A noticeable change in this trend was discovered in task 7 which was in study Phase 3. This might originate from the structure of the course. Between independent learning Phases (1 & 3) Phase 2 exposes students to teacher-guided and peer interventions. One might also speculate on the influence of the teacher and peers on students SDL, thus reducing the impact of LA. Therefore, the need for LA-based learning support in online environments could be even more important when students study independently. Aldowah et. al. (2019) point out that the lack of interaction among students, and between students and teacher has been associated with MOOC learners' dropout behavior, indicating that social interaction is one of the elements influencing student dropout rates, in addition to other factors such as course design and feedback.

Examining students' study progress according to RAV showed statistically significant difference between control group G1 and both test groups G2 and G3 (Table 3). When excluding students who had returned all their learning tasks on schedule, the significance between both test groups and control group even increased. This could indicate that those students experiencing difficulties with returning their learning tasks on schedule might benefit from LA-support.

These results are very preliminary but give positive indications of the effect LA has on those students experiencing problems returning tasks on time, and that should be further explored. (see also Durall & Gros, 2014). In future, a validated SDL meter could be used to observe in more detail differences between the students of different return behaviours. Recent studies also indicate improved learning effectiveness experienced by the students while using LA dashboards (see e.g. Wang & Han, 2021) as well as recommendations for systematic research on implementation (Valle et al., 2021). However, to explore students' learning, various complementary methods would be needed, such as qualitative analyses of student reflections, since study process observed through return rates of learning tasks is not an indication of the quality of learning itself.

Furthermore, **NPS score changes** between the 2018 implementations compared to 2020 might indicate that applying LA and re-designing the course accordingly could have a positive effect on students' satisfaction. Our research design does not support direct causal conclusions due to several influencing factors, but it would be beneficial in future research to consider the effects of both course re-design and LA as elements for improving student satisfaction and quality of online courses (see also Heilala et al., 2020). A broader feedback survey for the students could be used as

complementing element. In addition, the role of teacher effect on study satisfaction should be examined in more detail.

Practice Based Conclusions

The applied elements of LA seem to support students returning their learning tasks. Suitable plugin elements which are part of the Moodle should be easily deployed in UAS courses. These preliminary study results indicate that they might have positive effects on supporting self-directed learning by having a guiding effect especially when studying takes place independently.

It should be noted that the use of LA in online courses requires pedagogical course re-design in order for LA support to be enabled accordingly. It would be a great success for UAS if part of online students' needs for guidance were handled by LA-based support enabling students self-directed learning with the knowledge they gained from their own data (MyData).

Students should also participate actively in the process of designing online learning, by providing feedback from the courses. NPS is an easily implemented tool for teachers to collect course feedback, but it should be used with caution, since it is not suitable for measuring quality. It is however a valid indicator for pedagogical development on whether it is progressing in the right direction.

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CHANGES BROUGHT ABOUT FOR JAPANESE JUNIOR HIGH SCHOOL STUDENTS BY SCHOOL CLOSURES DUE TO INFECTIOUS DISEASES (COVID-19)

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ABSTRACT

The Government of Japan implemented a three-month school closure during the initial stage of the COVID-19 pandemic (March-May 2020). Because the Government measures imposed few behavioral restrictions on adults, the school closure might not have prevented viral transmission but brought considerable domestic loneliness to children. This study focused on 205 junior high school students (13.23 ± 0.84 years, female 97; all enrolled in the same school = homogeneous conditions) and investigated the effects on activities of daily living and mental states (activities of daily living, feelings/moods, and anxiety) under such unprecedented circumstances. The results indicated students' sleep time became longer during school closure ($F_{(1,204)} = 50.68$, $p < .001$). The results also showed changes in activities of daily living, feelings/moods, and anxiety ($\chi^2_{(1)} = 76.00$-80.00, $p < .01$), and the relationship between them ($r_s = .22$-42, $p < .01$). The analysis of the survey sub-items also showed the relationships as follows: Delayed wake-up time - Frequent naps - Loss of motivation; Delayed bedtime - Frequent use of games/smartphones - Loss of motivation ($r_s = .27$-33, $p < .01$). Contrary to the expected long break benefits, the school closures caused disturbance of routine and mental stagnation. This study provides useful suggestions for more desirable educational policies and interventions to address unprecedented situations such as pandemics.

INTRODUCTION

Sudden school closure in Japan

Since the onset of COVID-19, many schools have experienced closures worldwide. In Japan, if partial closures are factored in, the average duration of closures represents 34 weeks or nearly a full academic year. Also, in Japan, the Government issued a state of emergency in several areas in March 2021 to prevent novel coronavirus infections. The Government took steps to completely close all schools for three months, from March 2 to June 1 in 2020. It made students stay home for three months. It was officially announced on the previous day before it began. It meant that school teachers practically had no time to prepare for the school closure.

Loose infection control for adults

The extraordinary measures did not impose legal restrictions on adults and allowed them to travel abroad and return until April, leaving viral transmission in the home quite possible. Therefore, the effect of infection prevention due to the school closure was limited (Viner et al., 2020), while students' isolation at home without guidance became a concern. Under such a situation, it was necessary, especially for teachers, to grasp students' behavioral and mental changes. Long breaks are generally beneficial to students' health as they relieve the mental burden of school activities and allow students free time management (e.g., ACHA, 2016). However, the school closure may have undermined social needs through lack of activities and isolation from classmates. Therefore, it was essential to empirically evaluate the impact on the students' living activities and mental changes under homogeneous conditions of the same area, time, and social circumstance.

How did the sudden school closures affect students' life and health?

The key question of this study was, "How did the sudden school closures affect students' life, behavior, and mental health?" As noted above, breaks are generally considered beneficial to students' health because they relieve the mental burden of school activities and allows a certain degree of autonomy in time management. Probably, for most students, a long school break should be one of the most enjoyable events. However, the school closure in Japan was so peculiar that it was more likely to have been detrimental than beneficial to the students.

School closure too early, border measures too late

To answer the key question, we need to first explain the characteristics of Japan's infection control measures (Table 1). Before the Government announced the school closure on February 27, the total number of domestic infection cases was only 192. One reason for the early school closures might have been the quarantine trouble of the cruise ship, Diamond Princess. It had stayed at a Japanese harbor for a few weeks without disembarking passengers. The Government's response was so slow that it had been criticized, and the press broadcasted the news worldwide.

Then, the school closures began on March 2. The Government prohibited foreigners from entering Japan three weeks later and Japanese citizens and residents from returning to Japan five weeks later. One and a half months after school closure, the Government started to expand the state of emergency nationwide. However, the measure was very loose, and the lifestyle of adults was almost the same as before.

Table 1

Time series of infection prevention measures in Japan in 2020.

Month	Day	Measure
January	23	Lockdown for the first time in Wuhan, China
February	19	Passengers of cruise ship (Diamond Princess) disembarked
	27	The total infected cases reached 192 in Japan
	28	Government announced school closure
March	2	School closure started (all schools)
	22	Foreigners were prohibited from entering Japan
April	3	Refusal of Japanese re-entry
	7	1st state of emergency (some metropolitan areas)
	16	2nd state of emergency (expanded nationwide)
June	1	School closure ended (all schools)

Requested adults to refrain from going out, but not legally enforceable

What did different infection control measures for adults and children cause?

The first characteristic of Japan's infection control was that "only students" had to stay home. The Government requested students to refrain from going out, so they needed to suspend most activities outside. On the other hand, adults had no restrictions on going out. In other words, the loss of school activity and communication opportunities simultaneously happened to students.

The second characteristic was that most students were trapped in their homes alone. It must have been quite different from the usually exciting long breaks. In Japan, the birth rate has been very low. Most households comprise the nuclear family. In over 60% of families, parents are not at home because of work. In addition, about 10% of students are in single-parent homes, with just either the mother or the father. Therefore, it was estimated that about 75% of students might have spent a lot of time at home alone.

How did students' life activities, feelings, and anxieties change?

This study aimed at clarifying the effects and factors on students' lives and mental states due to school closures. The research sub-questions were:

1. How did students' life activities change during the school closure?
2. How did their feelings change at that time?
3. What kinds of anxiety did events that students faced after school reopening cause?

More specifically, we investigated the following outbreaks and clarified their relationship:

1. Decrease of communication opportunities and alternative behaviors as a consequence of restrictions,
2. Loneliness, stress due to family relationships, loss of motivation, frustration, and depression,
3. Anxiety about delayed schoolwork, decreased physical fitness, interruption of club activities, routine changes, and building/keeping friendships with classmates.

Before conducting the survey, we needed to consider that the impact varied depending on the school. So, it was essential to assess the impact under homogeneous conditions. Therefore, we investigated all students enrolled in the same junior high school.

METHOD

On June 1, 2020 (immediately after the school reopened), the teachers conducted a questionnaire survey in one junior high school in a small city in Japan. Participants were 205 junior high school students (13.23 ± 0.84 years, female = 97). The main questionnaire items were: whether life activity changed (A, Y/N), whether feelings/moods changed (B, Y/N), and whether anxiety due to the school closure arose (C, Y/N), compared to the standard period before the school closure.

We also used 6 to 8 sub-question items for each of the main question items: life activities such as decreases in outing opportunities (A1), increase in games/smartphones use (A2); change of feelings/moods such as loss of motivation (B1), stress in family relationships (B2), depression (B3); the anxiety such as falling behind school work (C1), lack of exercise (C2), future (entrance/school) test (C3). We also investigated the state of sleep, such as changes in amount of sleep time (S1, S2) and wake-up/bedtime (S3, S4).

Table 2

Main and sub question items.

Questions (compared to before school closure)	
A: Change in life activities	
Main	Did life activities change?
Sub	Decrease in outing opportunities, increase in time for games/smartphones, etc.
B: Change of feelings/moods	
Main	Did feelings/moods change?
Sub	Loss of motivation, stress on family relationships, depression, etc.
C: Anxiety	
Main	Did anxiety due to the school closure arise?
Sub	Behind in study, decreased physical strength, entrance exam/test, etc.
S: Sleep time	
	Amount of sleep time (before/during), wake-up/bedtime

For category A to C, students were asked to answer the questions compared to the standard period before the school closure (Yes/No). For category S, they were asked to report amounts and other indicators of their experiences.

RESULTS

How did the students' sleep states change?

The results showed that sleep time during the school closures became longer than before (before = 7.47 ± 1.80 h / during = 8.08 ± 1.59 h; $F_{(1,204)} = 50.68$, $p < .001$). First, we found that the participants in this study were considered standard because their sleep time before was almost the same as the average for junior high school students in Japan (mean = 7.34 h; Benesse Educational Research and Development Institute, 2008). But then, sleep time increased by 0.61 h during the school closure (Figure 1). Therefore, the results indicated that students became healthier during the school closure than before. However, we should note that they delayed their wake-up time and their bedtime by more than one hour. Also, a significant correlation was found between the delayed wake-up time and the delayed bedtime ($r = .75$, $p < .001$). The results indicated that late bedtime and late wake-up time during school closure were closely related. These results also showed that they could take longer sleep times by making the wake-up time delay greater than the bedtime delay.

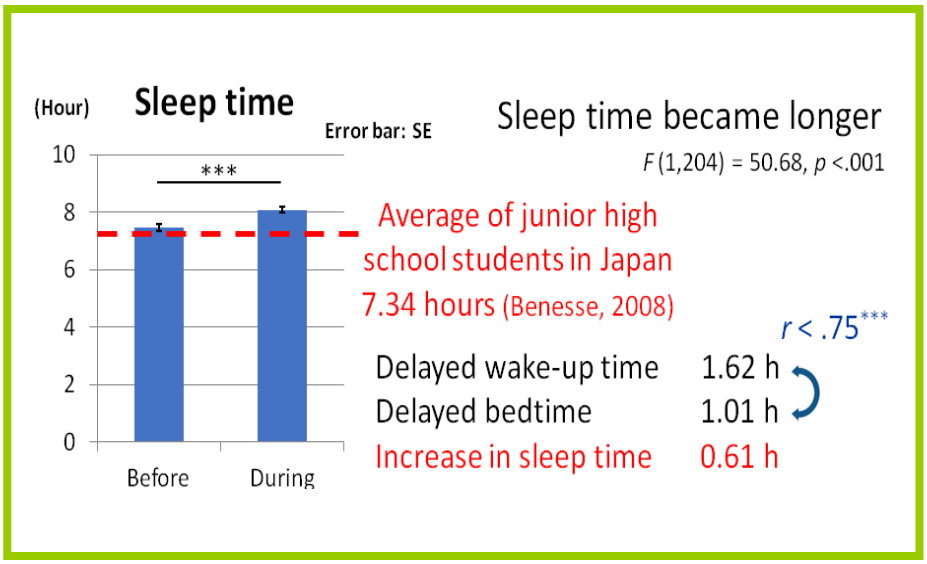

Figure 1. Changes in sleep time before and during school closure.

A: Did students' lives change?

The results showed that life activities changed for 80% of the students ($\chi^2_{(1)} = 80.0$, $p < .01$). The results of sub-items showed that opportunities for going out and communicating decreased and that game/smartphone use and naps increased instead.

- Decrease in outing opportunities (79%)
- Increase in time for games/smartphones (62%)
- Decreased opportunities to talk (44%).
- Frequent naps (27%)
- Irregular eating patterns (16%)

B: Did students' feelings change?

The results showed their feelings/moods changed for 76% of the students ($\chi^2_{(1)} = 76.0$, $p < .01$). The results of sub-items showed that the school closure caused the students to feel unmotivated and restless. On the other hand, about one in four students felt stressed about their relationships with their family members as time spent at home increased.

- Loss of motivation (38%)
- Restlessness due to loss of school activities (28%)
- Stress with family members (26%)
- Depression (19%)
- Loneliness (15%)
- Frustration (15%)

C: Did students feel more anxious?

The results showed that anxieties increased for 76% of the students ($\chi^2_{(1)} = 76.0$, $p < .01$). The results of the sub-items showed that the students were worried about getting left behind in learning at school and in preparing for high school entrance exams. The results also showed that about one in two worried about diminished physical fitness, and one in four worried about changes in friendship.

- Getting left behind in study (58%)
- Decreased physical strength (52%)
- Entrance exams or tests (38%)
- Friendships with classmates (25%)
- Disruption of life rhythm (19%)

Interrelationship of survey items

Correlation analysis was performed to test whether the three main question items mentioned above (i.e., life activity changes, feeling/mood changes, and anxiety) were related. The results showed a significant correlation between those three main items (r_s = .22 - .42, p < .01). Therefore, those factors were shown to be relevant to each other.

We also performed a correlation analysis for sub-items for the three factors and sleep state (delayed wake-up time and delayed bedtime) to investigate those in more detail. From the results, we found significant correlations between delayed wake-up time, frequent naps, and loss of motivation (r_s = .30 - .33, p < .01), and between delayed bedtime, increased time for games/smartphones, and loss of motivation (r_s = .27 - .30, p < .01). These results indicate that changes in bedtime and wake-up time, living activities, and feelings are interrelated. However, no significant correlation was observed for all of the anxiety sub-items.

DISCUSSION

We administered a questionnaire survey to Japanese junior high schools to answer the question, "how did the sudden school closures affect students' life, behavior, and mental health?" The results showed that the school closure caused changes in their life activities, feelings, and anxieties. In addition, we found the relationships between the changes in life activities, feelings, and anxieties.

Students' sleep time turned out to have increased when sleep time during and before school closure was compared. Judging from the results, students seemed to have become healthier than before. However, further analysis found the increase in sleep time was driven by a delay in wake-up time greater than the delay in bedtime. The results from sub-items showed that delayed bedtime was related to an increase in games/smartphones use and loss of motivation, and delayed wake-up time was related to frequent naps and loss of motivation. These results indicate that disturbances in life rhythms cause unwanted behaviors, resulting in loss of motivation.

The reason for unwanted behaviors might be the difficulty of going out and the sudden need to switch to their activities primarily at home. In particular, the relationship between the increase in time for games/smartphones, frequent naps, and loss of motivation can be explained by motivation theory (e.g., Ryan & Deci, 2000). As they were still junior high school students, they would have belonged to the stage in which extrinsic motivation plays an important role. They would have been less motivated to learn because of the loss of the school control and guidance in what to do. So, behaviors triggered by intrinsic motivation which they can carry out on their

own might have increased in frequency (e.g., games/smartphones, naps). The results indicate that schools in Japan play an essential role as pacemakers for a large proportion of students to engage in something they must do and adhere to a regular routine.

Increased sleep time should probably be positive for the students' physical health, but sudden school closures could have had a negative mental impact. The present study's results indicated that the life changes caused by the sudden loss of school activity made the students feel more negative and caused anxieties. According to a Japanese government survey, 90% of junior high schools could not introduce an online system during the school closure period. Fortunately, this junior high school we surveyed successfully introduced an interactive online system for the morning meeting. Still, we found undesirable impacts on the mental health of students there. So, the results demonstrated the significance of the risk from sudden school closures and the need for sufficient time for teachers to prepare.

Why they could not use the online system

Most junior high schools failed to introduce an online system as described before. It was not because Japan's communication infrastructure was not in place but because of internal and external factors. According to some actual junior high school teachers, as an internal factor, most teachers did not have the skills to create online classes or lessons (i.e., they never received training or professional development in such skills). Family members were not familiar with using the online system either. They also pointed out the external factors that schools were not free to conduct online courses. The Boards of Education of local governments emphasized the copyright of teaching materials supposed to be used in the online class, legal issues such as portrait rights of teachers and students, and security issues of internet communication, even in such an emergency. The unstable and unbalanced judgments and actions by various Boards of Education significantly stagnated the actual teachers' addressing online education for each.

Evaluation of infection control of Japan

Figure 2 shows that school closures were implemented earlier than the prohibition of no entry or exit and states of emergency. In contrast, economic promotion measures such as "Go To TRAVEL" and "Go To EAT" were implemented soon after the termination of the state of emergency. The Tokyo Olympic Games were also held in the summer. Thereby the number of infected cases dramatically increased. School closure was issued only once, at the point when the lowest number of infected cases were present. The Government had not implemented a second school closure even when infected cases increased hundreds of times. At the time of writing this report, the number of infected cases per day in Japan exceeded 80,000 due to the Omicron variants. The size is thousands of times larger than when the Government decided to

close all the schools nationwide in 2020. However, only a few schools are closed now. Based on those, we should objectively consider whether the Government's response was correct so as to guide decision making in the future. It is useful to note that the Japanese prime minister has already been replaced twice during this pandemic period.

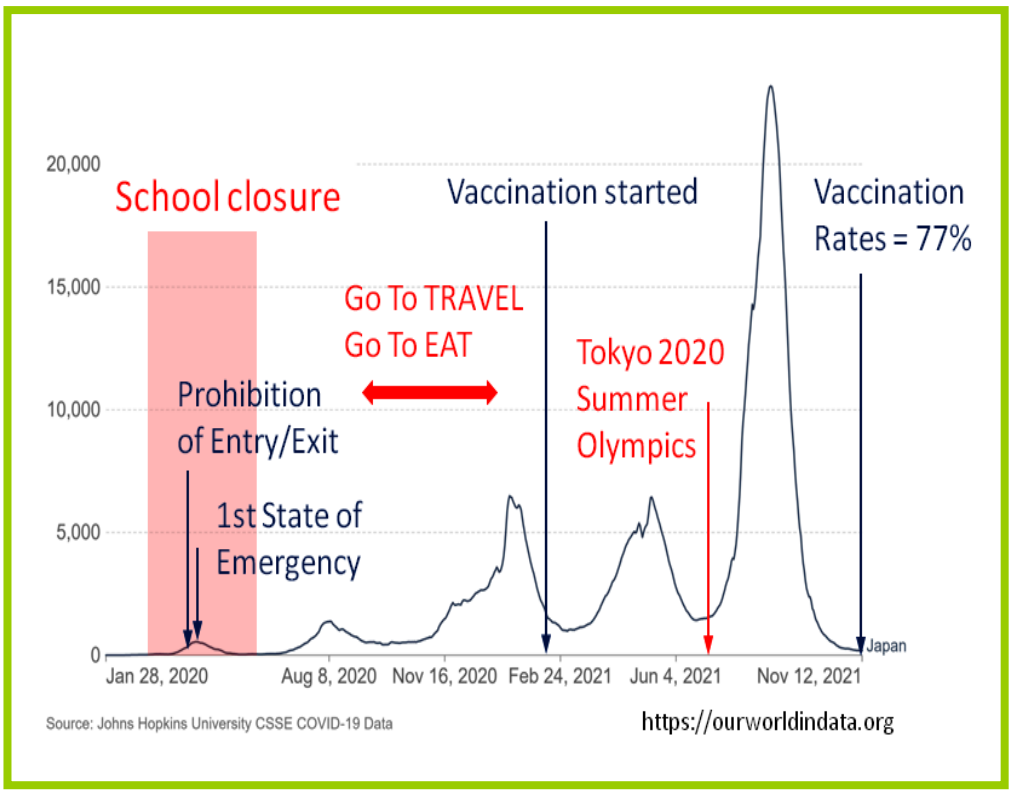

Figure 2. Changes in Number of Infected Cases in Japan.

CONCLUSION

This study provided valuable insight for objectively judging school closure. The measures may have appeared to be physically effective for protecting students from infection, and many governments implemented them. However, we have not evaluated how it affected their daily lives and feelings/moods and the costs incurred by students, families, and the education system.

The study also provided new insights for the Government to objectively judge whether school closures are beneficial. It has been pointed out that the sudden school closures did not follow sufficient epidemiological and psychological evidence. So, this study may contribute to a protocol for school closures in the future. However, it portrayed the impacts of the closures only in one school, so that is one significant limitation.

The conduct of this research was also notable because actual junior high school teachers initiated and rapidly undertook the timely survey in their school by working closely with researchers. It would be a future challenge to build and expand on an investigation network for unprecedented situations such as COVID-19. Such a collaboration could be helpful in managing situations beyond our experiences according to the actual problems in the future. Novel coronavirus (SARS-CoV-2) is still rampant even in the winter of 2022. Therefore, regular collaboration between schools and researchers can be a powerful option for managing and overcoming the challenges that this pendemic continues to present.

Finally, the findings of this research have some important implications for teacher training requirements and the cultivation of student competencies. First, the problem that many teachers in Japan encountered of not possessing the necessary skills to implement online teaching indicates serious deficiencies in the training that is provided by some universities/institutions to teacher trainees: at the very least, they should ensure acceptable levels of computer and IT (information technology) literacy in such trainees. The Ministry of Education also needs to ensure that opportunities are provided for in-service teachers to take professional development courses to improve/update their computer and IT literacy. And schools need to cultivate self-regulated learning skills in students. However, for this to happen, teachers again need to be provided the corresponding knowledge and skills for such cultivation, and some shift in priorities in schools need to be made – away from subject knowledge memorization/retention to the cultivation of competencies that would usefully serve students in their present and future lives (which include the ability to self-regulate learning/study and other activities).

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THE DEVELOPMENT OF INTERACTIVE QUALITY OF ONLINE TEACHING AND LEARNING DURING THE CORONA CRISIS

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ABSTRACT

In March 2020 schools in The Netherlands closed to contain the spread of Covid-19 virus. Shortly after, schools took to online education.
The condensed setting of the Covid-19 situation provided a background to study which learning activities and tools teachers choose in online education and how they use them to promote interaction. Interaction is quintessential to learning but in online education it is not easy to provide room for interaction. Our central research question therefore is how interaction within online education activities change over time.
An online longitudinal survey amongst teachers was conducted. The first four rounds took place in the early stages of the lockdowns and shortly after. In total 179 different secondary school teachers participated of whom 16 responded three rounds or more.
Most teachers use tools in online education that can facilitate more interaction than necessary for the Instructional Design. This means that improving interaction in online education is more a pedagogical challenge than a technical one.
It was also found that teachers who deploy Instructional Designs that require more interaction use more and different tools. However, only few of these tools seem to facilitate the interactive quality the teachers pursued. Over time we saw the interactive quality of Instructional Design and tools converge. We are in awe of the artful way in which some teachers manage to combine the possibilities of different tools to establish high interactive quality in the online learning processes they conduct.

INTRODUCTION

On March 15th, 2020 the decision was taken in The Netherlands to close primary, secondary and vocational schools to limit the spread of Covid-19. Three days earlier, universities and college buildings were closed for students. Immediately schools collectively turned to online education. On March 18th, 2020, 88% of the schools reported to be technically ready to facilitate online education. After the technical possibilities had been put in place for online education, the next challenge was to carry out learning processes online.

In general, interaction is quintessential to learning (Chen et al., 2015; Tanner et al., 2005)), highly valued by students (Baeten et al., 2010; Lear et al., 2010; M. Roblyer & Ekhaml, 2000; Smith et al., 2006) and appears to be a key factor in student success in online classes (Glazier, 2016). We perceive interaction as interpersonal communication (de Koster et al., 2012; Roblyer & Wiencke, 2003; Wagner, 1994) which can involve one or multiple people.

In online classes this interaction takes place by means of technology. The characteristics of the technology determine the way interaction can take place, i.e. one-way, two-way, multiple way and the number of people involved, i.e., interpersonal, intra groups, inter groups. Wagner (1994) summarizes these characteristics as the *interactivity* of the technology.

According to Roblyer and Ekhaml (2000) technologies allow high interactivity when they facilitate interactions in multiple directions within and between groups of people. Technologies with the lowest level of interactivity merely broadcast information which people can receive, but not react upon. In online situations "Technologies that allow high interactivity seem necessary to allow high person-to-person, person-to-group, and person-to-system interaction" (Roblyer & Ekhaml, 2000; Roblyer & Wiencke, 2004). Put in other words, the level of interactivity of technologies limits the interaction possible, but within this level the people involved determine the degree of interaction that actually takes place. The combination of the two determines the overall *Interactive quality*: the degree of interaction that takes place in distance learning courses (Roblyer & Wiencke, 2004)

Making use of the interactivity of technology to establish interaction is easier said than done. In regular face to face education, teachers make more use of digital tools for sharing information than using them to establish communication (Heitink et al., 2016). Research by Almås and Krumsvik (2008) and by Pareja Roblin, Tondeur, Voogt, Bruggeman, Mathieu, and van Braak (2018) shows that teachers havetrouble in matching available digital tools with the learning activities that constitute a learning process as intended.

During the Covid-19 pandemic the only way to interact with students was through technology. This was to be done by teachers more familiar with the use of technology to share information (Heitink, Voogt, Verplanken, Van Braak & Fisser, 2016) than familiar with the possibilities of available tools to facilitate the desired interaction to establish sound learning processes.

During online education teachers need to combine both their pedagogical knowledge about the importance of interaction in learning processes as well as their technological knowledge about the interactivity the tools used can facilitate (Mishra & Koehler, 2006) in their Instructional Design (Dalziel, 2013). Within their instructional design teacher create, share and implement sequences of teaching and learning activities that include both content and collaboration (Dalziel, 2013). These learning activities consist of verbs that describe what students do to progress from the intended learning outcomes towards assessment (Laurillard, 2012 (pp 70).
A teacher well capable of conducting learning activities within an instructional design with high levels of interaction in a physical classroom, might not be able to do so online through lack of technological knowledge. Vice versa might also be possible, that teachers fail to exploit the interactivity of the technologies they deploy because of a limited pedagogical repertoire of learning activities that promote interaction.
Learning how to combine this knowledge and select and use tools that can facilitate or even promote interaction during online learning processes might be an important factor in student success during periods of lockdown. However, little knowledge is available on how to do so.
The purpose of this study therefore is to gain more insight in how teachers match tools and learning activities and which combinations of tools might, contribute to student success in online classes. This knowledge can be valuable for both apprentice and in-service teachers when designing technology enhanced learning processes in both distance and face to face settings

In this study we therefore focus on the matches teachers report between their instructional design and the tools they deployed. Following Roblyer and Ekhaml's line of thought, best matches between instructional design and tools are those that facilitate the way interactions take place between the number of people involved.
In order to identify matches we compare the interactions intended within the instructional design with the interactivity of the tools. Although Roblyer & Ekhaml's (2000) Rubric for Assessing the Interactive Quality of Distance Courses (RAIQ) still stands today, the tools mentioned are quite outdated. We slightly adapted the rubric and included pictograms to help understand the differences between their levels of interactive quality, see table 1.

Table 1
Interactive Quality of learning activities within Instructional Design and technologies

level	Interactive Quality	Ways of interaction	Example learning activity within Instructional Design	Example technology
1, very low	Broadcasting		Students gain information from a presentation	information on a website
2, low	Individual communication between two people or one person and a technology		Students respond to questions on a test or quiz	quiz software
3, intermediate	In addition to individual communication, small group work takes place with just the group members involved in the interaction		Students engage in dialogue with one or more peers synchronous/asynchronous	Chat
4, high	In addition to communication within small groups, the groups share their outcomes with the other groups and reflect and comment on each other's work		Students participate in or develop graphic organizers, semantic maps, etc.	Collective boards (padlet)
5, very high	In addition to small groups sharing their outcomes, outside experts are involved, harvesting information within and outside class and instant sharing of outcomes with all participants		Students discuss a concept or process with an external expert	Videoconferencing

This rubric portrays five different descriptions of instructional design with increasing interactions amongst students and gives examples of different technologies that can facilitate the interactions needed for the instructional design.

When instructional design and technologies match we can plot them in a graph, figure 1. On the x-axis the interactive quality of the instructional design is plotted which corresponds with the descriptions of Interactive Quality with the same name in table 1. On the y-axis technologies are plotted with the interactivity to facilitate the interactions needed for the level of interactive quality ascribed. At first glance this might seem obvious. However, if this were so in teaching practice there would be no reports on mismatches like those of Almås and Krumsvik (2008) and Pareja Roblin et al. (2018). Plotting the interactive qualities of the instructional design that teachers establish against the interactivity the technologies they use facilitate, can contribute to a deeper insight on how teachers match the two.

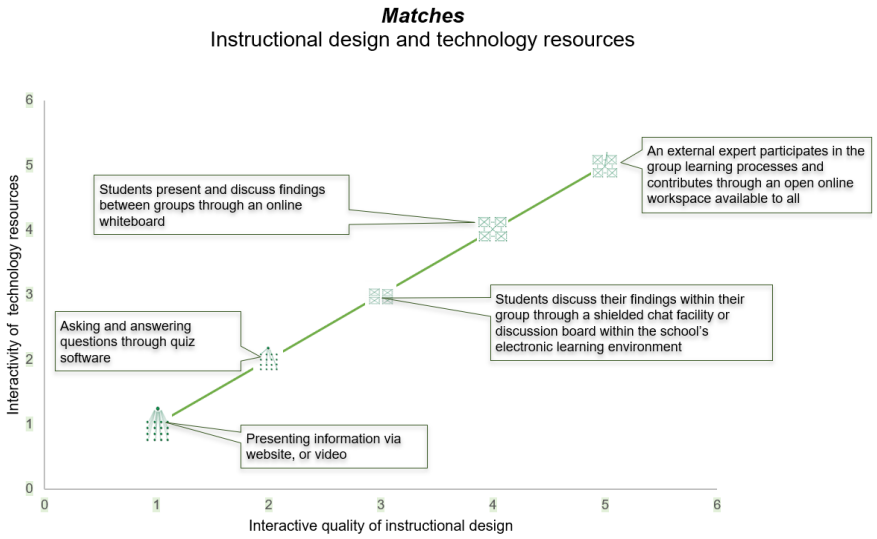

Figure 1. *Matches of instructional design and technology resources*

We presuppose mismatches to be deviations from the slanted line drawn in the graph. The distance from the line is an indication of the extent of the mismatch. The larger the deviation, the larger the mismatch.
Online education forces teachers to make use of tools to conduct the learning activities within the Instructional Design chosen. In physical settings teachers might be able to steer students to do whatever is intended, even when a tool might not support so. Online, this possibility is cut off and it follows that the interactivity of the tools chosen determine the highest level of interactive quality that can take place and hence influence the instructional design. In other words, when tools are chosen with an interactivity at level 2, the interactions that can take place between the people involved can be at interactive quality level 2 at the highest. When tools facilitate interactivity at level 5, then interactions between people can take place at interactive quality level 1, 2, 3, 4 and 5. When a higher level of interaction is needed for the instructional design than the tools chosen can facilitate, the learning activities intended for the instructional might be frustrated. Vice versa might be of a lesser problem. A tool then facilitates interaction that remains underused.

Our central research question therefore is

- How does interaction within online education activities change over time?

With the following sub questions

- How does the interactive quality of online education change during the Covid 19 period?
- What combinations of tools do teachers use at the different levels of interactive quality?

METHOD

To monitor a possible shift in interactive quality during the transition to online learning we used a longitudinal survey (Baarda, Bakker, Hulst, Julsing, Fisher, Vianen & & Goede, 2012) and analysed the responses of teachers that participated multiple rounds. For the survey we used a questionnaire based on the Rubric for Assessing Interactive Qualities in Distance Learning Courses (RAIQ) (Roblyer & Ekhaml, 2000). Although technologies have significantly advanced since Roblyer and Ekhaml created the rubric in the year 2000, their levels of interactive quality are still valuable and used regularly (Banna et al., 2015; Bawa, 2016; Martin & Bolliger, 2018). The survey questions focus on two elements of the Rubric, namely
1. instructional designs, i.e. the learning activities
2. technology resources

For each of these elements, five different levels of interactive quality are described. The technology resources were based on the meticulous collection of over a hundred tools by www.Doedactiek.nl. This collection is maintained by teachers with broad practical knowledge of educational tools. Within the collection all tools are meta dated on several taxonomies, one of which is interactive quality. The meta dation of each tool is checked by at least one other teacher. Because the meta dation is very much at the heart of the work of Doedactiek, regular collective sessions are conducted to insure different tools are meta dated in the same way. To make the questionnaire manageable for the respondents, the tools in the questionnaire were grouped into 42 groups on similar functionality and equal interactive quality based on the meta data of Doedactiek. In the questionnaire respondents could tick the groups of tools used in the past two weeks.
Because we expected many changes to take place in the early stages of the transition to online education, the questionnaire was set out three times during the initial period of closure of schools. The questionnaire was set out another three times afterwards.
The questionnaire was conducted anonymously. Participants were invited to respond through the personal social media networks of teachers involved with Doedactiek and through the networks of the teacher training institutes of NHLStenden and Windesheim in The Netherlands. Participating teachers who wished to respond in subsequent rounds could leave their e-mail address. In total 179 secondary school teachers responded at least once. A group of 16 loyal teachers responded at least 3

rounds. This made it possible to follow changes they made in their instructional design and the tools they chose over time.
First we analysed the changes in matches in time of the responses on instructional design and technology resources. We plotted the highest interactive quality of the instructional design given and the highest interactivity the tools ticked could facilitate per teacher per round for all teachers.
We then calculated the average deviation from the line with matches as shown in figure 1. We calculated the difference between the highest interactive quality of the Instructional Design and the highest interactivity of the tool used and squared the result to eliminate positive and negative differences. We then determined the average chi square per round and plotted the changes in chi square over time.
Thirdly we portrayed the changes in interactive quality of instructional design and tools over time for the 16 teachers who responded three rounds or more and grouped them around patterns of changes that emerged.
With a different analysis of the same data, we grouped all respondents according to the highest level of interactive quality reported in the questionnaire. We then listed the tools they used and calculated the average number of tools per teachers per level of interactive quality.

FINDINGS

Changes in interactive quality of online lessons over time

In figure 2 we see the highest interactive quality of the instructional designs given and the highest interactive quality of the tools ticked per teacher per round. During the first analysis it stood out that during the months of full lockdown, April and May 2020, all the plots were above or on the slant line. During the other months small numbers of students were allowed to attend school. In these months we see plots both above and under the slanted line. When plots are above the slanted line it means that the interactivity of the tool facilitates more interaction than is needed for the Instructional Design chosen. When plots are underneath the slanted line, the tools cannot facilitate the interaction needed for the learning activities within the Instructional Design. In regular face-to-face education the latter is not problematic because the interaction needed for the Instructional Design can be conducted with face to face techniques. During online education however, the latter becomes impossible because all interaction is facilitated by the technology.
What shows up is that over time less dots appear at the lower levels of interactive quality of both instructional design and tools. This indicates that respondents made adaptations to their teaching during the Covid-19 period. In November 2020 we see more teachers deploying group work at interactive quality level 3, 4 and 5 during their online education than in the first three months of the first lockdown in March, April and May. The steady trend we see until November 2020 is not continued. In

February 2021 we see a slight relapse. At that time both teachers and students dearly yearned to come back to school physically. At this time concerns on the emotional and social wellbeing of students were being reported and political pressure increased to ease the measures in favour of children and students. The relapse we see might reflect the yearning.

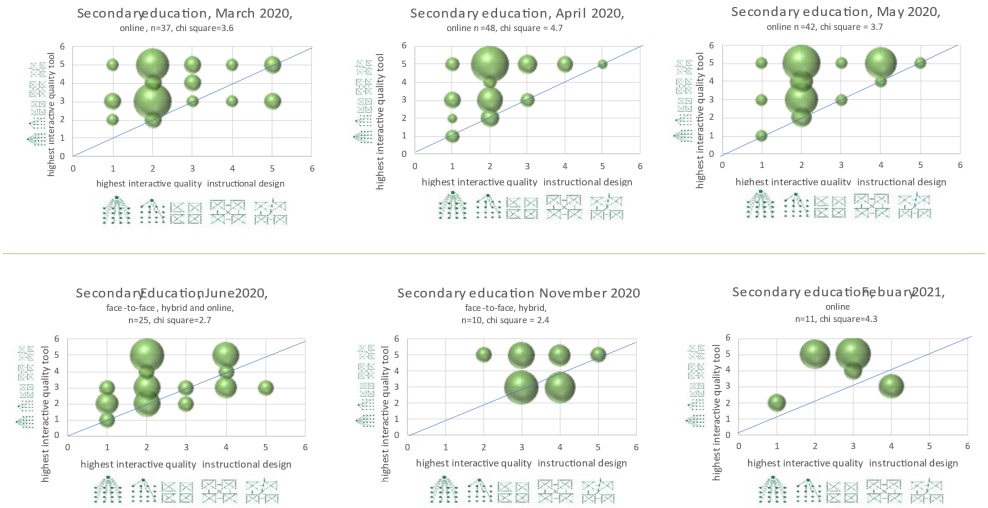

Figure 2. ***Highest interactive quality of instructional design plotted against highest interactive quality of tools***

The relapse shows up even more clearly figure 3. In the first weeks of the first lockdown between March 2020 and April 2020 we initially see larger differences in interactive qualities of the instuctional design and the tools. It is a time when many teachers get acquainted with the communicative possibilities of technology. Between April and November 2020 an increasing percentage of the respondents better matched the interactive quality of their instructional design and tools. In Febuary 2021 however we saw a strong relapse back to a level close to that a year earlier.

During the second lockdown from november 2020 till Febuary 2021 many schools had adapted their timetables, making it possible for small numbers of students to physically attend school. Unintentionally this made online teaching even harder. Teachers needed to pay attention to both physically present students and their online peers as well. At many schools the duration of lessons was halved. Many teachers reported the only thing they managed to do in these 25 to 30 minute lessons was to cover the content and do homework. Frustration is apparent in some of the open answers the respondents gave:

'How else can I do this?'

After a year of uncertainty and frequent changes, the many challenges teachers faced were starting to pay their toll, frustrating the learning processes of the teachers .

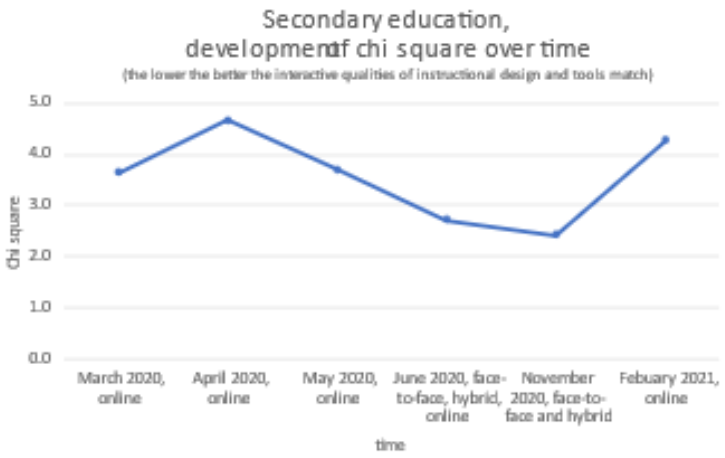

Figure 3. Changes in the average difference between the interactive quality of the instructional design and the tools over time

To date we have analysed emerging patterns of change through six rounds of the questionnaire. Sixteen secondary school teachers participated three rounds or more. We portrayed the changes in interactive quality of their instructional design and interactivity of the tools they deployed over time per teacher. We then compared the patterns and plotted them in figure 4 according the direction of the changes in interactive quality for both Instructional Design and tools used. We found respondents in all but two combinations.

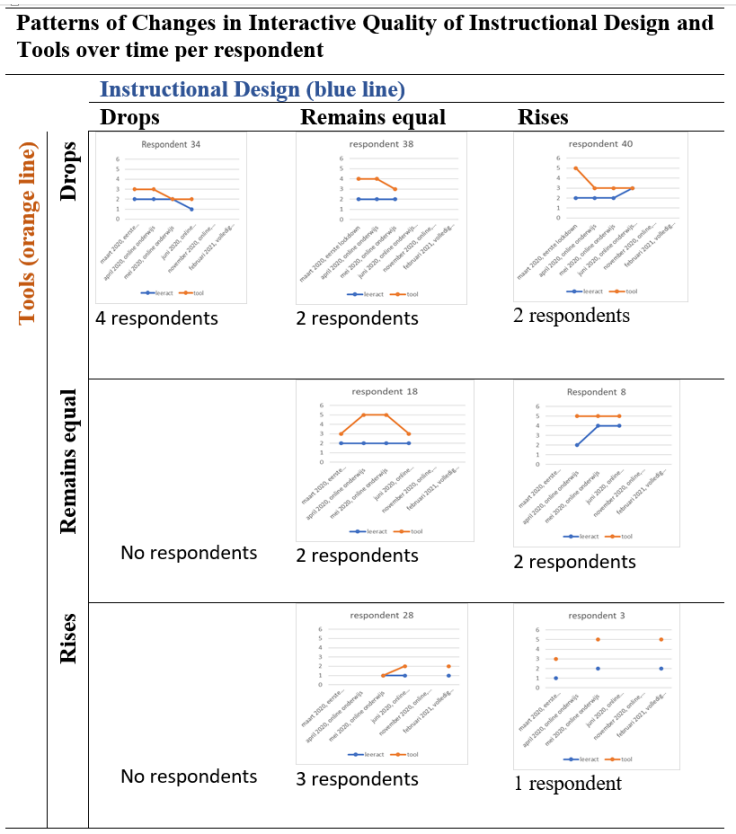

Figure 4. Patterns of changes in interactive quality per respondent over time

In all plots the interactive quality of the Instructional Design is lower than the interactive quality of the tools used. The other way round was not found in our data. Based on this analysis the impression arises that the potential of tools to facilitate interaction for learning processes remained under used. However, we do see slightly more respondents with convergence than divergence over time. This indicates that, although the interactive potential of tools remains underused, the differences between the two become smaller and match better.

In figure 4 we can see that two respondents converge by deploying tools with lower interactivity over time (interactive quality of instructional design remains equal and of tools drop). Two other respondents converge by raising the interactive quality of their Instructional Design (Interactive quality of Instructional Design rises but tools remain equal). Another two respondents converge by adapting both their Instructional Design and their tools (both interactive quality of Instructional Design and tools rise). Six respondents show no net changes over time, though they do make changes along the way (Interactive quality of both Instructional Design and tools drop; interactive quality of both Instructional Design and tools remain equal). Four respondents diverge either because the interactivity of the tools deployed rises or

because the interactive quality of both Instructional Design and tools rise, but to different extent.
All respondents tried to make sense of the situation they were in each with their own strategy. The diversity in the patterns found reveal the struggle the respondents went through whilst establishing online learning processes.
No clear or better strategy in terms of establishing interaction in online learning processes emerged from the patterns of the respondents above.
We therefor returned to the overall data to identify any differences in the combinations of tools that the respondents deployed at the different levels of interactive quality of the Instructional Design.

Tools used per interactive quality level of Instructional Design

In the last row in Table 2 we can see that teachers whose online instructional design consists merely of presenting information, interactive quality level 1, on average use four different tools to do so. The most used tools are for text, image and sound viewing, chat, recording and tools for students to hand in work. Teachers whose highest level of interactivity consists of question and answer systems on average use eight different tools. These teachers use the same tools as the teachers at level 1, but also include document sharing, image and sound editing, videoconferencing and various tools for both formative and summative testing. The largest difference with teachers with an Instructional Design at level 3 is that teachers at level 3 make less use of summative testing tools and more use of specialised tools like online picture stories, online labs and online museum visits. At level 4 of interactive quality of the instructional design, we see teachers use an average of ten different groups of tools from the list provided. The teachers make use of the same tools their colleagues at level 1, 2 and 3 use, but a higher percentage of teachers has marked the use of these tools. Tools for co-editing work is noteworthy and the use of mindmap tools seems more popular than at the other levels. At level 5 we see a slightly lower average of tool use per person, but we see an even higher percentage of teachers making use of the different tools than the teachers of level 4. A higher percentage of teachers in this group uses online search engines and simulations.
The general impression from this table is that teachers who conduct group work in their online classes at interactive quality levels 3, 4 and 5 use more different tools and use them more intensively than teachers at interactive quality levels 1 and 2.
A rather puzzling result is the interactive quality of the tools used by teachers with an interactive quality 4 or 5 of the instructional design. Amongst the ten most frequently used tools, only videoconferencing can facilitate the interactive quality for that instructional design. Only half of the respondents indicates the use of this tool. It is an intriguing finding that not all teachers use tools that facilitate the interactions needed for their instructional design.

Table 2

Percentage of respondents that use tools per interactive quality of the instructional design

Percentage of respondents using tools per interactive quality of their instructional design

Tool	interactive quality tool	Interactive quality of instructional design				
						
		1	2	3	4	5
Text, image and sound viewing	1	0.9	0.9	0.8	0.9	0.9
Chat (synchronous)	3	0.5	0.8	0.7	0.8	0.8
Recording	1	0.6	0.6	0.6	0.8	0.6
Hand in	2	0.4	0.8	0.5	0.7	0.8
Share documents	2	0.4	0.6	0.6	0.6	0.8
Text image and sound editing	2	0.3	0.4	0.4	0.6	0.5
Answering questions	2	0.2	0.5	0.5	0.3	0.8
Videoconferencing	5	0.2	0.4	0.4	0.5	0.5
Formative testing	3	0.2	0.4	0.4	0.5	0.4
Summative testing	2	0.2	0.3	0.2	0.3	0.5
survey	2	0.1	0.3	0.2	0.4	0.3
co-editing	3	0.0	0.1	0.2	0.6	0.1
lessonup/nearpod/learnbeat	2	0.1	0.3	0.2	0.4	0.0
interactive whiteboard	1	0.2	0.2	0.2	0.2	0.1
search engines	2	0.1	0.1	0.1	0.2	0.3
Whats app (a-synchronous)	4	0.1	0.2	0.1	0.2	0.0
Poll	2	0.1	0.1	0.1	0.2	0.1
data collecting (science)	2	0.1	0.1	0.1	0.2	0.1
reacting to answers	3	0.0	0.1	0.1	0.2	0.1
games (individual)	2	0.0	0.1	0.1	0.2	0.1
mindmap	2	0.1	0.1	0.1	0.2	0.0
simulation	2	0.1	0.0	0.1	0.0	0.3
interactive book	2	0.1	0.1	0.0	0.1	0.0
picture stories	2	0.0	0.0	0.2	0.0	0.1
digital method	2	0.0	0.0	0.2	0.1	0.0
portfolio	2	0.0	0.1	0.0	0.1	0.0
social media	4	0.0	0.1	0.0	0.1	0.0
museum	2	0.0	0.0	0.1	0.1	0.0
games (group)	5	0.0	0.0	0.0	0.1	0.0
instant aswers (like answer gar	3	0.0	0.0	0.0	0.0	0.0
online lab	2	0.0	0.0	0.1	0.0	0.0
feedback	4	0.0	0.0	0.1	0.0	0.0
conceptmap	3	0.0	0.0	0.0	0.0	0.0
storyboard	2	0.0	0.0	0.0	0.0	0.0
projectmanagement	3	0.0	0.0	0.0	0.0	0.0
podcast	1	0.0	0.0	0.0	0.0	0.0
timeline	2	0.0	0.0	0.0	0.0	0.0
virtual reality	2	0.0	0.0	0.0	0.0	0.0
Slido	3	0.0	0.0	0.0	0.0	0.0
wordcloud	3	0.0	0.0	0.0	0.0	0.0
meeting	4	0.0	0.0	0.0	0.0	0.0
other		0.0	0.0	0.0	0.1	0.0
Average number of tools used per person		4.0	8.0	8.0	10.0	8.0

average percentage of responents using these tools 0,1 t
average percentage of responents using these tools 0,3 t
average percentage of responents using these tools 0,5 t
average percentage of responents using these tools 0,7 t
average percentage of responents using these tools 0,9 t

DISCUSSION AND CONCLUSION

Though all teachers could participate in this study, the focus was on secondary school teachers in the north of the Netherlands. The study took place under very unpredictable circumstances. Covid measures changed frequently over time with an overload of challenges. Besides having to work online, teachers were also confronted with hybrid situations, changing schedules and changes in duration of lessons, facemasks, self-tests and last but not least the constant fear of contamination in poorly ventilated classrooms with near to no protection.

Despite the circumstances the interactive quality of online education has slightly increased over time. Several respondents managed to better match the interactive qualities of their Instructional Design and the interactivity of the tools. Some respondents did so by adapting their Instructional Design towards the interactive possibilities the tools provided. Others changed the tools they used. On average, respondents who report higher levels of interactive quality for their Instructional Design also report the use of both more and different groups of tools than respondents who reported lower levels of interactive quality in their Instructional Design.

During the first nine months of the pandemic we saw a steady decrease of the difference in interactive quality between the Instructional Design and the tools. However, during the second lockdown this trend stifled, possibly due to organisational changes that were intended to relieve teachers and students from the strains of online teaching and learning.

Our results show that over time more group work was adopted during online education. In concordance with Roblyer & Ekhaml (2000) we refer to this as an increase of interactive quality. However, the individual tools the teachers used could not facilitate the interactions needed to establish the higher levels of interactive quality for the group work. This contradicts the line of thought that technologies that allow high interactivity might be necessary to allow high interpersonal interaction (Roblyer & Ekhmal 2000).

At our round table discussion, E03 Secondary School Education, during the EAPRIL 2021 we discussed this finding. During the online EAPRIL event we were ourselves physically thousands of miles apart yet we all experienced a feeling of collectiveness. It gave us the inspiring insight that even though individual technologies might not facilitate the interactions needed to establish a higher level of interactive quality like Roblyer and Ekhaml (2000) suggest, a smart combination of tools and artful orchestration by the teacher might.

We do not know how often we will depend on online education in the future. If it becomes a regular back up, we will need to make online learning more inspiring. Roblyer and Ekhaml first reported interactive quality to be important for distance learning in the year 2000. Since then, the interactivity of the technologies available have improved, but our findings suggest many remain underused. This suggests that improving interaction in online education is more a pedagogical challenge than a

technical one. To progress teachers will need to increase their pedagogical knowledge on the importance of interaction for learning processes and learn how to deploy the full interactive potential of the technologies they already use. Despite the enormous constraints of the pandemic that faced them, several respondents in this study did so. They show us we can all adopt more interaction in our online classes. Let us do so too, on behalf of the learning of all the students entrusted to us.

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ADAPTATION OF NEW CREATIVE METHODOLOGY CRAFT FOR EDUCATIONAL CONTEXT: BENEFITS AND OBSTACLES

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ABSTRACT

Education always needs new ideas and solutions to non-standard problems to cope with the world's challenges. Existing creative methodologies, such as TRIZ, Design Thinking, Lateral Thinking, and CRAFT, help people develop new ideas and find solutions to problems. However, these methodologies were not created in the context of education. The team of creative experts and instructional designers of the "IKRA" group set a goal to adapt the grounded on the theory of frames creative methodology "Creative Algorithms, Frames and Tools" (CRAFT) for the field of education. This paper introduces the CRAFT methodology and discusses the main results of its adaptation for education considering current research on creativity. The experts of the CRAFT methodology, together with instructional designers, adapted 22 CRAFT techniques for the field of education, performed ten online workshops for testing the adaptations, and interviewed the participants. It turned out that the main benefits of using CRAFT methodology were an inspiration to generate provocative ideas and inspiration from own ideas, feeling of fun and team cohesion, understanding that the creative process could be systematic. The found obstacles seemed to be typical for the creative process in general; they were the unusual terminology, uncertainty, and doubts in their creative ideas. Theory of frames and grounded on it CRAFT methodology have the potential to improve the creative process of generating new and valuable ideas that could solve educational problems.

INTRODUCTION

Creativity is an integral part of education and one of the critical competencies of educators as they *create* educational programs, curricula, and instruction according to the students and the world's needs (Kasirer, & Shnitzer-Meirovich, 2021; Liu, Lin, & Wu, 2022). Existing creative methodologies, such as Theory of Inventive Problem Solving (Al′tshuller, 1999), Design Thinking (Brown, 2008), Lateral Thinking (De Bono & Zimbalist, 1970), and Creative Algorithms, Frames and Tools

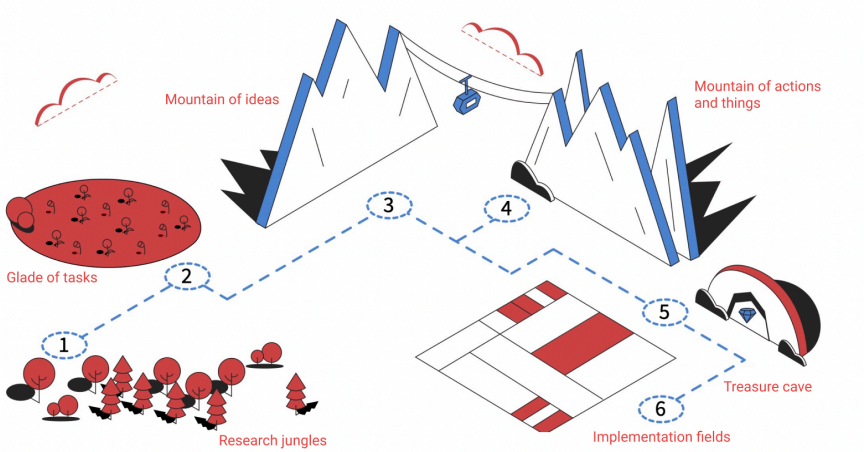
(CRAFT; Lebedev, 2017), help people come up with new ideas. However, these methodologies were not created in the context of education. That is, they could require additional efforts from educators to adapt them for the educational context. To help educators with the creative process, we set a goal to adapt the "Creative Algorithms, Frames and Tools" creative methodology for education. The CRAFT methodology could potentially complement the common instructional design approaches, namely, from goals, from experience, from holistic problems, as CRAFT methodology focuses on creating new role models, relationships, and the context in education. We assume that this methodology would help educators create new educational formats and rethink the instruction and entire programs. We also set a goal to analyze applying adapted for education CRAFT methodology to identify possible benefits and obstacles.

CRAFT — Creative Algorithms, Frames, and Tools

CRAFT methodology inherits the concepts of frame and role model from George Mead (1934) and Erving Goffman (1974). It helps in creating new ideas and finding solutions to problems through re-thinking of the original roles, relationships, and context of the educational system, that is, through re-thinking of frames (Lebedev., 2017; "IKRA" Group, 2020). For example, the lecture is a frame with its roles (students and teacher), relationships (teacher explains the theory to students), and context (classroom). Using the CRAFT methodology, one could merge the initial or basic educational frame with another one. For example, what if we merge the online program for developing coding skills with a football match? The new roles and relationships could be created — teams of students who solve problems and compete with other teams in writing code; fans (employers and other students) who cheer the favorite team, and even the favorite student with the most impressive coding skills. By imagining that our educational program is a football match, we can also improve the context of our online program — add a Friday' Zoom meetings during which students could chat or do homework (the analogy of a yard where you can go out and play football); add recordings of the coding process of the best programmer (the analogy of recordings of exciting football matches); add a tournament where teams will compete each other showing their programming skills.

Figure 1 shows the CRAFT algorithm's five steps, which organize the creative process.

Figure 1
CRAFT algorithm



The first step, "Research jungles," is dedicated to collecting information about own educational frame. During the second step, "Glade of tasks," one analyses the educational frame, identifies main problems, and formulates the objectives for the following creative process. These steps are needed to represent the own educational frame with its problems appropriately. This representation should guide the further creative process.

This representation of own educational frame possibly contributes to the further formation of breakthrough ideas, alongside mentioned in other creative models' assumptions about the importance of teamwork. In particular, different creative team models, for example, Harvey's Creative Synthesis Model (2014), Zhang and Yan's Vital Few Model (2021), Chen and Adamson's (2015) evolutionary synthesis model emphasized the importance of sharing ideas between the team members for generating the breakthrough ideas. CRAFT methodology assumes that the preliminary analysis of the initial educational frame and its problem is also needed. Moreover, it is assumed that the representation of one's frame could contribute to finding effective and valuable ideas, not just new ones.

After representing the frame and identifying the problem, one moves to the third step, "Mountain of ideas" — the heart of CRAFT methodology. During this step, one searches frames from all possible in the universe frames in which the problem is already solved. For example, one has a problem with students' connectedness to the program — they do not feel like part of a big learning team. On "Mountain of ideas," one asks the question "Where and when somebody or something feels connected to the system?" and then searches for the suitable frames. For example, it could be the football team,

the cells in the brain, the heroes of the film “Matrix,” and other frames in which somebody or something feels connected to the system.

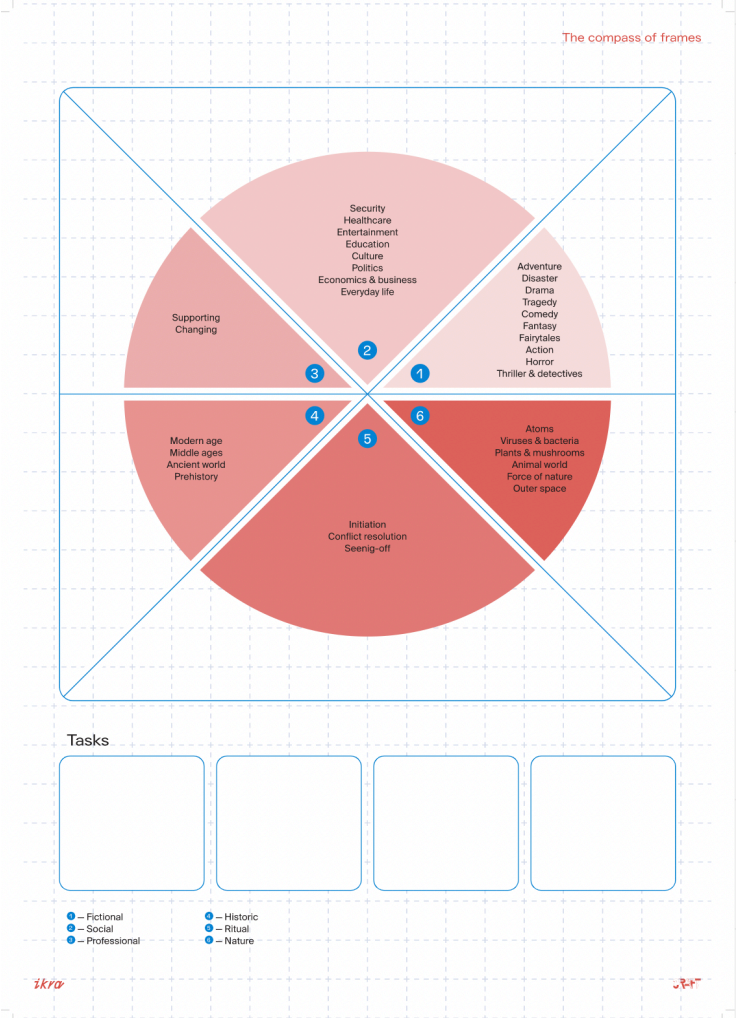
It is assumed that turning to frames as a source for future ideas is essential for the inspiration and the creative team’s dynamics. As for inspiration, one of its sources is the analysis of other works and comparison of own work with others (Ishiguro & Okada, 2021). In CRAFT methodology one compares own frame with the different frames from the universe, for example, an online program with a football match. Frame comparison makes the whole world the source of inspiration. It could neutralize the possible negative effects of social comparison like envy, shame, or resentment as there is no comparison with other people (Ishiguro & Okada, 2021).

As for CRAFT methodology’s contribution to the dynamics of creative teams, the Vital Few Model of team creativity suggests that teams could be heterogeneous in expertise where experts could lead the creative process due to their high status in the team hierarchy (Zhang, Li, & Yan, 2021). CRAFT methodology could change the dynamics of the creative team as the team’s heterogeneity in *erudition* comes to the fore. Erudition is involved in the third step, “Mountain of ideas,” where one looks for a non-educational frame like a football match in which one’s educational problem is already solved. In other words, team members’ knowledge about different frames in different areas is more critical than their expertise in a familiar field like education.

When the appropriate frame is found, one moves to the fourth step, “Mountain of actions and things,” where the abstract ideas (yard for playing football) transformed into practical actions and things that can be implemented in a natural context (Fridays’ Zoom meetings for chatting and doing homework). This transformation is made by making analogies between own educational frame (online program for developing coding skills) and another frame (football match). The last two steps of the CRAFT algorithm are the “Treasure cave” and the “Implementation fields,” which help make the ideas more valuable and prepare them for implementation in the real context.

Overall, in CRAFT methodology, one appeals to the universe’s wisdom for finding solutions and generating new ideas for own problems using analogies. CRAFT methodology consists of different techniques and frameworks that help creators with each algorithm step. These frameworks were carefully designed to support the usage of techniques (see the examples in Figure 2).

Figure 2
CRAFT framework "Compass of frames"



Moreover, the algorithm is flexible, suggesting that the creator could choose an appropriate set of techniques for a particular case. As originally CRAFT was not developed for education, we set a goal to adapt it to education and analyze the possible benefits and obstacles.

METHOD

The project involved ten teams of educators, consisting of 1-5 people. The teams represented different areas of education that focused on teenagers (1 team), adults (2 teams), employees (2 teams), university tutors (1 team). Four teams also created ideas for professional online adult education.

The project consisted of four stages. Firstly, the CRAFT experts and instructional designers adapted the original CRAFT techniques for the educational context. Each technique was analyzed by the instructional designer for the potential of application for education. As a result, 19 techniques were adapted: 8 techniques from the glade of analysis step, six techniques from the mountain of ideas step, five techniques from the mountain of things and actions. Figures 3 and 4 show examples of adapted frameworks.

Figure 3

CRAFT framework "The frame merging" adapted for education

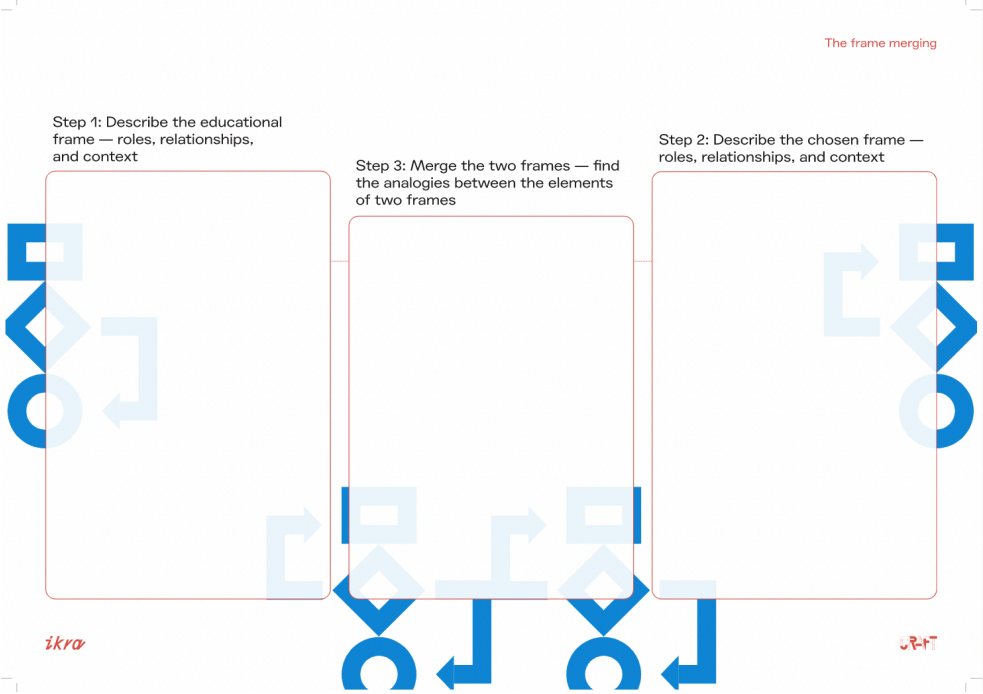
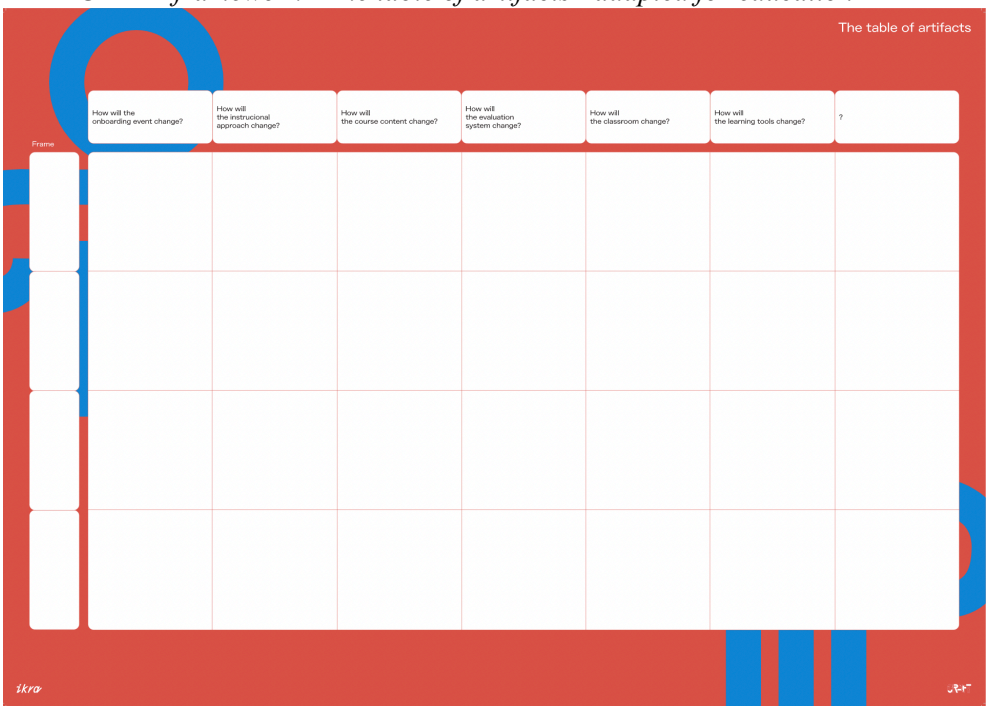


Figure 4

CRAFT framework "The table of artifacts" adapted for education



Secondly, the project team found educators who wanted to participate in the project through social networks. Out of 21 applications, the CRAFT experts and instructional designers selected ten teams of educators with the most interesting requests. Thirdly, each team (re)designed their educational programs using the CRAFT methodology during online sessions in Zoom and Miro. It took from 2 to 4 hours. Before each session, the CRAFT experts and the instructional designers selected the most suitable CRAFT techniques for each case. CRAFT experts trained the educators to use the techniques and facilitated the creative process. Instructional designers helped to (re)design the educational programs based on the created ideas and recorded the difficulties encountered by the educators during the creative process and their general impressions of the CRAFT methodology. Finally, a team of CRAFT experts and an instructional designer analyzed all the sessions and identified factors that potentially helped and hindered creation ideas.

RESULTS AND DISCUSSION

During the practical workshops, participants came up with new educational ideas using different techniques from CRAFT methodology under the facilitation of craft experts. Further, we will tell you about the pros and cons of the creative process guided by the CRAFT methodology, which the participants mentioned.

The most important benefits were the participant's inspiration from the co-designing with CRAFT experts and own ideas; understanding that the creative process could be systematic, not chaotic; and feeling of fun and team cohesion.

As for mentioned advantage of understanding that the creative process could be systematic, it could be reached because of the CRAFT's clear algorithm and techniques. Additionally, it could affect the participants' self-efficacy and creative confidence (Puente-Díaz, Cavazos-Arroyo, & Puerta-Sierra, 2021; Taggar, 2021) and uncertainty (Chen et al., 2021), which in turn relates to their creativity.

Concerning the mentioned feeling of fun and team cohesion, it could appear because of the critical action of CRAFT methodology — searching and analyzing frames in which the initial problem is already solved. Thinking about whether the initial problem is better solved in the frame of visiting the swimming pool or in the frame of the destruction of the death star by the rebels could be fun. Fun is essential as positive emotions potentially support creativity (Boekhorst, Halinski, & Good, 2021; Yefet & Glicksohn, 2021). Concerning the feeling of team cohesion, it could be related to the specificity of working with frames — participants exchanged knowledge about the world, not expertise in the professional field.

As for the difficulties in applying the CRAFT methodology, the educators most often pointed out the following: need to understand the unusual terminology and doubts about the created ideas they came up with. Doubts about own ideas had three reasons: (1) there is no evidence that idea will work as it is new; (2) lack of understating what motivational and educational outcomes the implemented idea will bring to students; (3) lack of understanding of how to implement a new idea in an existing system and where to find resources for implementation hindered the participants' beliefs in own ideas. Doubts in creative ideas are a common part of the creative process in general. To be a full supporter, CRAFT methodology should also focus on working with such doubts and willingness to engage creative risk and uncertainty (Creely et al., 2021; Boekhorst, Halinski, & Good, 2021). Belief on own ideas is essential for their implementation.

To conclude, educators can improve their process of creating new ideas and solutions with creative methodologies adapted for education. However, creating new ideas and solutions can be complicated due to methodological and personal obstacles. In our project, CRAFT algorithm and techniques supported the feeling of systematicity of the creative process, aroused a feeling of fun and team cohesion, and craft experts inspired participants to come up with provocative ideas. However, the distrust in

their ideas due to the novelty of the idea and the lack of evidence hindered the usage of the CRAFT methodology.
Adapted for education CRAFT algorithm and used in it frames as the main source of creative ideas have a protentional to improve the creative process of generating new and valuable ideas in education.

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CRITICAL THINKING AMONG PRIMARY TEACHERS IN ESD CONTEXT

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ABSTRACT

Living in an overloaded world with many sources of information, demands urgently to choose wisely. At the same time, due to the climate changes, society needs to ensure the sensitiveness to handle the available natural resources. In this intersection I present some theoretical considerations and empirical findings which points to the importance of Education for Sustainable Development (ESD) as a learner-centred and Critical Thinking (CT) as a participatory decision-making tool. The specific argument that is put forward is: learning in the Age of Industry 4.0 should privilege digitalization and digital technologies with the critical awareness of various facets of Critical Thinking (CT) such as source criticism (as part of establishing validity of information) in a sustainable perspective (demanding the local intertwined with the global arena). Addressing ESD with the focus on CT is an imperative to rethink about modern didactic concepts specially with focus on securing sustainable future through educational actions. CT is the spine-core of the ESD field, ensuring the best way to act with purposeful sensitivity while knowing how to search and judge the available sources to tackle the decisions. The purpose of this paper is: how do primary teachers able to deal and cope with CT when they are considering their own teaching with the students through ESD tasks? The findings are elaborated with selected empirical data.

Keywords: Critical Thinking, Education for Sustainable Development, Teachers Professional Development

CRITICAL THINKING (CT)

Historically, the concept of Critical Thinking (CT) can be traced from the ancient's Greek civilization (Sophists in ancient Athens) particularly addressed through the reasoning base. This presupposes to interrogate and discuss what could be socially

acceptable as a foundation of the human behaviour (Kaplan, 1991). The argumentation skills are the foundations of the philosophical view. It is through the psychological branch that the CT spectrum extend to the dispositions, towards the comprehensive human individual development (Meneses, 2020).

Today, CT can be interpreted from philosophical, psychological, and educational approaches (Lai, 2011; Lai et al, 2016). Despite of these different interpretations, most researchers typically agree that CT involves a set of skills, abilities, and dispositions (Lai, 2011; Ennis, 2015; Facione, 2016; Vieira, Tenreiro-Vieira & Martins, 2011). In this regard, as a theoretical construct, CT can be perceived as skills (Ennis, 2015):

1. have a focus and pursue it,
2. analyze arguments,
3. ask and answer clarification questions,
4. understand and use graphs and math's,
5. **judge the credibility of a source,**
6. observe, and judge observation reports,
7. use their background knowledge, knowledge of the situation, and previously established conclusions,
8. deduce, and judge deductions,
9. make, and judge, inductive inferences and arguments (both enumerative induction and best-explanation reasoning),
10. make, and judge, value judgements,
11. define terms, and judge definitions,
12. handle equivocation appropriately,
13. attribute and judge unstated assumptions,
14. think suppositional, and
15. deal with fallacy labels
16. be aware of, and check the quality of, their own thinking (metacognition)
17. deal with things in an orderly manner
18. deal with rhetorical strategies

On the other hand, the CT dispositions (idem) are:

1. seek and offer clear statements of the thesis of questions,
2. Seek and offer clear reasons,
3. try to be well informed,
4. **use credible sources** and observations, and usually mention them,
5. take into account the total situation,
6. keep in mind the basic concern in the context,
7. be alert for alternatives,
8. be open-minded (seriously consider other points of view, withhold judgment when the evidence and reasons are insufficient),
9. take a position and change a position when the evidence and reasons are sufficient,
10. seek as much precision as the situation requires,
11. try to "get it right" to the extent possible or feasible,

12. employ their critical thinking abilities.

Despite of the quite exhaustive and detailed list of CT in skills and dispositions, the understanding *in situ*, is still a significant and probably important aspect. One of the main reasons why social context is important because it comprehends the human behaviour in the collective dimension. Here in the case of CT, the social context gained visibility particularly through the struggle for self-emancipation and social change in the society through the work of Frankfurt School (1932). While rejecting all forms of rationality that wedded science and technology into new forms of domination, all forms of rationality that subordinates human consciousness and actions to the imperatives of universal laws are also rejected (Giroux, 2003). In the American context, Dewey (1910) developed the foundations for the CT, while raising the question "how we think?". Many Programmes developed CT as formal courses as can be in USA tended to teach political conformity rather than political autonomy (Kaplan, 1991). Looking back to Ennis (1985) previous work, for example, CT courses typically simplify the matter by presenting students with a list of reasons that do not support entirely claims in a very particularized context. Considering that society is evolving rapidly, the context becomes easily overlooked, because it highly determinate the action. In this matter, Paulo Freires' (1970) contribution through the "pedagogy of the oppressed" focused and highlighted the social context (oriented through civics and social impacts). Offering a critical perspective in the societal context and therefore, also called "critical pedagogy" is at the same time linked to the evolving moral dimension (Meneses, 2020) *i.e.,* CT as an intellectual capability pervasive to goals of social responsibility can underpin the collective decision making (Aikenhead, 1994; 2016). CT can, therefore, be considered the spine-core of the ESD field, through the implicit action that is embraced through the context complexity. Despite of CT recognition as an increasing area of research in the educational sciences, there is still a recognized lack of research on the meaning of CT from students' and teachers' perspectives at schools (Nygren, Haglund, Samuelsson, Geijerstam & Prytz, 2019).
Even though in today's world CT is an important twenty-first century skill as identified by the European Commission (2016), the collective dimension has not been yet highlighted *per se*, unless a context such as ESD has also a collective goal. In this sense, CT is an important tool for making informed decisions (Belluigi & Cundill, 2017). The set of thinking skills approach (with less emphasis on morality, ethical virtues and the social dimension) is directly linked with the Bloom (1956) construct (Meneses, 2020). Even when considering a simplistic view of CT such as an attempt to achieve a desired outcome by thinking rationally in a goal-oriented fashion (Butler, 2012), the social context has implication for peoples' decisions.

2. EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

Firstly, introduced in the early 1970s the concept of Sustainable Development (SD) has become a widely embraced concept on the political agenda. The main goal of SD is to "meet people's needs today without diminishing opportunities for future generations" (Brundtland Report, 1987, p.43). Nevertheless, the emphasis and prioritization in the education sustainability field became more obvious in the official documents and Education for Sustainable Development more recently. ESD (Education for Sustainable Development) is increasingly understood as the cross-cutting means for SD and all areas of SDGs (Sustainable Development Goals). The importance of social goals (such as handling the climate change) has been highlighted by the United Nations' (UN) 2030 Agenda for Sustainable Development (UN, 2015). ESD is recognized as a central goal of education in Norway (UD, 2017; 2019) and internationally (UN, 2015; UNESCO, 2018). ESD was originally conceived as idea of progress (in the pre-modern time) that slowly developed as a concept that emerged in the context of a growing awareness of an imminent ecological crisis (Du Pisani, 2006). This awareness means that there is a link between humans' life conditions and the way they cope with diverse conditions in different aspects. How humanity is foregrounding and making sense about i) what they are dealing with; ii) how they decide how to cope with the conditions; is at the core of SD since the beginning of human existence.

The how-dimension in the UNESCO report from 2018 is defined as a teaching approach that includes a participatory dimension. This brings to Sustainable Development the collective actions dimension through education, also known as ESD. Recognizing the rapid changes in information affects the way ESD collective decisions are taken. How much are teachers aware about this process? How much the ability of exercising CT while judging sources, can be influencing students' perception? These are some interrogations that are present through the process of articulating the CT and ESD in the school's context through teachers' professional development.

This provides an undeniable support to the why-dimension when investigating ESD, due to the teaching practices (Sund & Gericke, 2020). When observing ESD practices related with different subjects, Borg et al. (2012) found that science teachers focus on facts, while social science teachers focus on developing students' abilities. According to these authors, sustainable education principles are becoming more pluralistic and acknowledges different perspectives, views, and values – (*what* dimension in ESD).

Despite of the fact that ESD concept is most often defined by the three dimensions environment, society and economic. The interconnectedness between these three dimensions is probably not so clear to operationalize. It is still unclear how this multidisciplinary of ESD is held in education (Sund & Gericke, 2020). There is, however, an unquestionable fact that teachers act as facilitators for students' understanding of social, economic and environmental aspects related to sustainable development (Berglund, 2020).

As already stated, there is strong support for ESD in the Norwegian Formal Curriculum (UD, 2019). In 2006 the *Knowledge Promotion (KP-06)* appeared with the designation of SD and ESD-thinking, while defining six different "human beings" such as "the environmental aware human being" (Andresen, Høgmo & Sandås, 2015). Previously Norway participated the *Environmental and School Initiatives (ENSI)* network initiated by OECD in 1986 to discuss if ESD could be a proper instrument as an effective learning in school development. ESD themes were formed in 1997 to promote scientific competence in Norwegian schools (*ibid*).

3. CRITICAL THINKING WITHIN ESD CONTEXT

The historical interdependence between people needs (what) and how to use the knowledge they already have about a certain aspect related to issues in sustainability, makes ESD an interesting educational context. In other words, ESD teaching has the potential to cover the complexity of SD issues and prepare students to be aware about the importance of their decision-making (what and how). Through teachers` discourse, it is possible to experience how they relate to the ESD construct. Munkebye et al. (2020) have highlighted the specific challenges that primary teachers face in supporting their students to take critical stance on sustainable development. Exploring causal links between CT and real-world outcomes (here perceived in the ESD context), demands how thinking critically about the information we consume is of the utmost importance (Butler, 2012).
How society responds to the ESD recall in partly covered through the way teachers are handling the issues and how they are they handling the available information. "Make and value judgements", the CT skill number 10 (Ennis, 2015) is also dependent from "judge the credibility of a source", CT skill number 5 (*idem)*. CT conceptualization through skills and dispositions can be helpful to understand "How" individual as part of the society are making their own choices in the ESD context.

4. EMPIRICAL DATA

Through the qualitative study there is a potential to respond to epistemic challenges and crises, to unmask the layers of the social life and depth of human experiencing (Smith, 2007). Questions such as how human make sense of the reality, what are the ways they create meaning within the context, how they think, and reason are at the core of the qualitative analysis method (Creswell, 2013). To understand more deeply how teachers relate with the teaching related with CT and ESD, qualitative research as a form of social inquiry that tends to adopt a data-driven research design to study several occurring cases in detail, while using a verbal rather than a statistical approach (Cohen, Manion & Morrisson, 2018) was chosen.

This verbal form of approach presumes that the inner world of the participants` in the study can be accessed by the researcher (Yin, 2009; Stake, 1995). Through a focus-group interview to 3 teachers (November 2020) and 2 researchers from the main project (developing in primary schools in Norway) the questions were related with teachers understanding about CT and ESD. While studying a case within a real-life contemporary context or setting (*idem*), the selected case study contributes for understanding teachers' experiences about sustainability issues located in three different schools in Trøndelag. In this study I focus on one excerpt from the first interviews that took place in the 1st year of the project (CriThiSE) at the end of 2020.

5. PRELIMINARY FINDINGS

The interview took place on November 2020 in the common area (eating and meeting place for all the teachers in the school) after teachers finished the teaching. When inquired about the importance of the CT in ESD context in a very early stage, one teacher explains that CT is very much linked with how people, especially the students are gathering information (about ESD context).
In this example, the teacher is elaborating through one classroom episode. Here the importance of choosing the proper source with critical lens, as a purposefully decision making has a turning point on the collective action through one individual judgement, when one student is sharing a TikTok alert.

> I remember this TikTok episode, where everyone should wear yellow on Monday after the winter holidays because it was childhood cancer day. But then we are in October, then someone (a student) saw it in TikTok. (B-2, School C)

The realization that, extracting an information without noticing the date of the source for example, is a vivid example how CT particularly through the "judgment of a source" skill (Ennis, 2015) can be a powerful tool in the digitalization Era. Afterwards this teacher explained how useful and fruitful this example was to discuss in the classroom. One of the valorised aspects, is how much trust people can imply in a certain source without verifying the validity. At the same time, this discussion provides an opportunity to reflect about human choices and while doing so, questioning the human behaviour (Kaplan, 1991). That can be interpreted as the danger (versus trust) in exposing the collective action through the individual choice. This social dimension is here highlighted through the fact that all the students from the same classroom took the same action: deciding wearing using yellow clothes. But the collective dimension is emphasized through one individual judgement, in a way the first student sharing the TikTok, decided in a way that afterwards affected a collective action (all wearing yellow clothes). Despite of the fact that the individual standpoint is represented through the act of picking certain kind of information, or

in other words, while “judging the source” (Ennis, 2015), this act is taken from the individual standpoint. The sense about sustainability is somehow unclear here in this excerpt, but still the main idea to be discussed is how students are relating strongly with digital technologies as a tool to be informed about sustainability issues (as a context), that moves dynamically between individual and collective standpoint, and how individual choices can misguide the collective actions based in a pseudo-informed decision. This is happening in the Age of Industry 4.0, where digital technologies with critical awareness should take place.

6. DISCUSSION

One of the intriguing facts is that issues related with sustainability or Education for Sustainable Development are more highlighted, where there is a struggle to fit in the global demands (Ichinose, 2017). Local community choices are reinforced at the same time with the global dimension, visible through the TikTok episode, where importing an event revealed a complete disaster while ignoring the proper “cancer day”. Looking closer to CT conceptualization (Ennis, 2015) skill number 5 “judge the credibility of a source” and disposition number 4 “use credible sources and observations, and usually mention them”. Choosing the “proper source” seems however incomplete to understand the digital media while appropriating the sources.

Kaplan (1991) claims that CT and Critical Pedagogy provide i) criticism of arguments; ii) critique as a foundation for criticism of the world around them. In this way, ESD context provides a good opportunity to do so. The foundation of ESD lies with i) what; ii) how and that turns a “fertile land” to exercise the critical awareness.

In relation to Teachers Professional Development, Giroux (1988) invites teachers to examine their institutional role and to redefine themselves as “critical intellectuals”. The critical pedagogy movement is grounded in Paulo Freire`s “Pedagogy of Oppressed”, as a guidebook for the radical educators teaching the members of the working class. Here teachers are the active subjects of education and students are the passive objects (Kaplan, 1991). But through the TikTok episode, the active and passive role are very fast moving from students to the teacher. This means that CT courses have failed to provide students with autonomy (Kaplan, 1991), while not merely asking for convincing reasons from leaders. In the teachers comment about the importance of choosing properly the available information under certain kind of circumstances, CT requires to some extension that is something broader than Ennis (2015) checklist, because following them directly doesn’t prevent us to them use in a “failure mode”. In other words, CT *per se* can be risky, since a broader perspective is needed to be incorporated to evaluate society trends, while discussing what is socially accepted as a foundation for the human behaviour (Kaplan, 1991).

But CT through the dispositions can offer an interesting way to challenge the self-emancipation and social change in society (rooted in the Frankfurt School). Teachers Professional Development can play a big role in addressing and questioning the social changes, particularly through the judgement of the sources (from an individual standpoint) to the collective action – as a self-emancipation and broadening the CT (skills and dispositions aspects). The changing of the paradigm from the humans' life conditions (including the way humans cope with diverse conditions in different aspects) includes definitely the judgement of the sources through the social media in today's life. From the ESD conceptualization, the "what" dimension is definitely connected with the "how" connection (through the scrutinizing of CT). In the illustrated data it is possible to recognize the true danger of the possible non-academic source of CT as a primary cause of decision-making (from the students' perspective) and it demands a close monitorization from the teacher's perspective (in a broader sense of CT, as a proposed opportunity to reflect about human choices) and while doing so, questioning further the human behaviour (Kaplan, 1991) in the sustainable sense.

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CAN STUDENTS BENEFIT FROM PROJECTED UNCERTAINTY IN SCHOOL-BASED CHALLENGES? AN EMPIRICAL EXPLORATION

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ABSTRACT

The conditions of students' success in their educational, professional, and personal future seem a moving target and many have called for education that more strongly focuses on students' responsibility as well as sustainable education and learning, such as self-regulated and challenge-based learning in classrooms. In a hope to foster these skills in students and help them deal with the uncertainty future holds, an increasing number of secondary schools have implemented outdoor adventure projects called "Challenges" in their school programs, in which students work on a self-chosen, extra-curricular challenge. This research explores whether "Challenges" can be successful in raising students' ability to deal with uncertainty and whether students with a more positive and/or stronger future orientation and ability to deal with uncertainty at the outset will benefit more from the project and experience stronger effects on personal competences as well as their evaluation of the learning experience. Findings reveal a relatively high tolerance of uncertainty at the outset which correlates with student perseverance and students (positive) considerations of the future. Nevertheless, tolerance of uncertainty decreased over the "Challenge", which some data suggest to be linked to students' sense of responsibility and ownership.

1. INTRODUCTION

That the future is unpredictable is not a new insight we have gained from the current SARS-CoV-2 pandemic; but it has got strong support in the current situation. Even before that, Lerkkanen and Pakarinen (2019) pointed out that "recent societal, political, and economic changes in the world have presented new challenges for

education and in raising children to face the unpredictable future and attain the skills needed in the twenty-first century." (p. 152). Unpredictability of the future and perceived uncertainty lead to diffusivity in learning goals and ultimately affect student motivation as learners cannot make a connection between what they are learning and their future goals (Creten et al., 2001; Kauffmann & Husman, 2004; Phalet, Andriessen, & Lens, 2004). Today more than ever, future for many students represents "uncertainty and preoccupation" rather than "a challenge full of striving and achievement" (Carelli, Wiberg, & Aström, 2015, p.88). The conditions of students' success in their educational, professional, and personal future seem a moving target and many have called for education that more strongly focuses on students' responsibility as well as sustainable education and learning, such as self-regulated and challenge-based learning in classrooms.

In Germany, recent years have seen a movement across schools trying to tackle the effects of an uncertain and ambivalent future on students' educational attainment and motivation by fostering their competence to deal with uncertainty and ambiguity. By means of an outdoor adventure education project called "Challenges", in which students are deliberately placed in situations provoking uncertainty and exhaustion, schools hope for their students to nevertheless experience themselves as autonomous, capable of decision-making and problem-solving in these situations and thus benefit when facing real-world challenges in later life. The aim of this research is to explore whether "Challenges" can be successful in raising students' ability to deal with uncertainty. Also, this study will focus on whether students with a stronger future orientation and perceived ability to deal with uncertainty at the outset of this outdoor adventure education project will benefit more from the project and experience stronger effects on personal competences as well as their evaluation of the learning experience.

2. THE PERCEPTION OF TIME AND FUTURE

There are a number of different approaches that have tried to capture how an individual views and is affected by their perception of their past, present, and future. What usually first comes to mind when thinking about how individuals differ in this respect, is referred to as time attitudes. Time attitudes describe "a subject's more or less positive or negative attitude towards the past, the present and the future" (Nuttin & Lens, 1985p. 11). Researchers (e.g., Boyd & Zimbardo, 2005; Carelli, Wiberg, & Wiberg, 2011; Zimbardo & Boyd, 1999) were able to show a number of empirically distinguishable factors, namely past negative (actual or reconstructed unpleasant or traumatic events), past positive (a warm, sentimental attitude toward the past), present-hedonistic (hedonistic, risk-taking attitude toward time and life), present-fatalistic (absence of focused time perspective, lacks the goal focused of future-oriented individuals as they believe that future is predestined and uninfluenced by own actions), future-positive (feeling optimistic about future events), and future-

negative (individuals feel worried and upset as they do not believe they will be able to fulfil their goals and meet obligations and challenges in the future). These time attitudes have been shown in multiple studies to be related to further relevant aspects, e.g., negative and fatalistic attitudes with depression, low-self-esteem and unhappiness (Zimbardo & Boyd, 1999) and positive attitudes toward the future are positively correlated with optimism and hope and more generally psychological well-being (Andretta, Worrell, & Mello, 2014). Nevertheless, research has shown that higher optimism does not necessarily go hand in hand with lower pessimism, but these are two independently varying factors (Herzberg, Glaesmer & Hoyer, 2006).

Whether a person scores higher or lower on optimism or pessimism scales, i.e., whether they see their future more positively or negatively, however, does not transfer any information about the scope of these views. Individuals vary with regard to how far they look into the future and, for example, the end of the year may seem closer or a time span of six months may seem shorter to them than to others. This phenomenon is referred to as (future) time perspectives.

Time perspectives are assumed to be a non-conscious process and subsume "the totality of the individual's views of his psychological future and his psychological past existing at a given time" (Lewin, 1952, p. 75) but not necessarily relate to how physical time passes (Husman & Shell, 2008). Some people have a more extensive future perspective than others, allowing them to set goals in the more distant future and that the incentive value of these goals is higher for them than for people with a short FTP, because goals, for example set in five years' time, seem nearer to them (e.g., DeVolder & Lens, 1982; Husman & Shell, 2008; Lens, Paixao, Herrera, & Grobler, 2012; Tucker, Vuchinich, & Rippens, 2002). Accordingly, these people "can anticipate […] future needs and hence act now to secure not just the present, but also future survival" (Suddendorf & Busby, 2005, p. 117).

These ideas were reflected in Strathman and colleagues' (1994) Consideration of Future Consequences (CFC) approach, which comprises the ideas of balancing utility and immediate pleasure. Individuals more or less strongly consider future consequences of their actions. The consideration of future consequences approach "refers to the extent to which individuals consider the potential distant outcomes of their current behaviors and the extent to which they are influenced by these potential outcomes. It involves the intrapersonal struggle between present behaviour with one set of immediate outcomes and one set of future outcomes." (Strathman et al., 1994, p. 743).

3. FUTURE THINKING AND SCHOOLING

Individuals' views of and attitudes toward the future are specifically relevant in the school context, as "schooling and education are by definition future oriented" (Leondari, 2007, p. 21) and "the knowledge and skills [students] gain today would

have little value if [they] did not use them at some time in the future" (Husman, Brem, Banegas, Duchrow, & Haque, 2015). Prior research has shown that positive attitudes towards the future positively correlate with higher academic achievement (e.g., Lennings, Burns, & Cooney, 1998) and students' view of the instrumentality of learning contents for future goals affects learning motivation (e.g. Creten et al., 2011; Eccles et al., 1983; Eccles & Wigfield, 2002; Kaufmann & Husman, 2004; Phalet, Andriessen, & Lens, 2004; Wigfield & Eccles, 2000). Van der Veen and Peetsma (2009) however found a decrease in Dutch lower secondary school students' intrinsic value of school work over the school year which led to a decrease in students' motivated behaviour. The above research has, however, not taken into account that students today may perceive their future as more uncertain and preoccupied than ever and "the real cause of lack of academic engagement in students, [may be that] young generations do not see the future as something to aspire to, but rather as something to escape from." (Morselli 2013 p. 312). Own prior research in the field focused on adolescents' views of challenges in their academic, professional, and personal future, and how adolescents' views of the future and consideration of future consequences affect the perceived usefulness of schooling (Helker, under review, a). Results showed that adolescents generally hold a positive view of their personal future while their perceptions of society's future were more mixed. Adolescents mentioned a broad number of challenges they saw in their personal, professional, and academic future deriving from aspects such as learning and working, achievement, career, social and personal aspects, school organization and politics as well as more general aspects. Only few adolescents stated not to see any challenges (yet). The quantitative data showed that age positively predicted scepticism regarding the usefulness of schooling for future success. Furthermore, analyses showed that adolescents' consideration of future consequences mediated the effect of helicopter parenting (as perceived by the adolescent) on scepticism regarding the usefulness of school for future success.

In order not to neglect the main stakeholders in adolescents' development of future time perspectives, we explored the interplay with parents' consideration of future consequences as well as views of their child's future and schooling, and how these affect those of their children (Helker, under review b). This research for example showed that students' perceived academic usefulness (with regard to the subjects of math, German, science and social sciences) was found to be positively predicted by their consideration of future consequences of current actions as well as parents' perceived usefulness of these learning contents. While Helker found that family cohesion and climate moderated the relation between parents' and child's consideration of future consequences, as well as parents' and child's scepticism regarding the relevance of schooling for future success, parents' and child's perceived usefulness of specific school contents was shown to not undergo from the same moderating effect. The data had been collected shortly before the SARS-CoV-2 pandemic, but the findings put even more emphasis on the fact that little predictability of the future may affect future thinking in school, school motivation and learning behaviour.

4. SCHOOL-BASED LEARNING TO DEAL WITH UNCERTAINTY

As has been laid out in the above, most of the existing research focusing on how present and future time orientation and perspectives collude with schooling have focused on specific school subjects, most often perceived usefulness of learning contents for future goals and how these can be affected by (teachers') interventions (e.g., Bembenutty & Karabenick, 2004; Hulleman & Harackiewicz, 2009; Phalet, Andriessen, & Lens, 2004).

Some schools have gone a step further trying to trigger their students' sense of responsibility for their learning progress and process by granting them more autonomy (e.g., Bryan & McLaughlin, 2005; Peterson et al., 2011; Zimmermann & Kitsantas, 2005) by deliberately provoking students sense of uncertainty. Helker and Wosnitza (2016) conducted a study with all students of a school that strongly emphasizes student autonomy by offering learning contents in modules that students can work on in open workshops in their own time and pace. Results showed that these students' sense of responsibility for the learning process and learning outcomes correlated with all their motivation, competence and autonomy beliefs as well as school outcomes (as measured by students' math grades).

In Germany, the results of the first PISA study yielded an emphasis on the learning of competences, i.e., to teach knowledge and skills in a contextualized way so that they can be transferred to new situations and also for example enable reflective and self-regulated processes (Klieme & Hartig, 2007). Students' self-regulation of learning, i.e. " learner's deliberate planning, monitoring, and regulating of cognitive, behavioral, and motivational/emotional processes towards completion of an academic task/goal" (Hadwin, Järvelä, & Miller, 2011, p. 68) is promoted by task environments that include motivational, cognitive or behavioural challenges. This has sparked interest in so-called *challenge-based learning* (e.g., Apple, 2010), which is increasingly used, predominantly in higher education, to foster students' transversal competencies, knowledge of sociotechnical problems, and collaboration with industry and community actors (see Gallagher & Savage, 2020 for a review).

Nevertheless, the above described approaches to creating learning environments that allow for students' autonomy and developing a sense of responsibility and competence that would help them deal with future uncertainty, all still focus on specific learning contents.

Despite sharing the same goal of endowing students with the skills they need when confronted with unpredictable future prospects and future challenges, there are approaches which are even more detached from lesson-based learning. One of these approaches are outdoor adventure education projects implemented in school curricula, that focus less on students' content learning but rather "learning objectives [that] are achieved alongside enjoyable and challenging activities which cannot be performed in conventional settings" (Fox & Avramidis, 2003, p. 268). As Garst, Scheider & Baker (2001) suggested that young people "placed in a natural setting

and released from the pressures of reading, writing, and teacher approbation, discovered new interests and capabilities" (p. 36), these outdoor adventure projects are hoped to allow students identify challenges and learning objects which match their current state of personal development (Havighurst, 1974; Hentig, 2007; Milton, Cleveland & Bennet-Gates, 1995; Sliwka, 2018; Trautmann, 2004).

In Germany, for example, an increasing number of secondary schools have implemented outdoor adventure projects called "Challenges" in their school programs (we currently know of around 50 schools). In these activities, students from a certain year group (usually 15-17) are released from school-based lessons for a certain time period (usually two to three weeks before or after the summer holidays) to either on their own or in small groups of two to six students meet a self-chosen, extra-curricular challenge. This challenge usually involves leaving their home town, travelling by foot or bike with limited money and having to forego familiar comfort. With these projects, schools hope for their students to experience themselves as autonomous, capable of decision-making and problem solving and thus benefitting when facing real-world challenges in later life.

As "it seems that adventure programs have a major impact on the lives of participants, and this impact is lasting" (Hattie et al., 1997, p. 70), a lot of research has studied the impact of school-based outdoor adventure education projects (e.g., Beames, Mackie, & Scrutton, 2020) but still struggle to identify positive, universal effects of such programs in quantitative data (Williams et al., 2018). Nevertheless, some studies have shown for example improvement of self-esteem and well-being after participating in a school-based intervention program (Boeger, Dörfler & Schut-Ansteeg, 2006) as well as self-efficacy (e.g., Kümmel, Hampel, & Meier, 2008; Markus, Eberle & Fengler, 2019).

5. THIS RESEARCH

Of course, no intervention will be able to lift the fog that lies over adolescents' future. Just because a student participates in an outdoor adventure education intervention, they will not be able to see their future more clearly or change their more or less strong consideration of future consequences of current actions. Nevertheless, outdoor adventure education projects such as "Challenges" aim at fostering students' ability to deal with uncertainty and their grit which are both supposed to help students meet future challenges. Furthermore, own prior research in the field has shown that participating students rated the usefulness of the challenge rather positively, experiencing it as mostly useful for their personal and least useful for their academic future. Students' sense of the challenge's usefulness correlated with their experience of autonomy, competence and relatedness during the challenge and affected their evaluation of the success of the challenge and of the overall project idea (Helker & Rürup, 2016). As that exploratory observational cohort study only drew on data collected after the students' return from the challenge, some questions

remain unanswered, regarding whether participating in an outdoor adventure education project such as “Challenges” will strengthen students’ skills to deal with (uncertainty of) their future and whether students with a stronger orientation towards the future and tolerance of uncertainty will benefit more from “Challenges” in improving personal skills.
Therefore, this study aims to explore whether “Challenges” can be successful in raising students’ ability to deal with uncertainty and answer whether (1) students’ future time attitudes and consideration of future consequences of current actions affect their learning in the Challenge? and whether (2) students with more beneficial views of the future show more benefits regarding a change of grit, tolerance of uncertainty, and their perception of the usefulness of schooling over the course of the Challenge?

6. METHOD

6.1 Setting

In order to make a first attempt to answer the above research question, we conducted a longitudinal study with students participating in the novel de-schooling project ‘Challenges’. For this study, students were asked to fill in a questionnaire before they even started preparing their challenge (T0, i.e., more than 6 months prior to departure). A second questionnaire (T1) was filled in right before students embarked on their challenge, and within three weeks after their return, students were again contacted to fill in the third and last questionnaire (T2). Questionnaires were fully online and teachers who were facilitators of the challenges organized data collection on the school sites so that data collection took place at the specific time points (6 months prior, immediately prior to and three weeks after the challenge) in accordance with the schools timetable. Students created an individual pseudonym by which their replies to the three questionnaires were to be matched.

6.2 Measures

The first questionnaire (T0) included questions exploring attitudes towards the present and future, consideration of immediate and future consequences of current actions as well as self-reports on personal competencies, e.g., tolerance of uncertainty and fit, school interest as well as scepticism regarding the relevance of schooling for future success. Furthermore, this questionnaire included two single-item questions asking students of whether their viewed their own future and society’s future positively or negatively.
The second questionnaire (T1) included the same measures on personal competencies, school interest and achievement as well as scepticism regarding the relevance of schooling. After their return, students were again asked to fill in a

questionnaire (T2) that again included measures on personal competencies, school interest as well as scepticism regarding the relevance of schooling but also asked students for their evaluation of their challenge, the project in general as well as perceived changes in attitudes. Table 1 provides an overview of all scales used in the student questionnaires with references, where applicable, as well as scale reliabilities and descriptives.

6.3 Sample

It should be noted, that some schools only asked their students to participate at timepoints 1 and 2 or even only at T2, so that numbers of responses vary considerably between timepoints, T0 and T1 may have less responses than T2, and linking participants across timepoints may be difficult. While overall 587 students participated in the study (45.5% female; age: M=14.28 SD=0.97), as already described above, participation rates over the different timepoints were quite mixed which resulted in much smaller numbers of complete questionnaires that could be used to address the research questions. 124 students participated in T0. 38 of these skipped T1 and only filled in T2 after their return. 202 students filled in T1 and T2, leaving out T0, and only 51 students filled in questionnaires at all time points. As measures on students' future time perspectives and considerations of future consequences were only included in T0, we can only draw on a sample of 89 students for analysing effects of these on learning across the participation in the Challenge.

Scale	References (where applicable)	# items	Scale	Sample Item	Reliability	M	SD
T0 School interest		4	1-4	'I like going to school.'	α .79	2.92	.61
T0 tolerance of uncertainty	Dalbert, 2002	5	1-4	'I like trying out new things even though there may not always be results.'	α .53	2.65	.47
T0 Grit							
Continued Interest	Duckworth et al., 2007	6	1-4	'My interests change from year to year.'	α .67	3.49	.54
Perseverance		6		'I have overcome setbacks to conquer an important challenge.'	α .73	2.72	.51
T0 responsibility		3	1-4	'I like taking responsibility for a task.'	α .81	2.84	.62
T0 Scepticism re schooling	Midgley et al., 2000	6	1-4	'Even if I do well in school, it will not help me have the kind of life I want when I grow up.'	α .80	2.40	.66
T0 Time Perspectives							
Fatalism	Laghi et al., 2013	5	1-4	Fatalism: 'Since whatever will be will be, it doesn't really matter what I do.'	α .75	2.53	.60
Hedonism		5		Hedonism: 'I feel that it's more important to enjoy what you're doing than to get work done on time.'	α .58	2.82	.50
T0 Consideration of…		7	1-4	Immediate: 'I only act to satisfy my immediate concerns, figuring the future will take care of itself.'	α .75	2.43	.50
Immediate Consequences Future Consequences	Joireman et al., 2012	4		Future: 'I am willing to sacrifice my immediate happiness or well-being in order to achieve future outcomes.'	α .68	2.66	.56
T1 School interest		4	1-4	'I like going to school.'	α .72	3.02	.53
T1 tolerance of uncertainty	Dalbert, 2002	5	1-4	'I like trying out new things even though there may not always be results.'	α .63	2.65	.53
T1 Grit							
Continued Interest	Duckworth et al., 2007	6	1-4	'My interests change from year to year.'	α .70	3.43	.53
Perseverance		6		'I have overcome setbacks to conquer an important challenge.'	α .70	2.78	.49
T1 responsibility		3	1-4	'I like taking responsibility for a task.'	α .80	2.87	.66
T1 Scepticism re schooling	Midgley et al., 2000	6	1-4	'Even if I do well in school, it will not help me have the kind of life I want when I grow up.'	α .74	2.46	.60
T2 School interest		4	1-4	'I like going to school.'	α .81	2.96	.65
T2 tolerance of uncertainty	Dalbert, 2002	5	1-4	'I like trying out new things even though there may not always be results.'	α .69	2.58	.55

T2 responsibility		3	1-4	'I like taking responsibility for a task.'	α .83	2.85	.67
T2 Experience		6	1-4	'It was a lot of fun.'	α .79	3.10	.66
T2 Success		1	1-4	'My challenge was a huge success.'	—	3.26	.91
T2 Overall evaluation	Rürup, 2016	7	1-4	'My challenge was exactly what I had wished for.'	α .84	2.95	.72
T2 Project evaluation	Rürup, 2016	2	1-4	'Overall, I am a fan of the project.'	α .53	3.17	.80
T2 De-schooling experience	Hecht, 2015; Jürgens & Greiling, 2012	10	1-4	'This was very different from school and lessons as I know them.'	α .64	3.07	.48
T2 Attitude changes	Hecht, 2015; Jürgens & Greiling, 2012	4	1-4	Since participating in the *Challenge* '…I find school more interesting.'	α .91	2.07	.82
T2 Usefulness		6	1-4	'The challenge was a waste of time.'	α .71	2.63	.61

Table 1. Overview of the scales used in the questionnaires

7. RESULTS

In order to answer the above research questions of (1) whether students' future time attitudes and consideration of future consequences of current actions affect their learning in the Challenge and (2) whether students with more beneficial views of the future show more benefits regarding tolerance of uncertainty over the course of the Challenge and their evaluation of their learning in the Challenge, we first drew on data from all students who had filled in a questionnaire at timepoint 0 (i.e., more than 6 months prior to departure and before having started preparing the challenge).

7.1 Timepoint 0

At timepoint 0, 6 months prior to starting the challenge, analyses showed a somewhat mixed picture. Students generally expressed a relatively high tolerance of uncertainty (M=2.65 SD=.47) which correlated negatively with students' continued interest (r=-.178 p=.040) and positively with perseverance (r=.248 p=.004). Students high on tolerance of uncertainty also more strongly agreed to hedonistic present time attitudes (r=.360 p<.001) and also more strongly reported considering future consequences of current actions (r=.406 p<.001).
Independent samples t-tests were conducted to compare the scores of students who had expressed a more positive view of their personal future versus those students reporting a more negative view. There were significant differences regarding students' tolerance of uncertainty (positive view: M=2.71 SD=.43; negative view: M=2.24 SD=.59, t(133)=4.03 p<.001), continued interest (positive view: M=3.45 SD=.52; negative view: M=3.81 SD=.54, t(131)=-2.58 p=.011), perseverance (positive view: M=2.78 SD=.46; negative view: M=2.31 SD=.68, t(131)=2.63p=.018), school interest (positive view: M=2.96 SD=.59; negative view: M=2.65 SD=.70, t(133)=2.03 p=.044), hedonistic attitudes (positive view: M=2.89 SD=.44; negative view: M=2.36 SD=.57, t(131)=4.28 p<.001), as well as considerations of future consequences of current actions (positive view: M=2.70 SD=.52; negative view: M=2.34 SD=.72, t(130)=2.46 p=.015). No differences could be identified in students' scepticism regarding the relevance of schooling for their future success.

7.2 Changes in tolerance of uncertainty across the three timepoints

Our research questions focused on how students' future time perspectives and consideration of future consequences of current actions would affect changes in tolerance of uncertainty over the challenge and further outcome variables of participating in the challenge, e.g. experience, success, overall evaluation, project evaluation, de-schooling experience, attitude changes and perceived usefulness of the challenge at timepoint 2.

Correlation analyses of the scales across the different time points revealed that students' perseverance at T0 correlated with school interest (r=.300 p=.004), school achievement (r=.225 p=.003), tolerance of uncertainty (r=.307 p=.003) at T2 and a reported change of attitudes after participating in the challenge (r=.336 p=.005). Nevertheless, no correlations with students' future time perspectives and consideration of future consequences of current actions were found.
One-way repeated measures analyses of variance were conducted to study changes in students' tolerance of uncertainty and school interest across the three timepoints. Regarding tolerance of uncertainty, the analyses showed that there was a significant, large effect ($\eta 2$=.187) for time, Wilk's Lambda=.81, F(2, 50)=5.73, p=.006, with pairwise comparisons revealing a significant decrease of tolerance of uncertainty from T0 (before starting preparing) to T2 (after returning from the Challenge). No significant changes could be identified for students' reported school interest.

7.3 What causes this decrease?

Finding a decrease in students' reported tolerance of uncertainty was quite unexpected, as most schools specifically tie the goal to raise students' ability to deal with uncertainty to the implementation of the "Challenge" project. Therefore, further analyses were conducted to learn more about possible moderators and mediators of this decrease. As discussed above, we expected students' time attitudes or considerations of future consequences to explain some of the changes.
Mixed within-subjects analyses of variance were conducted to assess the impact of students' more or less positive view of their personal future on changes in their tolerance of uncertainty over the three timepoints, but revealed no significant interaction. With regard to students' view of society's future, comparing students with more positive and more negative views, there was no significant interaction between view of the future and time (Wilk's Lambda = .93, F(2, 48)=1.88, p=.164, partial eta squared = .07). There was a substantial main effect for time (Wilk's Lambda = .794, F(2, 48)= 6.22, p=.004., partial eta squared = .206) with both groups showing a reduction of tolerance of uncertainty across the three time periods. The main effect comparing the two views of the future was not significant (F=.043 p=.836, partial eta squared=.001) suggesting no difference in changes of tolerance of uncertainty for the two groups. Furthermore, moderation analyses were also not able to show significant effects of students' fatalistic or hedonistic attitudes, continued interest or perseverance on the changes in students' tolerance of uncertainty.
These findings strongly suggest, that other variables, that are possibly related to the experience during the challenge itself, may have led to a decrease in tolerance of uncertainty. This hypothesis is being supported by a correlation between students' tolerance of uncertainty at T2 and reported change in attitudes after returning from the challenge (r=.241 p<.001). But although students' perceived success of the challenge moderately to highly correlated with most other outcome variables

(experience (r=665 p<.001), overall evaluation (r=.694 p<.001), project evaluation (r=.365 p<.001), de-schooling experience (r=.391 p<.001), and perceived usefulness (r=.505 p<.001), again no relation with tolerance of uncertainty after the challenge or moderation of the change could be found. Small but significant correlations of students' tolerance of uncertainty at T1 and T2 with their self-reported preference for taking responsibility at T1 (r=.282 p<.001) and T2 (r=.213 p<.001) provides suggestions for the focus of future research.

8. WHAT DOES THIS MEAN AND WHAT ARE FUTURE DIRECTIONS?

Finding a decrease of tolerance of uncertainty over the course of the challenge was a quite unexpected finding that contradicts the aims schools hold for the implementation of the Challenge. Given the exploratory nature of this research, which was a first outset to explore this issue, we have a number of possible explanations for these results, that should be investigated more closely in future studies on "Challenges". First, students' reported tolerance of uncertainty may be higher before the challenged because students may not have experienced as fundamental feelings of uncertainty as they would during the challenge. Furthermore, students' sense of uncertainty obviously can be assumed to correlate with students' planning of the project. If they experience that entering a difficult situation, such as the challenge, with little planning, is more likely to go wrong, they may be more inclined to plan more in the future and less motivate to expose themselves to uncertain and ambiguous situations. Students' positive view of the future may entail their rating of how much uncertainty is awaiting them.

There are many open questions in this area that may also be due to the limitations of this study. First and foremost, the self-report measures to capture students' sense of uncertainty and their attitudes and experiences before, during and after the Challenge need to be revised regarding their reliability to capture the concepts in question. Given the correlations of students' sense of ability to deal with uncertainty, we feel that students future time attitudes and consideration of immediate and future consequences, i.e. in how far students take the future into account when making decisions in the present, should also be surveyed when students return from the "Challenge". It may well be, that students report less consideration of future consequences just because their experience during this outdoor adventure project told them, that all plans can be corrupted by all kinds of things ranging from the weather to their project team mates.

It might be worthwhile to include more open-ended modes of data collection to get a more conclusive impression and also understand more about students' sense of ownership of the project.

Another issue is that data collection was organized via schools and may have resulted in a lot of missing data with students not returning to filling in a questionnaire or

skipping one. Furthermore, data on students future time attitudes and consideration of future consequences have only been collected at time point 0, and given the changes in students reported tolerance of uncertainty, students' views of the future may have also changed during the challenge. In the future, it will be useful to look into the role of personal skills that may or may not contribute to students' being tolerant of uncertainty, i.e. taking responsibility, working collaboratively and also independently.

As this is an ongoing project, the authors would like to invite everybody interested in the "Challenge" project idea and research to get in touch with the research team!

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‘PLAYFUL’ QUIZZES IN HISTOLOGY FLIPPED CLASSROOM

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ABSTRACT

The aim of the research was to study the use of quizzes as a tool of flipped classroom on learning histology. Quizzes of the interactive presentation software Mentimeter (Stockholm, Sweden) were used at the beginning and end of histology practical sessions in autumn semester 2020/2021. 70 first year medical students had the possibility individually and voluntary solve the quizzes on four different topics of general histology and at the end of the term they were asked to voluntary feedback how they experienced quizzes.

Comparing the results of the quizzes conducted at the beginning and end of the internships, the scores of quizzes at the end of the practical sessions were 17% higher. Results of the feedback showed that 91% of the students who took quizzes gave feedback stating that the tests are important for getting feedback on both pre-classroom (30%) and classroom (70%) learning. The playful role of quizzes was noted to be important (76,5%). As the results of student’s feedback revealed the importance of quizzes in learning, it can be assumed that further use of quiz tests improves both the level of preparation for contact learning as well as the level of knowledge acquisition during learning.

INTRODUCTION

In recent years number of new teaching strategies which activates the learner prior classes have been introduced at universities (Martín-Blas & Serrano-Fernández, 2009; Yusuf & Al-Banawi, 2013). The reasons of using new teaching strategies in university teaching are mostly connected to the decreased hours of contact learning in classrooms and the need and possibility of using new technologies (Castedo et al., 2019; Bhavsar, 2020). One of the newest teaching strategies is flipped classroom (Fraga & Harmon, 2014; Kurtz et al., 2014; Al-Samarraie et al., 2020). The term ”flipped classroom” means a teaching method in which students first learn about a

new subject at home, especially online, and then have discussions on it in class (Cambridge University Press, 2021) The flipped classroom method has gained importance especially due to the Covid-19 pandemia, where the amount of individual preparation of students has increased drastically in the conditions of distance learning (Dhawan, 2020; Coman et al. 2020). It is reported that flipped classroom designs quite often apply quizzes to support students' learning (Felszeghy et al., 2019).

The FC design usually consists of three phases: the preparation phase before the scheduled class session, practice phase during the class and the phase for after-class follow-ups. In the preparation phase the lecturers create and introduce to the students instructional materials- tutorial videos, chapters of textbooks (Heiner et al., 2014). In order to gain a high learning effect, the materials have to be interactive: quizzes, forums, polls embedded within or required after a videos, allowing the students automated feedback to help them assess their initial understanding (Munyofu et al., 2007). In the contact-learning phase active learning activities that require students to apply the content they reviewed before class, analyze, evaluate, create, synthesize, and make connections to other content areas takes place. Also the learning in smaller subgroups, solving quizzes or polls in larger groups, discussions, presentations, hands-on works are common. In the third phase of the after-class follow-ups students should review, reflect, and act upon the feedback and experiences from the two first phases. The feeback for teachers is also the participation of students in the studies (Agarwal & Bain, 2019). In FC for solving quizzes interactive and game-based Web tools, Kahoot and Mentimeter applications, can be used (Gökbulut, 2020).

Mentimeter is a web-based Clicker, Audience Response System (ARS) or Student Response System (SRS) which allows students to answer digital questions using a mobile device (Mohin et al., 2020). Likewise in Kahoot® (NTNU), in Mentimeter the quizzes can be utilized in a live, class setting in two ways: 1) Questions are projected on a large screen and each student answers the questions on their mobile device. 2) Students view the questions on their own mobile device and submit the answers (Felszeghy et al., 2017). The questions, answers, and feedback from a session can be stored as data, e.g. excel file for further analysis. Mentimeter has been proved to promote student engagement, participation, classroom interaction and inclusion which are the key factors for an effective learning environment. The data can be collected anonymously and they can also be saved for analysis, comparative purposes and educational research (results can be exported, for instance, into Excel format) (Rudolph, 2017).

It has been noted at the univeristies that students often struggle to understand the complexity of the structure and function of tissues histology (Hamilton & Carachi, 2014; Johnson et al., 2015). Histology educators are usually facing the task of teaching a large volume of content in a limited time (Bergman, 2008; Craig et al., 2010). As the student-focused approaches improve learning compared with more traditional educator-centered strategies (Walker & Leary, 2009) educators are interested more often to include active learning techniques to enhance students' interest in histology and help them to appreciate its clinical relevance (Gould et al.,

2008; Felszeghy et al., 2019). Studies suggest that students are more likely to remain engaged in an educational activity if technology is involved. Web-based programs, mobile applications and virtual patient simulations are just a few examples of platforms that can incorporate “gamification” in learning anatomy and histology.
As the contact learning hours have been decreased in recent years also at the University of Tartu and to activate the student’s preparation before class sessions, the FC method was introduced to students at schoolterm 2020/2021. The FC method was used in teaching general histology which is a subject in the basic curriculum of medicine. Human histology is a discipline concerning the study of microscopic structures of human tissues and organs and in traditional teaching histology is composed of two separated components, theory and practice (Xiaoye Lu et al., 2016).
The aim of the the current research was to study the use of quizzes as a tool of the flipped classroom on learning histology.

METHODS

Ethical issues

All students were informed that they participated in the research project, their participation was voluntary. Prior the quizzes students were asked in writing form for consent to participate in the study.

Study design, participants and outcome

The study on quizzes was conducted as a part of a flipped classroom method. Before the practical sessions the students were asked to prepare themselves for the classroom studies by reading the thematical texts from histology textbook, listening to the audiolectures and solving self(control) tests on the University of Tartu’s Moodle histology e-course (”Histoloogia” ARAN.02.005). Histology practical sessions usually consists of the short introduction by a lecturer and microscopy of the histological slices by students. Quizzes were performed during the contact-learning phase weather in the beginning or end of the practical session.
Quizzes of the interactive presentation software Mentimeter (Stockholm, Sweden) were used at the beginning and end of the histology practical sessions in autumn semester 2020/2021. 70 first year medical students had the possibility individually and voluntary solve the quizzes on four topics (epithelial tissues; fibrous-, osseous- and fluid connective tissues) of general histology. The general histology course was worth 4.0 credits consisting 16 lectures and 16 practical sessions (2-h per session) and covered the microscopic principles of the human body, from the organization of its cells through major tissues.

Two of the tests (fluid connective tissue and osseous tissue) were carried out in the beginning of the histology practical sessions and two quizzes were solved at the end of the practical sessions (epithelium and fibrous connective tissue). Each quiz-tests consisted of five short questions on the practical session's topic on which the students could answer using their tablets or mobile phones.
At the end of the autumn term 2020/2021 the students were asked to feedback how they experienced the quizzes, filling in the feedback was voluntary. In the questionnaire students had to answer to the following questions:
- Participation in quiz tests (answer options: always / mostly / sometimes / never)
- Importance of quiz tests – students could mark more than one suitable option (answer options: provide feedback on their pre-classroom learning/ provide feedback on their classroom learning / diversify practical sessions)
- Influence on learning - students could mark more than one suitable option (answer options: the most motivating at the beginning of the internships / the most motivating at the end of the internships).

RESULTS

After each quiz-test the results of the quiz-tests were analyzed. Using quizzes by Mentimeter software, the percentage of correct answers is visible just after every quiz-test.
The answers of the quizzes and to the feedback were analysed separately.

I Results of the quizzes

The medium amount of correct answers of the quiz-tests carried out in the beginning of the practical sessions was 54% and in the end of the practical sessions 71%. Thus, comparing the results of the quizzes conducted at the beginning and end of the internships, the scores of the quizzes at the end of the practical sessions were 17% higher.

Table 1. Results of the quiz-tests

Theme and timing of the quiz-test	**The amount of correct answers (%)**
I Epithelial tissue – in the end of the practical session	65%
II Fluid connective tissue – in the beginning of practical session	58%
III Fibrous connective tissue- in the end of the practical session	78%

IV Osseous tissue- in the beginning of the practical session	51%

II Feedback

The voluntary feedback was asked from the students in the end of the autumn term 2020/2021. From the total 70 students 64 gave their feedback.
The results of the feedback showed that 91% of students who took the quizzes gave feedback stating that the tests are motivating both their pre-classroom and classroom learning. According to the feedback the most important value of the quiz-tests was receiving feedback to the classroom learning (79,7%). Additionally receiving feedback on students' pre-classroom learning (60%) and the playful role of quizzes in diversifying practical studies (76,5%) were considered highly important.

Table 2. Feedback to quizzes

Feedback's question	**Number of students (percentage from total number)**
Participation in all quizzes	55 (85,9%)
Participation in most quizzes	7 (10,9%)
Participation in some quizzes	2 (3,1%)
Never participated in quizzes	0
Importance of receiving feedback on pre-classroom learning	39 (60%)
Importance of receiving feedback on classroom learning	51 (79,7%)
Diversifying practical studies	49 (76,5%)
The test are the most motivating learning when carried out in the beginning of the practical sessions	19 (29,6%)

The test are the most motivating learning when carried out in the end of the practical sessions	45 (70,3%)

DISCUSSION AND CONCLUSIONS

The previous studies have shown that when a large amount of complex information is provided in a short period of time, the lesson material may be partially or entirely forgotten by students (Wheeler et al., 2003). However the amount of information learned during teaching session may be more easily recalled by students if they are quizzed (Felszeghy et al., 2019). Moreover, the learning readiness after gamification has shown to be highly associated with being prepared - the more prepared the students were for their topic, the more accurately and actively they participated. Therefore the theoretical framework is suggesting that educators can consider integrating new digital technologies into curricula (Rinaldi et al., 2012).

The practice-based educational research on the role of quizzes in flipped classroom was carried out at Medical Faculty of Tartu University for the first time. The FC design allows for multiple methods of learning, increases metacognition, and embeds within the course routine many evidence-based teaching strategies (Agarwal & Bain, 2019). In FC the understanding and remembering is aquired before classes and higher cognitive levels of learning is carried out during contact-learning (Lage et al., 2000; Steen-Utheim & Foldnes, 2018). Due to the pre-class activities and preparation for contact learning in FC design, students can take more time for hands-on practice and active learning which is very important in studying histology (Rinaldi et al., 2017). While students benefit from flexible learning environment, the professor can collect important data about the students and their level of understanding of both the current material and prior knowledge (Pakpahan, 2020).

The response of medical students to the gamification shows to be very positive. Students valued the ability of the game shows to engage them, to provide a positive learning environment, to clarify concepts, and to develop clinical thinking (Pettit, 2014).

Although comparing the results of the quizzes conducted at the beginning and end of the internships, the scores of the quizzes at the end of the practical sessions were 17% higher, the results of the student's feedback revealed the importance of the quizzes both in their pre-classroom as well as classroom learning. Therefore it can be assumed that further use of quizzes improves both the level of preparation for contact learning as well as the level of knowledge acquisition during learning.

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DIGITAL POVERTY DURING THE PANDEMIC

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ABSTRACT

Although the world was already at the brink of digitalisation, the COVID-19 pandemic accelerated the process which has increased inequalities in access and quality of education. Digital poverty is one of the inequality problems. While some students have a good chance of benefiting from technology, some education systems have difficulty reaching disadvantaged students. This study discusses digital poverty experienced by students in higher education due to COVID-19. It was conducted with a qualitative method and the data was gathered with semi-structured interviews. According to the results of the study, the subthemes of the perceived concept of digital poverty were access to internet, access to technological devices, digital literacy, and internet infrastructure, conditions of the internet and digital devices. The subthemes related to the problems they experienced during online classes are lack of technological devices, conditions of the technological devices, unstable internet infrastructure, number of siblings and access, home conditions, geographical factors, socioeconomic factors, different ICT backgrounds, motivation, attention, digital literacy, psychological problems during COVID-19 lockdowns and restrictions, attendance, teachers' digital literacy, teachers' instruction methods, limitations in reaching course materials, and communication problems. The subthemes of the problems during assessments are cheating, bad internet infrastructure, and confusions about assessment types. In addition, students generally prefer hybrid education in the future because it is practical.

INTRODUCTION

The COVID-19 pandemic has revealed one of the worst global crisis of our lives so far. Across national borders, the pandemic has affected everyone, regardless of nationality, income, or gender (Schleicher, 2020). Since the World Health Organization announced the Pandemic of the COVID-19, almost all countries around the World have decided to close the schools as a rapid response. School

closure was a big decision for all countries but especially for the under developed or developing countries. Countries were not ready for the possible threats, therefore, the impacts will be seen in quite a near future. Inequality is one of these problems. Although Sustainable Development Goals state that countries should “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” in SDG 4 (UN, 2015), the Covid-19 pandemic has added new discrimination to already existing ones based on “gender, remoteness, wealth, disability, ethnicity, language, migration, displacement, incarceration, sexual orientation, gender identity and expression, religion and other beliefs and attitudes” (UNESDOC, 2020, 1). One of the problems added with the Covid-19 pandemic is digital poverty.

After closing the schools, the countries have taken various types of measures. Some of them send materials to the students via post, some used broadcasting via TV or radio and some used digital platforms. Most of the countries using conventional types of methods had to improve their digital infrastructures. The countries who are lack of sufficient broadband suffered more. Some countries fell behind severely. However, the countries who have sufficient technological infrastructures cannot achieve to reach every student as well. This on-going situation is still affecting millions of students. Countries have attempted to open the schools as quick as possible since the beginning of the pandemic. We still need reliable data to decide how education should be pursued. It is especially important to collect data across the country to identify disadvantaged groups. We need to know the physical conditions of students and teachers about electricity, internet and devices in order to create effective learning. More research is needed on each area to take decisions which should be evidence based. Therefore in this paper I discussed the digital poverty in relation with digital inequalities caused by school closures because of the COVID-19 pandemic.

School closures and digitalization overnight

When the COVID-19 emerged, countries began to produce emergency solutions in the field of education almost overnight to maintain education services mostly with technology. There were some platforms of the countries or big companies and they were used immediately to recover quickly. Some platforms were educational but some are just for gathering people like Zoom and Teams. All these platforms were used together to reach and provide content to the students. This situation put both students and teachers into unexpected difficulties. Students used their own resources like the Internet, television or radio to continue their distance learning. However, students with low achievement found it difficult to acquire new teaching materials at home without teachers’ guidance and support (Hanushek & Woessmann, 2020). Although social media, online networks, and interactive technologies, including the internet, are enabling young people to view themselves and their education as agents of their own learning (OECD, 2019), some students are left behind because of the

digital poverty. Teachers, on the other hand, had to adapt to new pedagogies and teaching methods that they may not have received training (Schleicher, 2020). Lack of access to core digital infrastructure, a quiet place to study, appropriate online course materials, a computer, laptop or tablet and slow or unreliable internet connection (OfS, 2020) have had severe effect on education.

Since the beginning of the use of technology in education due to the pandemic, countries try to take some measures to deal with the problem of inequalities. However, the slowdown in economic growth affects the availability of public funding for education in relation to the spread of the virus and emergency funds are transferred to support increased health and welfare costs (Schleicher, 2020). Schools followed a variety of ways including the use of technology, written materials, and hybrid approaches to sustain education under pandemic conditions. However, the home schooling approach relies heavily on parents' teaching skills and tablet, computer and internet access in terms of using technological solutions. Van de Werfhorst et al. (2020) found that students and schools were not equally ready for online education before pandemic and inequality stems from both ICT resources of the schools and students according to ICILS and TALIS.

The COVID-19 pandemic both increases inequalities and differences in the education systems and adds new challenges to reaching all students. These challenges are particularly relevant to digital inequality. Correspondingly, digital poverty has caused learning loss which may have economic consequences in the future. This loss of learning occurs both as students forgetting their previous learning and reaching less of the learning they have acquired in this process compared to previous years. Turkey is below the OECD average (89% of students have a computer for schoolwork) in PISA 2018 report, with 67% of students saying they have one. A lower percentage of students in the bottom quartile reported having a computer they could use for schoolwork, 36%, than the OECD average of 78%. Also, in cases when home computers might have had to be shared with family members, access to them might have deteriorated with the crisis (OECD, 2020). Immediately after the closure of the schools, Turkey started to use its existing platform EBA both in digital and via television broadcasting for primary and secondary level due to the inequalities in access to the internet and technological devices. On the other hand, for higher education, digital distance education approach was planned based on tablet, computer and internet access. Turkey tried to prevent inequalities that could arise in this period but digital poverty has emerged as an important issue. According to studies conducted during the COVID-19, while some students have a high chance of benefiting from technology, some disadvantaged students have difficulty in accessing digital platforms in Turkey. As there is an insufficient level of digital equipment, skills, and experience, school closures impact socioeconomic inequalities in education (Van de Werfhorst et al, 2020). In another study from Turkey, 55 students stated that they could not communicate at all in the online live lessons, 47 students partially agreed, and 43 students stated that they could fully participate in classes (Kalaç et al., 2020). Another study concluded that the most important problem that arises in the distance education process in Turkey is related

to the physical conditions and the most important problem was the limited working environment (Akbal & Akbal, 2002). The studies in Turkey show that the problems about digital poverty can be various.

What is Digital Poverty?

The concept of digital poverty is also named in literature as digital divide. Digital divide measures "the inequalities in ICT access and in the use of ICT at the household or country levels" (Barrantes, 2007). The term refers to "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities" (OECD, 2001). Mid-90's the term digital divide was started to be used first in America then in Europe for the gap between students from advantaged and disadvantaged households' access to computers and the internet (Van Dijk, 2005). Barrantes (2007) argues that "contrary to the concept of digital divide, the digital poverty concept tries to find the minimum ICT use and consumption levels, as well as the income levels of the population necessary to demand ICT products". In this study, digital poverty is used because this term is also used in the literature and also I believe the word poverty has a strong meaning which may define the situation better. In the rest of the paper digital poverty is used instead of digital divide.
There are numerous dimensions to digital poverty, such as access to computers and the internet, skills and technology usage, and the effect of these factors on outcomes, as well as the inability or unwillingness to adopt advanced technologies (Van de Werfhorst et al., 2020). Digital poverty was not limited to lack of the internet or internet tools but to use them efficiently and safely during Covid-19. Digital poverty includes digital literacy which is defined as "the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life" (UNESCO, 2018). At the beginning of the Pandemic, teachers and students found themselves on digital platforms to continue education but according to studies most of them did not have digital literacy.
Socio-economic status, gender, and ethnicity have all been considered in the study of digital poverty (Rowsell et al., 2017). Various resources are less accessible to poor and minority families among society. Therefore, it is not surprising to find that the same pattern of development exists within the emerging digital infrastructure found in computers connected to the Internet at home, school, and the workplace (Natriello, 2001). Attewell (2001) discussed digital poverty under the headings of access and computer use. According to Attewell, digital poverty is being addressed as part of new policies that tackle social exclusion and inequality from a technology-based standpoint, while at the same time, taking into account the broader educational needs as well as economic problems of the poor. Policies making use of technology tend to assume access is the primary barrier. It is understandable that the focus is on

putting computers on every desk, but even then, social disparities would persist. A child with a lot of social and cultural capital will be capable of excelling in this new skill area (Attewell, 2001).
In order to access and use the Internet, basic telecommunications infrastructure that is needed to provide Internet access varies among countries and within them (OECD, 2001). The world's 3G network covered 93.1% of its area as of 2020. In Asia and the Pacific, the 3G coverage rate is 96.1%, while in Africa, the rate is 77.4%. In developing countries, there are 3.6 billion people who are unable to use the internet. Central Asia has the highest rate of access at 76.4%, while Africa has the lowest rate at 14.3% (Ingram, 2021). In recent years, internet usage has risen dramatically, but the rate is highly variable. Ingram cites 20 percent and 19 percent access rates for South Asia and sub-Saharan Africa, respectively (Ingram, 2021). A lot of people still do not have access to the Internet, even in wealthy countries like the UK (Allmann, 2020). The world is going through Fourth Industrial Revolution which was accelerated by COVID-19 with digital innovations such as use of data, information, and technology affecting communication, workplaces, and education by moving to virtual engagement. One of the disadvantages of a digital World is digital poverty during COVID-19 because in terms of computer skills and internet access those without fall behind (Ingram, 2021). Digital poverty remains a significant barrier to equitable access to 21st-century learning and services.

METHOD

This study embraces qualitative research method to have an insight about the problems related to digital poverty perceived by the higher education students. It is a descriptive study which used case study pattern. Case study was used to understand the situation about digital poverty during the pandemic which is a unique case.

Study Group

The sample for semi-structured interviews consisted of 8 prospective teachers from Education Faculty who had online education during the COVID-19. These students were selected with convenient and snowball sampling methods on voluntary basis.

Data collection

In this study, semi structured interviews were performed with university students via Zoom. Most of the data was collected during the online classes due to the Pandemic restrictions but one of the student was interviewed when the face to face classes started in order to enrich the selection criteria. That student could not reach any classes online during pandemic. Main themes addressed in this study were (1) The perceived concept of digital poverty (2) Difficulties during the online course (lack

of access to core digital infrastructure, slow or unreliable internet connection lack of access to a quiet study space, lack of access to appropriate online course materials, and lack of access to a computer, laptop). (3) Problems they have during the evaluation processes. (4) Their preferences (Online courses, face to face, hybrid courses)

Data Analysis

Qualitative content analysis method by following data analysis steps of Creswell (2009) was used to analyse the data. The interviews were recorded during Zoom meetings and then transcribed. They were read through several times. As the language used in the interviews was Turkish, the transcription was translated into English by the author who is an English teacher. The deductive and inductive data analysis approaches were applied to the data. Main themes were defined before and subthemes were identified according to the data itself with the concepts that emerged during the analysis process. The data was interpreted and reported by giving excerpts from the interviews. For comments and citations, the prospective teachers were coded with the initial P (Prospective teacher), and each student was randomly numbered as P1, P2, and so on to protect the participants' identities.

FINDINGS AND DISCUSSION

According to the results of the data provided by the interviews, there were main themes related to the research questions. After analysing each main theme, various subthemes were determined and supported with the excerpts from the interviews to discuss the findings. The main themes are (1) The perceived concept of digital poverty (2) Difficulties during the online course (3) Problems they have during the evaluation processes (4) Their preferences (Online courses, face to face, hybrid courses).

The perceived concept of digital poverty

The first theme is *the perceived concept of digital poverty*. The research question about the concept of digital poverty was asked to students in order to understand whether the prospective teachers were familiar with the term digital poverty and what they thought about it. Most of the students were aware of the concept and they defined it with its different dimensions. The subthemes of *the perceived concept of digital poverty* were *access to internet, access to technological devices, digital literacy, and internet infrastructure, conditions of the internet and digital devices*.
One of the prospective teachers mentioned about the access to the internet and technological devices and compared the different conditions of the devices people can access. «It may be lack of the access to the resources digitally. I guess everyone

has a tablet, a phone, but is there anyone who doesn't? There may be a lack of access to resources such as computers and phones. There may be no electricity or internet connection. There may be places where the phone is out of reach. For example, in our village. Also, the quality of the tools you use. Not everyone's phone is the same, or their computer is under the same conditions, or they don't even have a computer. While one's phone is in the latest model, it allows all kinds of applications, the other can only be an old technology phone, only for talking and texting. Or lower version phones cannot use every application. Even if the internet is connected, she cannot communicate as she wishes in every application or cannot do what she wants to do» (P5). According to this student, it is not only always about the access but also the quality of the access may also be a problem. This dimension of the problem is not generally discussed in the literature. Access may mean something totally different from lack of the devices and it may also be about the conditions of the devices. Technological devices are out of date quickly due to the fast changing and developing technology recently.

Another prospective student underlined the conditions of the family and emphasize the importance of the number of the siblings and number of the devices which cause problems if they need the device at the same time and cannot afford to buy a new one. «It may mean that the student does not have an access or it may not be enough. There is a family with 3 children, there is one computer at home. Each child must use it at the same time. It can be such a problem. You may not have financial sources to buy more. It might be about where you live. Some do not have telecommunication connections in remote places» (P6). Although people from low socioeconomic level should have been supported with technological devices and internet connection for education due to swift change into digitalisation, many people tried to solve their problems by themselves. Most of the students were aware of the inequalities in accessing internet and devices. «I think that not everyone has access to a computer, phone or internet. Not only a computer or phone but also they may not have internet… Let's say you have devices and infrastructure, you pay for the Internet. There are those who cannot not pay for the internet. I can't say anything because I've never paid the internet bill my father does, but in Turkey, there are people who can't access them» (P4). Another student mentioned about his situation to explain digital poverty. «I have 3 siblings younger than me. All three of them could not access anything during the pandemic due to the lack of technological devices. They are at secondary school. They watched EBA on TV (The National education Ministry education platform. There was not much on EBA. They were not very productive. They applied for getting free tablets to the ministry (government provided people who have not access to devices), they could not get it. That's why they could only study from what they see on EBA and from extra books» (P8).

Some students were expecting everybody has an access to internet and technological devices but when digitalisation started overnight they realized there were some people who might not have this basic devices. «The rate of those who have internet is below than what I expected. I thought more people could access it. We look at it this way, as if there is only Europe, there is America, but there is also Africa, we do

not think about it much» (P3). Socio-economical dimension of digital poverty was underlined by most of the students. They believe that this problem is mainly about the economy of the family or the country itself. They could not afford to buy new devices or pay for the internet. The numbers about access to the internet show consistency with the students views for example, Globally, only 53.6% of the population was online in 2019, and only 19.1% in underdeveloped countries (ITU, 2019). The number of the siblings make the scenario the worst because everybody was at home at the same time and the number of the devices and the broadband width were the dimensions of digital poverty during the Pandemic.

The problems they faced with their online classes during COVID-19

The subthemes related to the problems they experienced during online classes are *lack of technological devices, conditions of the technological devices, unstable internet infrastructure, number of siblings and access, home conditions, geographical factors, socioeconomic factors, different ICT backgrounds, motivation, attention, digital literacy, psychological problems during COVID-19 lockdowns and restrictions, attendance, teachers' digital literacy, teachers' instruction methods, limitations in reaching course materials, and communication problems*.

One of the students could not access any classes due to socio-economic problems of his family also he mentioned about the geographical disadvantages he experienced «I had to work due to financial difficulties. I did not have any device to take classes. That's why, I wasn't able to attend any classes. I'm taking all classes again this year. I live in Van, but I went to other cities to work. I was working as a construction worker as a labourer. I had a mobile phone at that time, but we had internet problems where we worked. We were in Bafra district of Samsun. We were working in an organized industrial zone at the top of the mountain. In other words, there was a lot of network shortage, there was no internet, and we couldn't talk even on the phone properly. We had to go down to the city centre to use our phone. This means that we were going downtown to meet the needs maybe once a month» (P8). One of the prospective teachers mentioned about the school differences. Where she had her education before university, the infrastructure was not sufficient. She said she did not learn how to use technological devices and mentioned about lack of digital literacy. «I went to primary and secondary school in the village until 7th grade. I attended high school in the city centre but the school I studied was also insufficient in infrastructure. It was a small school. I didn't know about things like using screen sharing. None of our teachers showed it in the class. We had an ICT class, but they never showed such things. We didn't learn at least such as screen sharing, Word and Excel. It was very hard. Some of my friends did not have difficulties. I can say that I am trying to adapt» (P1). This student is aware of the situation that that it is not their fault not having digital literacy. Although they have ICT classes at high school, they mentioned about the quality of these classes and they said they were not sufficient to follow the classes online. Another student mentioned about her mother

who is a teacher. «My mother is a teacher, I have a lot of trouble. For example, she did not know how to use Excel at first. I showed it. Then there was Zoom, I showed it, too. Even if you have the opportunity, even if you have a computer, it may be that you do not know how to do certain things» (P4).
Another prospective teacher explained the problems she had with her computer. She did not have suitable technological devices to follow the classes or they were in bad conditions. Because of that she failed her classes during the Pandemic. «My computer is broken. Screen brightness goes down. I'm trying to do homework and my computer's keyboard doesn't work, either. I am using a Bluetooth keyboard. I am very angry about this. I try to connect it to my computer but it takes two hours. It was disconnected the other day and I couldn't connect it again. The screen brightness is constantly decreasing and I can't see it, for example, I can't do my homework. I have to do it at night. Sometimes the screen brightness is not a problem at all. When I wrote my assignments, I connected the keyboard to the tablet and wrote in Google documents on the tablet because I could not write in Word. Then I could convert google documents to Word file from the tablet. It has such a feature. Then I sent my own email. I turned to the computer and opened the same file from the computer» (P2). This student suffered from problems of her computer and found some solutions on her own. This must be a stressful situation because wasting time on technical problems and also the pressure of the Pandemic restrictions could be overwhelming. The sudden shift to online education put almost every student into these kind of difficult situations and they tried to solve their problems on their own. Gundogan (2022) examined whether school burnout, depression, and subjective well-being directly or indirectly correlate with COVID-19 student stress. According to the results of this study, stress experienced by the students during the COVID-19 pandemic may be a reason for future depression. Almost all of the students experienced that kind of stress because of the internet connection and the devices they used. «At the beginning, I didn't have a computer, my phone had a bad battery, and it was constantly shutting down. I could not attend the classes. Basically, I was supposed to present an assignment, but my phone was turned off, I couldn't connect again, and I failed. My parents tried to help as much as they could, but everyone's financial situation is not good. I have a sibling. We changed my phone. I could see clearly on the phone but using Word and Excel files were very difficult. Then we bought a computer. I am very relaxed this year. In terms of Word files, I wasn't very good at digital literacy, but I watch videos. Frankly, I am trying to improve myself, such as how you can make a table in Word and how you can do it in Excel. Because homework is always done in Word files, I need to be proficient in this subject, I need to know how to use it, and so I work on these subjects. I do not have a problem with the internet infrastructure, I live in the city centre» (P3).
Absenteeism was another problem during the Pandemic. Most of the time it was because of the access but some students emphasized the attention and motivation problems because of the long hours they spend in front of the devices. There was too much stress and she said she gave up at some point. «It (Online class) is like TV is on. You can put it aside and deal with other things. I can't listen. Even if I join the

lesson, I listen to (the recordings) when I study for the exam. It is a waste of time. Why am I joining the classes if I can't listen?» (P6). Another student did not know the attendance was not checked by the lecturers during online classes and failed because of absenteeism. «Last year, after a certain period of time, I stopped attending all classes, my absenteeism increased» (P5). Another student tried to follow the classes but most of the students were not attending the classes. «I attend classes. Very few people attend our classes. I'm trying to join. I have a sleeping problem, but I feel bad for the teachers. On the one hand, they are recording. I say I can watch the recording later. 6 people attend the 80-person class» (P4). In addition, the students were distracted because of the COVID-19 restrictions and also the conditions of the house. «It was unbelievably bad at the beginning. The first week was good, but we lost the focus definitely when we stayed at home all the time. We were bored, we were depressed, our psychology could not handle it, and I wanted to go out all the time. Everyone wanted to go out. That's why it's very tiring psychologically» (P5). During our interview the internet was not stable. We had a conversation like this.
«My internet has gone. Let me switch to my mobile phone. This is a problem right now, this is exactly the issue we are mentioning. I am experiencing this situation. I'm on my phone now. One second, I can't connect with my phone right now» (P5).
«We can go on until it goes» (Interviewer).
«Is it fixed now? »
«Yes, we can go on» (Interviewer).
«During the lesson, the internet (wifi) goes like this, I can't connect to my own internet all the time. My own internet is also gone. When I ask a question to the teachers, my voice goes out in the middle of the conversation, the image goes, and someone else forgets his camera on and we see him. We have a lot of trouble asking questions to the teacher, for example, we ask questions, communication is late, the distance between us prevents our questions» (P5). Besides other problems, students experienced issues about internet infrastructure. When the internet is not stable, it is quite distractive and not easy to motivate yourself to follow the classes.
In addition, the teachers of some high-income countries have low levels of digital competency, and it is even worse in most low-income countries which limits the pedagogical performance of the teachers so professional development support on digital skills is needed by many teachers (McAleavy & Gorgen, 2020). They experienced problems related to teachers' digital literacy. «The teachers had difficulties, but they overcame them. I think they're pretty good at screen sharing or sending files right now. You expect something from the teacher or you will do something, you do not know how to send it, you do not know how to upload the file, but we got used to these and it was good in terms of lessons. I don't think there is much that teachers can do either. How much they can do if no one turn on their camera? The teachers want to see us, but when they ask they do not get any response from the students, then they read the slides. What can they do? They share their own experiences and knowledge to make the subject a little more understandable, I think there is not much that both sides can do» (P3).

The problems they faced with assessment of online classes during COVID- 19

The problems about the assessments was worldwide during COVID-19 restrictions. Many large scale assessments were cancelled or conducted online. Online assessments were being discussed because people who conducted and performed assessment both were not familiar with the platforms. The subthemes of the problems during assessments are *cheating*, *bad internet infrastructure, and confusions about assessment types*. One of the students stated that the teachers were worried about students' cheating and tried to take measures about it because of that students experienced some problems. «I studied Physics lesson, I studied a lot, but I have a hard time reading the text during the exam, I need to think again in order to understand. The teacher gave 30 minutes for 20 questions. Some people can understand right away, but I have a bit of a hard time. This may be due to the school I came from or some other things» (P1). The student took the responsibility about the measures teacher took such as time limitations but it affected the exam result severely. Many students had to rely on their mobile phones during online assessments. However, on a smartphone, it is not feasible to complete most of the school work such as essays, longer stories, and science lab reports. Accordingly, statistics on the digital divide do not take the needs of young people into account. Rubinstein- Ávila and Sartori (2016) develop a finding that points to the negative relationship between mobile phone use and educational attainment.
When teachers preferred formative assessment students felt that their workload increased, as they had several assignments, but it wasn't as troublesome as high-stakes summative exams, where cheating was more likely (Meccawy et al., 2021). Adapting digital exams and assessments to meet the needs of the digital age will be one challenge (Reedy et al, 2021). One of the students mentioned about the difficulties the teachers had during the assessments. «I think that they were also confused. They also did not know what to do. Somehow, a grade should be given and this grade must be fair. Not all of them were bad, of course, we made presentations in some of the classes, and you are graded according to your presentation. During online assessments, the internet suddenly goes off, for example, we are in question 32, I am texting to the teacher. The teacher becomes offline, although she says before the exam, write to me about the problems during the exam» (P2). Students felt left alone during the assessments.

Online? Face to face? Hybrid?

In terms of future scenarios, students prefer hybrid education since some of the online classes have been beneficial to them, but they think that practice-based classes cannot be implemented online. «Numerical lessons should never be online, I cannot understand some lessons well enough, such as physics, and chemistry should not be online. Apart from that, I understood the sociology of education and psychology of

education very well... There is a Turkish language course, for example, it can be online but English should not be online» (P7). Another student emphasized the importance of peer learning and school climate during face to face cases. «We can take the advantage of the courses digitally, but there is no interaction. When you are face to face, you can ask a question, for example, you can ask your friends about something you do not understand. We do not have this opportunity in digital. It is necessary to experience the lesson in every sense, the classroom environment is shaped according to it, and even your behaviour is shaped accordingly. I can turn off the sound and do what I want at home but there is a discipline and order at school. There are rules to be followed, and in this respect, I prefer face-to-face more» (P3). Another student emphasized practicality of online classes. «I want to go to school, it must be face to face but I prefer to take some classes online. It's good that we're talking online right now. For example, I have a class in half an hour and I will join the class with one click » (P2). Another student who could not have access during the Pandemic mentioned about cultural difference and why his parents do not understand classes on digital platforms. «I think it should all be face to face because we know the differences and inequalities in education. If it is not face to face, the east part of Turkey, I mean in our region, for example, they think if you're not in school, that is, if you don't actually go to school, there is no school. If you join the online lesson, it does not seem realistic to them. In our village, you go to your room and open a book and study but if you try to study on your phone, it is not studying» (P2). This student's comments on his situation may be explained by Bourdieu's cultural and social capital concept. The family do not have understanding of digitalism because they do not have access to the internet so they cannot help their children with their education. Family support was so important during the pandemic but many students could not get that support from their families and also their peers and teachers.

CONCLUSION AND RECOMMENDATIONS

Countries can only deal with COVID-19 with strong policies and flexible solutions. In this transition period, we should detect the problems we will face in the future. One of the difficulties we faced was digitalisation of education. In this study, I tried to analyse the problems in regard with digital poverty. As a result of this study, we can conclude that students realized what digital poverty was by experiencing it for a very long time. According to the study, students' digital poverty may stem from various reasons such as access to the internet and technological devices. Besides they know that although they have the necessary devices, they may suffer from digital illiteracy. They mentioned about the problems they had during the pandemic, therefore it can be concluded that they thought the problems were their own and they were not aware that they should have been supported during that period. Especially, it was more common for students with low SES to worry about falling behind in

school and their future. In addition, students with low SES generally had less confidence in their ability to handle schoolwork alone, and they were less prepared to deal with school closures (Meinck et al., 2022).

Although the economic impact of the covid-19 cannot be measured numerically, it may appear as a problem of the coming years in terms of the labour force grown in this period. Therefore, improving students' cognitive skills in this process will be the determinant of economic growth and long-term well-being of society (Hanushek & Woessmann, 2020). In this context, it is important that education should not be interrupted. Higher education understood that digital platforms provide flexibility so in the future they will be a significant component of education. However, if they cannot provide high-quality digital instruction with curricular and co-curricular policies, they will have greater problems (de los Santos & Rosser, 2021). The governments should take some measures such as investing in digital platforms, provide digital professional development trainings to empower their staff, adapting policies to reduce inequalities among students, cooperating with other countries, organisations and big technology companies and also using technology effectively to reach the students (Van der Vlies, 2020) in order to come over the inequality issues in digitalization. Leadership at universities must embrace a digital culture of equitable access to learning and the institutions that serve the most disadvantaged students need equitable access, practices, and investment to achieve equitable outcomes for all students (de los Santos & Rosser, 2021).

This study is limited with the students interviewed but future studies can be conducted cross-culturally to get an insight on differences and similarities.

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ANALYSIS OF LEARNING MOTIVATIONS AND CONSIDERATION OF APPROPRIATE INTERVENTIONS FOR ONLINE STUDENTS

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ABSTRACT

In the age of 100 years of life, providing working adults with the opportunity to study at an online university will play a role in facilitating continuous learning, job changes, promotions, and switching/starting a new stage of life. It is also true that there is a growing need for online education, especially after the new Coronavirus (COVID-19) pandemic. In an online university environment, continued motivation is the key to success. It is found that online students are more intrinsically motivated than regular college students who take face-to-face classes on campus, they are less motivated to make new friends, and the earlier they start learning, the more successful they will be. Therefore, the first week of each quarter is an important time to start learning, and faculty and staff intervention for students who are falling behind early can be effective. In order to increase the success rate, student support needs to be aligned with the type of student. Based on self-determination theory, it is found that students can be categorized into three clusters according to their motivation type. While the group of students who are highly motivated to learn and intrinsically motivated need less support, there is still much work to be done on appropriate interventions for students who are unmotivated and have low motivation to learn.

INTRODUCTION

Online learning environments have been used for quite a while. Before COVID-19, re-learning, 100-year life (Gratton & Scott, 2016), and lifelong learning all took place in online learning environments (Dumford & Miller, 2018). However, COVID-19 dramatically changed learning environments across the world as in-

person and face-to-face classes were suddenly forced to switch to online video conferencing (Pokhrel & Chhetri, 2021).

Under these circumstances, online learning could be a key factor in accommodating 100-year lifespans as it enables people to learn anywhere at any time. While the online learning environment has significantly developed due to the Covid-19 pandemic, one of the biggest issues has been the maintenance of the motivation to continuously learn (Chiu et al., 2021).

This paper describes a questionnaire survey and its analysis of the types of learning motivation of online university students. In addition, the learning process of online university students will be analyzed to identify the most appropriate learning interventions to maintain their learning motivation.

LITERATURE REVIEW

Even before COVID-19, higher education online learning environments were being employed in areas such as lifelong learning and industry digital transformation learning. To live a fruitful 100-year life, learning is a key to success, with online learning environments being essential for job switching and many occupations (Gratton & Scott, 2016).

COVID-19, however, changed the online learning environment significantly as all universities, K-12 schools, and corporate training organizations had to change their class delivery systems from face-face to online. Working styles were also forced to change as people moved from traditional office-based work to telework at home (Pokhrel & Chhetri, 2021).

A survey on the lifestyle of university students in Japan in March 2021 (MOEJ, 2021) explored the pros and cons of online classes. The main advantages of online classes were found to be being able to study anywhere at their own pace, and the disadvantages were identified as feeling lonely, having a lower motivation to learn, too much homework, and information technology (IT) related problems.

Lowman et al. (2021) conducted a large survey in an American university and identified four factors that needed to be considered when conducting online classes during COVID-19:

- **Lost interactions**, that is students have fewer opportunities to interact with peers or faculty in either the learning or extracurricular settings;
- **Motivation**, which is related to the need for students to have a better perception of their ability to learn and/or focus during the online instruction and online interactions;

- **Instructional support**, which was related to the students' beliefs in and need for responsiveness and communication from instructors and overall support; and,
- **Access to technology**, which was related to the students' ability to remotely access library resources and technology services.

The higher online learning dropout rate has been one of the biggest problems. Therefore, reducing this dropout rate has been an especially important focus for online universities. It has been found that around 60% of online students drop out; however, of those who continued until the final examination, most passed their courses (Simpson, 2006). It has been also found that 45% to 85% drop out and the graduation rate is 22% in UK Open University (Xavier & Meneses, 2020). Another article found that 40% of students dropped out of e-learning classes in favor of attending face-to-face. Typical dropouts had rushed or intensive learning styles; however, the dropout rate was lower in students who studied regularly and consistently (Nodera & Nakamura, 2016). Although massive open online courses (MOOCs) do not constitute formal education, they are globally popular, and many people have taken at least one course; however, it was reported that around 89% of MOOC students drop out (MOOCs@Edinburgh Group, 2013).

Self-determination theory states that there are four types of extrinsic motivation: external regulation, introjection, identification, and integration. External regulation is similar to amotivation, that is, behaviors are performed to satisfy external demands. Introjection is a type of internal regulation that is still quite controlling as people perform the required action under pressure to avoid guilt or anxiety or to attain ego-enhancements or pride. Identification is a more autonomous or self-determined form of extrinsic motivation, where the person has identified the personal importance of the behavior and has accepted the need for (personal) regulation. Integrated regulation is the most autonomous extrinsic motivation, which occurs when the identified regulations have been fully assimilated in the self (Ryan and Deci 2000).

RESEARCH QUESTIONS

This study was driven by an overall research focus on the role of motivation in enhancing online learning, and the specific research questions are as follows.

1. What kind of motivation can improve student learning?
2. Can motivation improve student learning outcomes without dropouts?
3. If students know their motivation type, can they improve their learning and better manage their activities? and,
4. What interventions by instructors and academic staff can be effective/appropriate in ensuring that the students continue to learn?

ONLINE UNIVERSITY

In order to solve these research questions, I conducted a questionnaire at the Tokyo Online University (TOU). Although I teach classes as a full-time faculty member at the TOU, I informed the entire university and invited participants. Here is an overview of TOU and its learning environments.

TOU was established in April 2018 and is currently in its fourth year of operations. TOU has two faculties: information and management, and human welfare. Each year, around 600 students enroll in each of these faculties, both of which offer online bachelor's degrees with some in-person practical elective courses. Around 80% of the students have full-time jobs and a small number attend TOU directly after high school. The students' ages range from 18 to 80 years old and they reside all over Japan and even abroad. Although the university accepts foreigners, all classes are conducted entirely in Japanese. In May 2021, there were about 4,000 students enrolled, with students in their 20s, 30s, and 40s accounting for around 75 %. The average age is around 35 years old.

The TOU classes are briefly explained in the following. Figure 1 shows that one class unit consists of four 15-minute asynchronous video sessions, preparation and review study, and one quiz session; therefore, one class unit is 90 minutes in total. Some classes feature online discussions or report assignments rather than a quiz, and most classes are delivered on-demand.

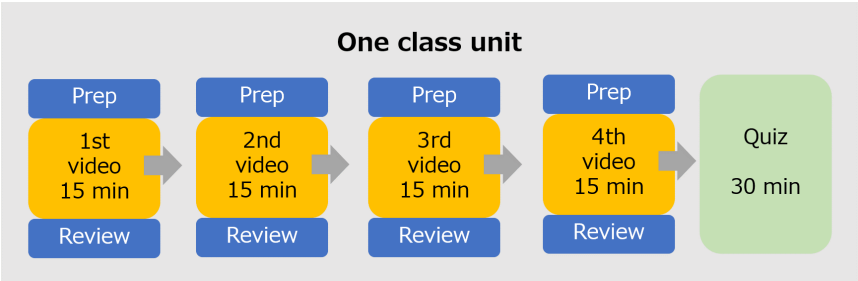

Figure 1. The structure of a class

Figure 2 shows the structure of one credit unit, which consists of eight class units, online discussions, a report assignment, and a final examination. TOU uses an academic quarter system and most courses open twice a year. The Japanese credit system is different from the European system. In Japan, a bachelor's degree requires 124 credits over four years of study, with each credit involving around 45 hours of study. One Japanese credit is equivalent to 1.5 ECTS (European Credit Transfer System), and most students take from 30 to 40 credits a year.

Figure 3 shows the special class delivery pattern for a mandatory freshmen course in the first term, 2021. While students can take every class from the first week of the

first term, the usual delivery period differs from this pattern. This pattern applies only to this course, which was analyzed in this study for student learning progress and the support provided by instructors. This is an omnibus course, with the order of the classes being independent of each other. One term is eight class delivery weeks and one week for the final examination; however, TOU students can take the online final exam at any time during the exam period.

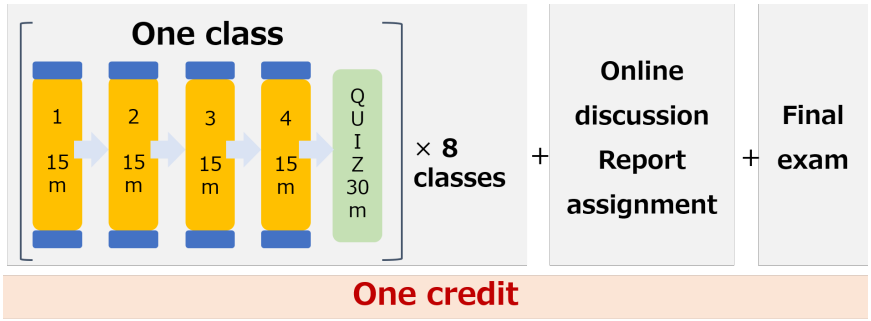

Figure 2. Structure of one credit unit

	1st quarter, 2021								
	1W	2W	3W	4W	5W	6W	7W	8W	9W
1	8/Apr~28/Apr								
2	8/Apr~28/Apr								
3	8/Apr ~5/May								
4	8/Apr ~5/May								
5	8/Apr ~12/May								
6	8/Apr ~19/May								
7	10/Apr ~26/May								
8	10/Apr ~2/June								
Final exam									29/May-7/Jun

Figure 3. Special class delivery pattern

LEARNING MOTIVATION SURVEY

A web-based learning motivation survey was conducted using Google Forms at the end of the Japanese academic year in March 2021 on 89 first- to third-year TOU student volunteers. The survey had 76 questions, all of which were based on previous motivation research, and was mainly divided into two parts; Survey I, which was designed based on self-determination theory; and Survey II, which was focused on topic-oriented motive classifications, the details for which are given in the following. The request for survey cooperation was posted on the portal site announcement of TOU, and the announcement duration was two weeks. Student volunteers were required to answer both Survey I and II.

Survey I comprised thirty-four learning motivations based on previous research (Okada & Nakaya, 2006). For factor analysis, the python module of sklearn and the ProMax rotation were used. For the clustering analysis, the hierarchical cluster function of python's scipy module was used.

Besides, Survey II comprised twenty-five learning motivations based on the previous research (Asano, 2002).

The question was: "Does this statement give you a reason to keep learning?"

Finally, the remaining seventeen questions were related to student life in general and to the experiences of the TOU learning system as well as student preferences for motivational interventions.

RESULTS

Results of Survey I

The top four reasons for learning in 34, with the highest and lowest average values are shown below, all of which were scored on a Likert scale from 1: strongly disagree to 5: strongly agree.

4.39: I want to do it.
4.20: It's fun to get knowledge and ability.
4.19: I will increase my own ability.
4.00: It's useful for many things in the future.

1.36: My parents, family, boss, and coworkers are too noisy.
1.35: I don't want to make my parents, family, bosses, coworkers sad.
1.20: I'm being forced to do it.
1.19: Everyone around me is telling me to do it.

In reference to previous motivation research (Okada & Nakaya, 2006) that identified four main motivations; IN (Intrinsic Motivation), ID (Identification), IJ

(Introjection), and EX (External Motivation); so the thirty-three questions were categorized into 4 factors:

Factor 1 comprising IN and ID;
Factor 2 comprising ID, IJ, and EX;
Factor 3 comprising IJ and EX;
Factor 4 comprising EX.

One reason was omitted because no factor was significant.

After clustering analysis, three clusters were found, named high motivation, intrinsic motivation, and low motivation, which included 45%, 47%, and 8% of participants, respectively (Figure 4).

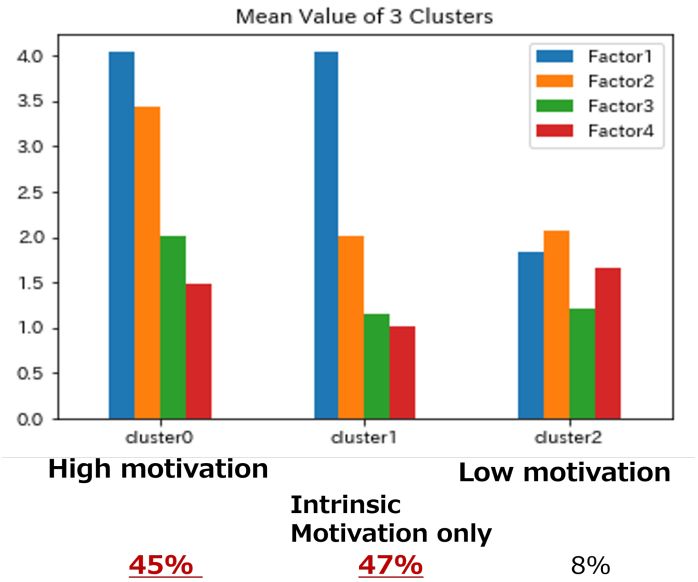

Figure 4. Mean value for each factor, based on the three clusters

Results of Survey II

The top four reasons for learning in 25, with the highest and lowest average values are shown below, all of which were scored on a Likert scale from 1: strongly disagree to 5: strongly agree.

3.40: I want to expand my range.
3.39: I want to broaden my horizons.
3.38: I want to improve myself.
3.34: I want to learn about a field that interests me.

2.11: It enriches my relationships with others.
2.10: It's a great way to mingle with a lot of people.
2.00: I can meet a lot of people.
1.83: I can make new friends.

The previous research (Asano, 2002) showed five factors, named SI (self-improvement oriented), EP (experience-oriented), FR (friend-oriented), PR (Profession oriented), and ST (specific topic-oriented).
For the factor analysis of this survey, twenty-three reasons were categorized into five factors:

Factor 1 comprising SI and EP;
Factor 2 comprising EP, ST, and PR;
Factor 3 comprising FR;
Factor 4 comprising ST;
Factor 5 comprising PR.

Two reasons were omitted because no factors were significant.

Table 1. Learning motivation (Survey II)

Motivation type	Regular College	Open University Japan (OUJ)	Tokyo Online University (TOU)
Friend (FR)	2.55	2.28	**2.03**
Self-improvement (SI)	3.27	3.42	3.30
Experience (EP)	2.76	2.76	**2.84**
Profession (PR)	2.93	2.82	2.80
Specific Topic (ST)	3.08	3.44	3.26

Table 1 compares the survey results with the previous study (Asano 2002). The results for regular colleges and OUJ are the data presented in the previous research. Survey II was conducted using the same questions, survey method, and analysis method as in the previous study. The regular colleges offer face-to-face classes, however, the OUJ is a distance learning university that uses satellite television broadcasting, and the average age of its students is nearly 60 years old due to the large number of retirees. The comparison of the three university types found that while the TOU students were less friend-oriented than the other universities, they had the highest experience orientation.

Other Results

Table 2 shows the results and comparisons with previous studies for the learning volitions. It shows the average values of Likert scale from 1: strongly disagree, to 5: strongly agree. Examples of the active involvement questions were; “I think I am highly motivated to learn,” “I think I am a proactive learner,” and “I like to study and learn.” Examples of the will to continue to learn questions were: “I want to continue learning for as long as possible” and “I have a constant desire to learn.” (Asano, 2002). The online students from TOU and OUJ were found to have higher volitions than the regular college students.

Table 2. Learning volition

Volition type	Regula college	OUJ	TOU
Active involvement in learning	2.40	3.00	**3.04**
A will to continue to learn	2.61	**3.32**	3.30

Table 3. Interventions

What interventions enhance motivation?	**Average (1 to 5)**
Current delivery period enhances motivation?	2.94
Academic advisors’ messages enhance motivation?	2.81
Messages from teachers or teaching assistants enhance motivation?	3.27
Teachers’ replies enhance motivation?	3.30
Progress map for how taking classes enhances motivation?	**3.50**

Table 3 shows the results of the questionnaire on student preferences for motivational interventions. The student progress map was the highest score. Figure 5 shows the student progress map, which is not a system that is already in place, but was given to the students as a sample of the question, "What would you think if you had a map like this?” As 124 credits are required for graduation, the image, which is of a building on the main TOU campus, is divided into 124 parts. When a student passes a required course, the image changes from the course name to a background image. The colored tiles are the required subjects, the white tiles are the elective subjects, and the colors indicate the subject categories.

Figure 5. Student progress map

LEARNING PROGRESS

The above surveys were the results of questionnaire surveys conducted by volunteers, from the first to the third year students. In this chapter, the trends in the learning process of all students in the first year were analyzed. The reason for this is that by analyzing the learning progress of all first-year students, I want to determine when and to what extent we should intervene in the students' learning process and consider actions based on the students' motivation type.

Figure 6 shows the relationship between the start date of the first class and the final graded score for the mandatory first-year course taken by 1086 first-year students in the first quarter of 2021, the values for which ranged from 0 to 100. The horizontal red line shows the mean score of 60, which is a borderline pass, the vertical thin red line indicates delayed attendance, and the right of the red line indicates the students that were late to the first class.

Table 4 shows the results. Of the students who completed the first class on the first day of the delivery period, 90% passed, of the students who completed the first class in the first week excluding the first day, 83% passed, of the students who completed the first class in the second week, 72% passed, of the students who completed the first class in the third week, 57% passed, and of the students who completed the first class in the fourth week, 38% passed. Overall, the average pass rate was 74%.

These results indicated that the earlier a student completed the first class, the higher the pass rate.

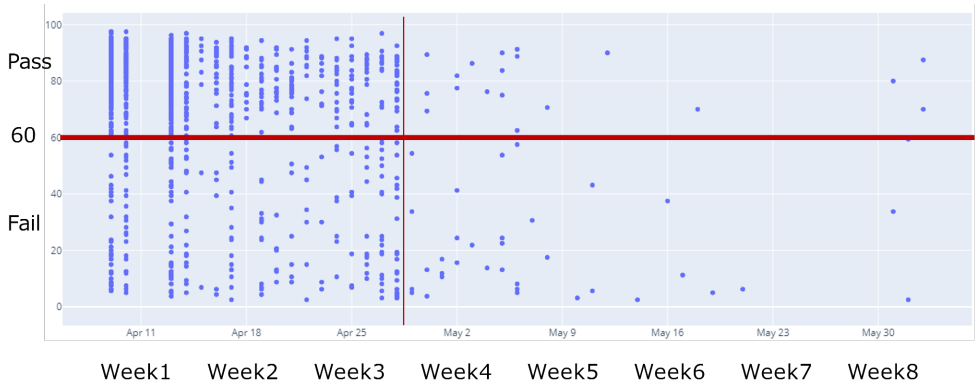

Figure 6. Relationship between starting the first class and the final score

Figure 7 shows the completion rates for a required first-year class from 2018 to 2021. In the first quarter of 2021, marked by the dark blue line, 98% of students watched the first 15-minute video marked "1-1," watched all four videos marked "1" in Figure 7, and completed one quiz. The participation in the second class decreased to 96%, with the lowest participation being in class 7 at 76%.

Table 4. Pass rate based on the start date

When was the first class completed?	Pass rate	Percentage of students
On the first day of the first week	90%	21%
In the first week except the first day (week 1)	83%	40%
In the second week (week 2)	72%	13%
In the third week (week 3)	57%	11%
After the fourth week (after week 4)	38%	4%

When compared to the 2020 results, which is marked by the light green line, classes 1 and 2 had higher completion rates, but classes 6 and 7 had lower attendance rates, which could have been because of a system failure at that time in 2021.

Figure 8 shows the weekly average of all students who took the same required online course in 2020 and 2021. The solid line shows the results for 2021 and the dotted line shows the results for 2020. Assuming average learning, 100% was achieved in 8 weeks; therefore, 12.5% was the average progress per week. Ideally, regular study over the entire eight weeks would bring the students closer to the straight red line of 12.5%. The first week was above average, but the second week was below average.

In the third and fourth weeks, there were major holidays in Japan. During the period, communication from the teachers to the students will be implemented to motivate the students. The details will be explained in the next chapter.

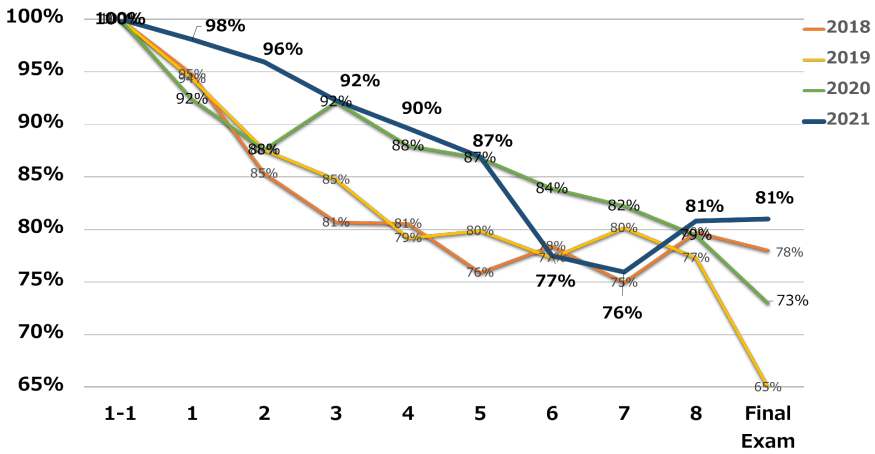

Figure 7. Completion rates for each class

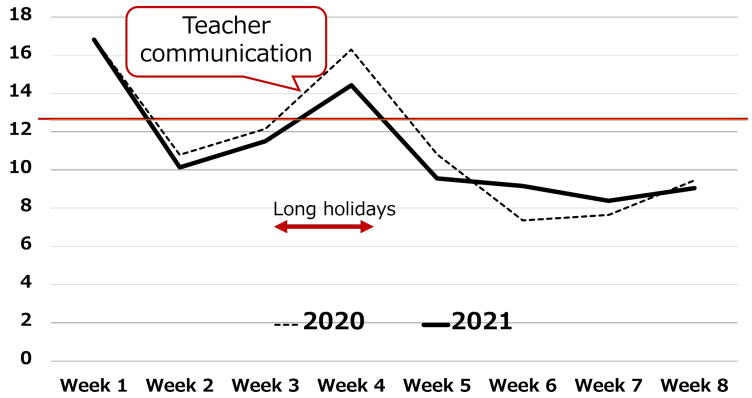

Figure 8. Weekly progress

INTERVENTIONS FOR STUDENTS

At TOU, all enrolled students are assigned an academic advisor, called an AA, who provides students with assistance on their course registration, course selection, course planning, and online learning methods. While new students are the AA's primary focus, all are assigned an AA until they graduate. A personal electronic bulletin board between the AA and the student is available, which allows for 24-hour communication through the use of an e-portfolio. Teacher-student interactions are also shared with other teachers to improve their communication.

Table 6 shows interventions for students: the student support provided during the quarter. Note that week 0 refers to the week before the start of the course. In week 0, the instructor and mentor greeted the students, in week 3, the instructor sent encouraging messages only to the students lagging behind, in week 4, the university staff contacted students by phone or mail who had not logged in at least once in the past four weeks, in week 5, teaching assistants sent encouraging messages to students who were behind schedule, and finally, in the eighth week, teaching assistants sent encouraging messages to registered students. Figure 8 shows an improvement of the weekly progress, because the AAs' encouraging messages in week 3 motivated the students and positively influenced their behavior, that is, the interventions in week 3 may have motivated the lagging students.

Table 6. Interventions for Students

Timeline	Who	Whom	What
Week 0	Instructor	Course participants	Greetings
Week 0	Mentor	Students in charge	Greetings
Week 3	Instructor	Delayed students	Encouragement
Week 4	Staff	Students with no logins	Encouragement
Week 5	Teaching assistant	Course participants	Encouragement
Week 8	Teaching assistant	Course participants	Encouragement

CONCLUSION

Staying motivated is crucial to success at online universities. While online students were found to be more intrinsically motivated than regular university students, they tended to be less motivated to make new friends. The data showed that the earlier the students started learning during the quarter, the higher their success rate. It was found that the students who started learning in the first week of each quarter had better grades and a higher completion rate. Therefore, the challenge is how to intervene and support students who are not motivated during this period.

Students were categorized into three groups. The first groups were the highly motivated students, who were able to learn autonomously and did not require intervention. Some interventions, however, can have a negative impact.

The second group of students included those who only had intrinsic motivation. These students could improve their learning effectiveness and efficiency by understanding their motivation type and also needed less motivational interventions. The third type of student was the unmotivated student who required certain interventions to enhance their learning outcomes. However, it is not yet known which interventions would be the most effective as this would depend on their specific preferences; therefore, further research is needed to identify the appropriate interventions for unmotivated students.

However, there are limitations to these web-based questionnaires. The surveys were conducted on volunteer students from TOU. Therefore, the student distribution may have been skewed as volunteers are usually more motivated than the general student population.

FUTURE WORK

For students with low motivation, it is necessary to make them aware of their motivational status and identify the appropriate interventions for their motivation type. For example, teaching new students how to learn online during orientation or as part of their pre-enrollment education and making them aware of their motivation type could be useful. Also, providing learners with real-time information about their learning status could help them to control and understand their motivation. Therefore, it is important to improve the students' metacognitive abilities. Smart glasses could also be used to measure concentration (Uema and Inoue, 2017). It is hoped that the use of such devices will improve students' self-awareness of their own state and type of motivation to learn, which in turn will accelerate their learning outcome (Kato, 2019).

ACKNOWLEDGEMENTS

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MATHEMATICS IN PLAY

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ABSTRACT

The case study in this paper describes characteristics of an early childhood education (ECE) teacher's learning. We reconstruct how this learning develops in a heterogeneous professional learning community (PLC) consisting of primary- and preschool teachers and researchers, aimed at stimulating young children's language and mathematics development in spontaneous play. The teacher's development is viewed from two perspectives. The first perspective is considering children's learning from an empirical global staging about children's learning in mathematics. The second perspective is formed by learning outcomes, such as knowledge and ideas. We establish that the teacher's learning, stimulated by discussions in the PLC and new experiences in teaching practice, did indeed develop in stimulating mathematics in children's spontaneous play. She uses opportunities and reflects on limitations hereof.

INTRODUCTION AND BACKGROUND

In our work we frequently talk to early childhood education (ECE) teachers. From this communication we learn that ECE teachers know how to stimulate mathematics in spontaneous play. However, they do not always do so in their teaching practice, where mathematics is usually presented by them as isolated activities. This teaching stems from the assignment for these teachers to realize specific nationwide objectives, for example as described by the Dutch curriculum organization SLO (2019). In the 'Mathematics in play'-project[1] ECE teachers, teacher educators and researchers in a professional learning community (PLC) cooperatively worked on this problem. Doing so can be effective in an educational setting if four conditions are met:

1. The activities in the PLC need to be focused on children's development,

2. PLC members need to share a common objective,
3. The variety of perspectives in the PLC supports obtaining this objective (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).
4. PLC members cooperatively work on establishing enduring changes in teaching practice (Henrichs, Slot, & Leseman, 2016).

In the 'Mathematics in play'-project ECE teachers from Amsterdam, Utrecht and Zaandam participated in three separate PLC's. These PLC's focused on stimulating mathematics spontaneous play. Herein ECE teachers observe the child's play and enriching it if needed. We label this approach in the triple: 'exploring', 'connecting' and 'enriching' (Damhuis, Van der Zalm, & Boland, 2016). In 'exploring' the ECE teacher checks the child's focus in the play. In 'connecting' the ECE teacher connects to the play; she/he plays along with the child, without adding something new to the play. When 'enriching' the teacher does add something new in the play, but this is done as such that the child's play and the focus in the play remains the starting point for teacher actions.

For mathematics learning we elaborated on Freudenthal's idea mathematics as human activity (Gravemeijer & Terwel, 2000). Children from a very early age are involved in mathematizing their world. Therefore there is a need for ECE teachers taking a similar mathematical perspective (Oonk, Keijzer, & Van Zanten, 2020). The 'Mathematics in play'-project aimed at connecting this teachers' mathematical focus with young children's mathematical activity in spontaneous play. The project simultaneously focused on children and ECE teachers development. Earlier we shared our work on children's development (Keijzer, Boland, Van der Zalm, & Peltenburg, 2020). This paper takes the second perspective.

RESEARCH QUESTION

This research focuses on analysing ECE teachers' professional development in a PLC setting consisting of ECE teachers, teacher educators and researchers. This PLC aims at young children's mathematical development in the context of spontaneous play. We here take one of the participant's perspective, ECE teacher Oumnia. We elaborated on her development in the PLC. Doing so, we aimed to answer the following research question:

What are characteristic of a teacher's learning and development in a heterogeneous PLC, consisting of ECE teachers, educators and researchers, that is focused on stimulating young children's language and mathematics development in the context of spontaneous play?

METHOD

Case study

In this research we reconstruct an ECE teacher's development. To do so, we set up a case study, describing Oumnia's development. We choose Oumnia because we considered her development as being typical for what we observed by all teachers: her input in the PLC was constructive and cooperative, she actively took what was offered in the PLC to her actual practice and shared experiences in the PLC. Apart from this she participated in all six PLC meetings and made herself heard. As a consequence she generated a sufficient amount of data in the form of transcribed video clips enabling us to reconstruct her development. However, since we did not know her development would be illustrative beforehand, we selected Oumnia for our case after the PLC meetings.

Data

The following data about Oumnia's development was collected:

- a transcript derived from an intake, focusing on Oumnia's teaching experiences and ideas on stimulating mathematics in spontaneous play,
- clips from the transcribed video of the PLC meetings wherein Oumia's provides input in the meeting or when she responds in any way to what is happening in the PLC,
- clips from the transcribed video of Oumnia's contribution to the group interview, wherein participants reconstruct their development over the PLC meetings.

Scheme for analysis

We used a two entry scheme for data analysis. The first entry is that of the hypothetical learning trajectory (HTL) developed by teacher educators and researchers describing the ECE teachers' hypothesized development. A HTL describes the learner's assumed development in the developed teaching (Simon, 1995). The second scheme entry concerns different aspects in professional development, namely the development in knowledge, in beliefs, in teaching practice, in intentions for teaching practice, and in emotions (Bakkenes, Vermunt, & Wubbels, 2010).

In the PLC meetings we opted for various ways of relating interaction modes (exploring, connecting, enriching) and mathematical activities. In the HLT we stated the development we thus expected to realize, in four stages:
HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,

HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

As second aspect in our analysis we focus on ECE teachers learning outcomes, that are a result of the activities in the PLC (Bakkenes, Vermunt, & Wubbels, 2010). These learning outcomes concern five ECE teachers' development aspects:

- knowledge, namely of mathematical aspects in the activity, for example knowing how an activity might be named in terms of mathematics domains,
- beliefs, namely about children's mathematical development, for example what children can learn in spontaneous play and where structured activities are needed,
- practice, namely how practice is or will be established from a mathematical perspective, for example why specific material is used for stimulating mathematical activity,
- intentions for practice, namely how practice might be structured for stimulating mathematical activity, for example what course of action could be used,
- emotions, namely the emotion discussing mathematical activity evokes, for example stating how exciting it is when children show certain domain specific development.

All PLC meetings Oumnia participated in were transcribed. The scheme for analysis is used for typifying Oumnia's statements in the transcript. Herein we consider a statement as one or more sentences where Oumnia's participates in the discussion in the PLC. We also consider statements as outings where Oumnia indicates she agrees or disagrees with something earlier said in the PLC meeting.

Analysis

Each statement Oumnia made is coded by connecting it to one or more stages in the hypothetical learning trajectory and with one or more learning outcomes. Three rounds were used to complete the coding:

- Two researchers coded the development of four ECE teachers in the first two PLC meetings. Coding was focused on choosing a case for the case study. Moreover, discussing the coding by the two researchers leaded to an improved coding, where both researchers agreed upon.
- One researcher next coded the rest of the transcripts for the selected case, Oumnia.

- The full code set, that was constructed in this way, was discussed between the coding researcher and another researcher and adapted in cases of disagreement. This leaded to consensus on all codes.

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

Figure 1. Coding scheme development stages HLT 1-4 and learning outcomes

Every statement Oumnia made was coded and placed in the coding scheme (figure 1). These codes are clustered for each PLC meeting and related to the activities in the meeting. We here – on a micro level – reconstruct and code relations between activities in the PLC meeting, discussions in the meeting, and Oumnia's development. For example when a PLC meeting aims at exploring mathematics in spontaneous play, in the PLC meeting the dialogue might focus on how the domain 'measurement' comes forward in playing with sand. If Oumnia illustrates this using an example from her practice and tells how she enjoys children playing in the sandbox spontaneously making all kinds of discoveries, we code this as 'HLT2-knowledge' and 'HLT2-emotion'. Doing so we schematize Oumnia's development in two dimensions in the scheme in figure 1. Next this provides a means to observe to what extent Oumnia's development matches the stages in the hypothetical learning trajectory (HLT1-4). The analysis of both intake and final interview are used to further sharpen insight in Oumnia's development.

Six PLC meetings at a glance

Oumnia participated in all six PLC meetings. In each meeting the group considered children's activity from the interaction perspective, namely 'exploring', 'connecting', and 'enriching', and from a mathematical perspective. In the first two meetings interaction modes and mathematics for young children is discussed. In meeting 3 and 4 participating ECE teachers are offered the opportunity to share in a 'picture novel' experiences with mathematics in spontaneous play in their practice. This 'picture novel' consists of a number of pictures from the group's work, explicated and commented on by the ECE teacher. This 'telling the story by pictures' replaces sharing video, as privacy considerations made video taking unfeasible. In the meetings the PLC members discuss the mathematics in the picture novel and how the ECE teacher chooses for a specific interaction mode, namely exploring, connecting, and/or enriching the child's spontaneous play. The final two meetings were devoted to objectives for mathematics in early childhood education. In these meetings participants talked about what nationwide objectives

are feasible by stimulating spontaneous play, and the enrichment thereof, in an adequately developed learning environment (SLO, 2019).

OUMNIA'S DEVELOPMENT

Intake

Oumnia's kindergarten group consists of 25 children, whereof two from Turkish and the others from Moroccan descent. All children are bilingual and within the group the level in Dutch language differs a lot. Some children can speak in full sentences, while others only utter in one-word-sentences.

Oumnia stimulates language and mathematics in the learning environment and in structured activities, she typifies this as little lessons. In her teaching she uses stages: orienting, demonstrating, enlarging and deepening. Oumnia recognizes words she offers to the children in children's play, later on are used spontaneously by them. In the learning environment there is a specific space dedicated to mathematics, where children for example find a scale and a number line. Oumnia also made a box where materials are sorted by colour.

Oumnia wants to see how she can use interaction modes exploring and connecting. She wants to learn more about enriching. She want to utilize opportunities during free play. She does not want to use readymade activities. She wants to connect to what children bring in during the activities.

First PLC meeting

The theme in the first PLC meeting is getting acquainted with mathematics in children's spontaneous play. In this meeting a video clip is discussed. In the clip a teacher sits next to a child in a sand box. Both teacher and child shovel sand and let the sand slide down between their fingers. PLC participants are asked to describe the teacher's behaviour and also to name what mathematics is revealed in the clip. After this first activity the triple 'exploring', 'connecting' and 'enriching' is explicated and aims for mathematics are presented (SLO, 2019).
In the meeting Oumnia tells what she does in her group. She furnishes her room for a new theme and allows the children to play: 'Next week we start a new theme: spring. That first day the children are playing, I look what they are actually doing.' She especially has an eye for what the children do with what she prepared: 'I once hang a measuring tape in the room. Children were asked to stand aside the tape to measure their length. One of the children took the tape. He wanted to measure clothes. This was so nice. I thought I made something and this is what we are going to do with it. But the children discovered other things to do with it.' We typified

Oumnia's enthusiasm for children discovering mathematics as 'emotion'. This emotion is related to intuitively recognizing mathematics. In the scheme in figure 2 we show this development as a coloured cell: HLT1-emotion. There also are moments when Oumnia tells children how to act. She uses these moments for stimulating learning, for example when tiding up. Becoming acquainted with mathematics in children's spontaneous play helps Oumnia to reflect on arranging her practice and share her ideas hereon. This is indicated in figure 2. The coloured cell HLT2-practice marks this development.
In describing her practice Oumnia implicitly shows she is acquainted enough with the triple 'exploring', 'connecting' and 'enriching' and mathematics to relate these with activities in her practice (figure 2: HLT1-knowledge). For example, she recognizes mathematics in children's building. She tells she observes this and start to play with a child, when this child proudly tells that he build a very high tower: 'He really was telling proud: "Teacher, have a look! I really build a very high tower!" And next he moved next to the tower: "See, how high it is!" And then I said something like: "What number of blocs are in it?" Then he went like: "One, two, three, four, five, six, seven, eight, nine, ten. There are hundred!"'

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

Note: HLT1-4 as described above.

Figure 2. Development first PLC meeting

Second PLC meeting

Participants' homework after the first PLC meeting is a photo activity, imaging children's mathematics. In the second meeting we relate this image to mathematical domains. Apart from this photo activity 'exploring' and 'connecting' as interaction modes are discussed. In this meeting Oumnia tells about the domain of measurement. She shows how she reflects on aims for this domain. Moreover, she recognizes mathematics being omnipresent, and that this helps her in her practice: 'When you discover it is everywhere and this can be used in spontaneous play, we have a win-win-situation.'
These utterances refer to both stage 2 and 3 in the HLT, as they are about reflections on mathematics in Oumnia's practice and using these reflections in order to further develop her practice (figure 3: HLT2-practice; HLT3-practice). We consider Oumnia's (initial) insight here as indication she moves away from thinking in terms of isolated mathematical activities.
Oumnia also shows she knows about the domain of geometry and what spontaneous play is related: '(…) constructing with general construction material and geometric

construction material.' Moreover, she knows how to describe relations between interaction modes and mathematics on a more general level, namely when presenting discussing day and week planning with children as a way of using a meaningful simple scheme (figure 3: HLT4-knowledge).
Oumnia observes children's mathematical discoveries and recognizes this as a consequence of the learning environment she developed: 'He actually started comparing measurement units, while I in fact did not aimed at mathematics.' This awareness leads to new ideas for her practice (figure 3: HLT3-intentions). Oumnia here considers questions you pose in the group to help children moving on.

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2			■		
HLT3			■	■	
HLT4	■				

Note: HLT1-4 as described above.

Figure 3. Development second PLC meeting

Third PLC meeting

The third PLC meeting is the first meeting where PLC participants share their picture novel. Doing so, in this meeting one of the participants tells about an 'ice cream shop' where toddlers buy 'ice cream' and another about children in kindergarten building a railway. In both cases interaction modes, 'exploring', 'connecting', 'enriching' and mathematics domains in children's activity are discussed. In the meeting Oumnia reflects on what another ECE teacher brings in, using generalized statements on interaction modes: 'All depends on what children come up with. If they are talking about it, you are connecting. When you take the initiative, it is enriching.' (figure 4: HLT4-knowledge). However when Oumnia reflects on her practice the distinction between 'connecting' and 'enriching' is less clear: 'I ask this quite often. I wonder whether I am enriching or actually still connecting.' She emphasizes that these reflections make her aware how one can notice children.
Oumnia recognizes in the situation where toddlers are in a row for the 'ice cream shop' the domain numbers and operations: 'They could say: "I see two," recognizing an amount. And then: "Surely two ice creams," That is their way of counting "How many ice creams do I have? How many do I want to buy?"' Next she reflects on her own teaching: 'When I arrange the room, I think: "(…) What aims are stimulated?" But when the children play, spontaneously more is coming forward (…).' Oumnia here implicitly names the mathematical activity arranging the room leads to (figure 4: HLT1-practice).

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

Note: HLT1-4 as described above.

Figure 4. Development third PLC meeting

Fourth PLC meeting

During the fourth PLC meeting Oumnia's shares her picture novel, on building a Lego lighthouse. The children use a picture as example, showing a red lighthouse with a clear white strap. When discussing Oumnia's work, participants again focus on mathematics in the situation and the interaction between teacher and children. For the mathematics involved, participants now do more than mentioning the mathematics domain only. Instead they provide precise descriptions of the nationwide objectives at stake (SLO, 2019).

Oumnia distinctly takes part in the dialogue. She names objectives, for example concerning the use of informal measuring instruments, like a footstep. In the discussion on objectives she shares her idea that for certain objectives the teacher should demonstrate to help children to learn (figure 5: HLT3-beliefs).

Oumnia explains what she did in the lighthouse situation she presents: '(…) at first I just joined, then: "Well, teacher look, we are building a lighthouse." But it falls down again and again. I sat there. (…) So I said: "Well, boys, how can we make it so that it does not fall down again, because I see it does over and over!" (…) And then a child said (…): "Teacher, we might need adhesive tape!"' Oumnia next provides adhesive tape, after which she leaves the children discovering that Lego building is unsuccessful when the bricks are glued together. Doing so, Oumnia shows previous considerations influence the learning environment she prepared for the children and also that she follows the children in their thinking. She lets children solve problems and tells she is curious what solution they will come up with. We consider this a clue for how Oumnia's ideas and insights have consequences for practice development and her interaction with children (figure 5: HLT3-practices). Moreover, Oumia states that she enjoys children who, like in the example, look for solutions. She provides children the opportunity to first draw the lighthouse and next build it. She thus shows how her previous considerations lead to children's curiosity. She also demonstrates how she reflect on experiences on a general level and considers how her experiences fit with how she choose to develop the learning environment. New experiences convince Oumnia more and more on the power of open, stimulating questions and she indicates she really enjoys all these new experiences (figure 5: HLT 3-emotion; HLT4-practices). Figure 5 provides an overview of Oumnia's development.

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

Note: HLT1-4 as described above.

Figure 5. Development fourth PLC meeting

Fifth PLC meeting

The fifth PLC meeting posters containing nationwide objectives for young children's mathematics are discussed (SLO, 2019). PLC participants order objectives on the posters by labelling them as 'easily obtained using spontaneous play', 'difficult to be obtained using spontaneous play', and 'impossible to obtain in spontaneous play'. Each nationwide objective is written on a piece of paper, enabling teachers in the PLC to place objectives under one of these labels. The resulting ordering in objectives is discussed.

In the discussion Oumnia shares her ideas on the objectives. For example she states 'Exploring and describing placing objects in the surrounding space' is a part of 'geometry'. She thus shows her general knowledge of mathematics domains (figure 6: HLT4-knowledge). However, being such a general relation also shows the notion being an intuitive one, as the utterance leaves much implicit (figure 6: HLT1-knowledge). For a significant number of objectives she state how they fit how she developed her learning environment (figure 6: HLT2-practices). She here provides general examples for objectives in the geometry domain: 'For example when they build something and make a ground plan, but that they take a specific perspective.' Also from the ratio and proportion domain: 'When they build a house, no matter with what they do so, there is a restriction that people from the doll house need to fit in the house.' (figure 6: HLT4-practices). Talking about objectives elicits Oumnia sharing her ideas on the children's level: 'Folding is very difficult for the children. (…) I notice four year old's and even five year olds find this really hard.' She reasons, that as a consequence for several objectives you need to demonstrate: 'So when you just show things, they next imitate it.' and 'For using geometrical words, I really think you first need to show. This is needed when you talk about words.' Oumnia names this showing as 'giving a push' (figure 6: HLT4-beliefs).

Moreover, exploring objectives makes Oumnia reflecting on whether or not she covers all and whether this may be done unconsciously. That she is occupied with this issue when she is aiming at stimulating spontaneous play, is exemplified by her statement: 'And if you had a mathematics textbook, you could read which objectives you work on.'

Figure 6 provides an overview of Oumnia's development.

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

Note: HLT1-4 as described above.

Figure 6. Development fifth PLC meeting

Sixth PLC meeting

The sixth PLC meeting also focuses on aims in teaching. PLC participants discuss objectives for measurement and geometry. Oumnia here repeats how she judges what support children need: 'When you ask children to work on their own, they often experience difficulty. They then really need your help. This is even so if you instructed them earlier. That they are able to built with blocs or show their fantasy is just fine. But certain things like money is a step to difficult for them to do this on their own.' She next tells how children in her group reason and choose. She here welcomes children's initiative: 'But they were really working on it.' Oumnia reflects on the learning environment and sees children's mathematical activity (figure 7: HLT2-practices). She elaborates this into general considerations on developing her practices (figure 7: HLT4-practices). Figure 7 provides an overview of Oumnia's development.

	knowledge	beliefs	practice	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

Note: HLT1-4 as described above.

Figure 7. Development sixth PLC meeting

Final interview – most important developments in retrospective

In the PLC meetings Oumnia hoped to learn how she could enrich spontaneous play for the children in her group. She experienced some shyness of action: 'I often thought: I can do something with this, but do not know what question to pose.' She hereby mentions various interaction modes: 'Because you pose questions, but this is unconscious, not like OK what objective is at stake now? How can I enrich this?' Oumnia mentions that a focus on objectives for mathematics in the PLC meetings supported her in formulating aimed questions for children during their play. She shows raising awareness of interaction modes and mathematics domains and objectives in her practice. Based on this she realized changes in her practice. In the interview she tells how she is led by children's spontaneous play and not by aiming at a specific objective: 'A girl made a clay butterfly. She put two fiches on it: red and yellow one on the one side and also on the other side. And I said "just like a mirror", and I named "I see two red fiches here and two yellow ones." But if you look at the number domain only, you only say: "How many red fiches are here?"'

Oumnia tells she gradually became more conscious about children's mathematics. This made her better prepared in stimulating children's development. She here gives an example from a day to day routine, tidying up the room. She explains: 'One time a child knocked over all coloured pencils. So I asked a girl: "Do you want to fairly share?" There were six boxes. She did all red pencils in one box and did the same with the green ones. She sorted them by the colour. So I said: "No I want a red pencil and a green pencil and … in each box." and so she did.'

DISCUSSION AND CONCLUSION

We analysed Oumnia's development in answering the question what is typical for the participants' development in a PLC aimed at stimulating children's mathematics and language in the context of spontaneous play. However, we here described the development of one ECE teacher only. This makes results' generalizability limited. They are about Oumnia's development and possibly for the development ECE teachers like her, actively participating in the trajectory and developing teaching practice from talks in the PLC. This developmental trajectory's hypotheses was that Oumnia in PLC meetings would develop from initial notions on mathematics and interaction modes in supporting children's play to more elaborated ideas and insights. She would, we expected, use these insights in her practice, and next reflect hereon in the PLC to thus develop more generalized notions on mathematics and interaction modes in the context of children's spontaneous play.
However, Oumnia's development is not this linear, but depends on how discussions in the PLC more or less by accident progress. And if we take this into account, we see that on the whole Oumnia's development is in line with the projected hypothetical learning trajectory. We noticed that discussions in the PLC made she

gradually developed more idea's on mathematics in children's spontaneous play. When bringing in examples in the discussion at this stage, she alternately points at generic examples concerning children's development in a typical learning environment and at specific examples from her actual practice, typifying the fourth stage in the hypothetical learning trajectory, HLT4. Next, by confronting her ideas on stimulating mathematics in spontaneous play with objectives that need to be met, she also shows where she experiences limitations in stimulating mathematical activity in spontaneous play. She defends this by stating that developing specific skills needs separate instruction.
Oumnia thus takes a critical position on developing skills and in a sense opposing mathematical development in spontaneous play. But nevertheless she values learning in the PLC setting. This brought her a specific consciousness of children's development and how she could act accordingly. After the trajectory she notices children's mathematics and this awareness supported her growing in stimulating mathematics children's spontaneous play.

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STRATEGIC EDUCATIONAL DEVELOPMENT AS A CO-OPERATIVE INQUIRY

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ABSTRACT

This paper reflects findings from action research conducted at Metropolia University of Applied Sciences in Finland aiming at studying strategic educational development work at the institution. Metropolia University of Applied Sciences initiated a new institution-wide process for educational development to support the new strategy and its aims of lifelong learning.

The forming and working of a pedagogical expert group was studied in analysing the expectations of the members and the development of pedagogical competence in their disciplinary communities of practice.

This development work gives new insight to strategic institutional-wide educational development work, organising, and implementation at the higher education institutions. In the first place, the research evaluates the new approach chosen for the process of strategic educational development and gives an important research base for the development work.

INTRODUCTION

The high-quality education requirements of higher education institutions (HEIs) and the responsibility of developing and evaluating their operations are defined in the Finnish national legislation. Strategic educational development has been the response to implement institutional-wide development actions to enhance the quality of education at the HEI.

Together with the quality enhancement aspect, achieving lifelong learning goals requires higher education organisations to evaluate and reflect the way in which strategic educational development is implemented. This has a direct link to the educational approach and the pedagogical thinking of the organisation. In addition, educational development and educational leadership is certainly a critical factor in achieving sustainable development goals of education.

BACKGROUND

Metropolia University of Applied Sciences (later Metropolia) is a multidisciplinary higher education organisation operating in three cities of the Helsinki metropolitan area. Metropolia is the largest UAS in Finland educating students in the fields of technology, social services, health care, business, and culture and arts. Over 16700 students and 900 staff members in four campuses form a learning community of altogether seventy bachelor and master level degree programmes.

In 2020 Metropolia initiated a new institution-wide process for educational development to support the new strategy and its aims of lifelong learning. The pedagogical policies available at that time were from the last large-scale curriculum reform of 2015. The pedagogical policies were created by the strategic educational development group of that time, members being teaching staff members and educational development experts from the different disciplines. The pedagogical policies were closely connected to the curriculum reform and its aims; the pedagogical discussion was strongly connected to the first phases of the reform. Therefore, the pedagogical discussion was not very active the years after.

In 2020, instead of implementing new pedagogical policies top-down into the departments, teaching staff and students, a new process based on co-operative inquiry (e.g. Heron, 1996; Reason, 2002) and situated learning and communities of practice (Lave & Wenger, 1991; Wenger, 1998) was established and an institution-wide pedagogical expert group was founded. The objective of the process and the pedagogical expert group was to enhance pedagogical competence in the institution and the quality of education.

Firstly, the process was based on the idea of co-operative inquiry (e.g. Heron, 1996; Reason, 2002) where educational development was seen as a common research topic for the pedagogical expert group members through their context of different disciplines and varying pedagogical development needs. Secondly, the process was built up based on the idea of situated learning and communities of practice (Lave & Wenger, 1991; Wenger, 1998) where the joint group activities offered a learning environment and facilitated supporting structures and a possibility to reflect their community of practice; it is the educational development actors in their context.

To evaluate the development process and the new approach chosen to the institutional-wide educational development, research data was collected in different phases of the process. The research used an action research approach.

The development work was evaluated based on the following research questions below:

1. What kind of expectations do the pedagogical expert teacher group members have at the beginning of the process?

2. What is the role and community of practice of the pedagogical expert teacher in the departments?

3. Did the expectations of the pedagogical expert teacher group members change at the end of the first year of the process?

PEDAGOGICAL COMPETENCE DEVELOPMENT IN HEI

The pedagogical competence development process can be examined both at individual and community levels.

In educational development at HEIs, in addition to individual-level pedagogical competence development (meaning e.g. teachers pedagogical thinking, self-efficacy beliefs, reflection, course design, teaching and learning methods, evaluation methods), attention must be paid to pedagogical competence development of the HEI community (e.g. shared pedagogical discourse and principles, possibilities of interaction, pedagogical culture development, joint pedagogical policies, peer learning, motivational support for pedagogical competence development) too.

The community can form differently depending on the context and discipline. It is evident from the previous research (e.g. Nistor et al, 2015; Clarke & Reid, 2013) that the support of the community is crucial in the pedagogical development of an individual. Further, we know that pedagogical competence in teaching and learning is an important influencing factor of student study ability (Kunttu, 2011).

Developing pedagogical competence both at the individual and community-level has a positive impact on educational culture and student learning. Focusing only on the individual level may not result in the enhancement of the pedagogical competence of the HEI and can be a reason for quality deviations of education in HEIs.

FORMING OF PEDAGOGICAL EXPERT GROUP

Pedagogical expert teachers responsible for educational development and quality were named as members of the pedagogical expert group from all the 10 departments of Metropolia.

The impact of a pedagogical expert group of 10 members in an organisation of 16700 students and 900 staff members on the quality of education surely raises questions. The idea of such an approach was to create a so-called butterfly effect. Having a small group of experts working together in a facilitated, joint, and shared development process and having a local community of practice in pedagogical development at the same time, secured a direct connection to the disciplines and their pedagogical development needs and actors.

The joint process aimed to provide a supporting process, a framework including guidance, and peer support to the local development processes. The development aims, contents, and concrete actions were created and brought to the joint processes from the disciplines and their needs of educational development by the expert teachers.

The pedagogical expert group members had a role of a pedagogical expert at their department in coordinating the pedagogical development and quality work based on the Metropolia strategy. The group facilitator's role was to enable and ensure the systematic and productive progression of the process with joint meetings, guidance, and shared documentation.

DATA COLLECTION AND DATA ANALYSIS

The data was collected from two different phases of the process. First at the beginning of the process from a kick-off day of the pedagogical expert group in June 2020 and second after the first year of their work in June 2021.The data was qualitative as the type.

The first data set was field notes collected by the facilitator as a summary of the discussions and discursive exercises during the session. The second data set was a reflective written exercise given to the pedagogical expert group members at the end of the first year of the process.

The first data collection session involved all the members of the pedagogical expert group including the process facilitators and the process owner. The second data collection set was a reflective exercise assigned to all the members of the pedagogical expert group but was completed by four members of the group.

The data were analysed using qualitative content analysis.

RESULTS

We discuss here the results through the research questions set.

What kind of expectations do the pedagogical expert teacher group members have at the beginning of the process?

At the beginning of the process, all the members were enthusiastic about pedagogical development and the possibility to open pedagogical discussion and knowledge sharing. The members described that a joint pedagogical discussion was missing, and they had been waiting for it to be initiated. Pedagogical development was experienced as a meaningful activity in their work.

From the process as a whole (peer members, the facilitators, and the process structures), they expected help, joint knowledge sharing, a path towards joint goals, and sharing of good pedagogical practices.

The pedagogical group members saw the group as an enabler of educational development. They expected pedagogical freedom and joint alignments at the same time. They saw that it was critical to get the local discipline-based actors actively involved in the process.

The members saw that the joint process helped the community to learn and maintain the learning culture. The continuous and regular nature of the process was seen to benefit educational development, which tends to be short-sighted in many cases.

The role of a pedagogical expert in their discipline was interesting to the group members but still not conceptualised at this stage of the process. However, the members did not see this as a problem but believed that the process and concrete work at the departments will clarify the objectives of the task.

What is the role and community of practice of the pedagogical expert teacher in the departments?

In general, the members of the pedagogical expert group experienced that they had a community of practice of educational development in their departments. They could name several members in different levels of the community of practice including themselves.

They saw that some of the members of the community of practice were inactive in pedagogical development even if they were holding a position in which pedagogical development should be included (e.g. programme lead) as a focal part of the work.

An important finding was that many of the pedagogical expert group members saw that students were in many cases practically only on the outermost levels of the participation in the community of practice even if they were officially considered as the objects of the activity. This raises of course concerns about realisation of the learner-centered approach in teaching and learning.

The analysis of the community of practice realised that in many cases there was no dialogue but only one-way interaction between the levels of participation. This may be a sign of missing shared practice and a true community of practice with a shared domain of interest.

Some of the members reflected that the department was not a real community of practice but the degree programmes formed separate communities of practices that did not interact with each other. Some of the members saw that they worked alone even if they have management's support for their work.

The second important research finding was that working life was missing from participants' analyses of communities of practice altogether. None of the reflective writings mentioned working life partners as a member of their community of practice in educational development. This is highly deploring while working life is an important goal and task of the universities of applied sciences and it is prescribed in the legislation as well.

Did the expectations of the pedagogical expert teacher group members change at the end of the first year of the process?

After a year of action, the members of the pedagogical expert group saw that their role in educational development had become clearer through concrete working and a joint pedagogical development plan (documentation) as they were expected.

The members reflected their role as a coordinator of pedagogical development actions in the discipline context. Some of the members saw that during the last year they had understood that there was no need of doing everything by themselves, but the role of the pedagogical expert was more towards coordinating and making the local pedagogical development actions visible.

Some of the members experienced it difficult to motivate close colleagues from the new role of a pedagogical expert group member. They mentioned that the change in

the role from a regular teacher into a pedagogical expert affected the interaction with the colleagues.

Still, after a one-year's work, the members saw that their role was developing. The role of a pedagogical expert in the local community of practice was still ill definable and in reflection. Some of the members saw that they did not expect to be involved in as many pedagogical tasks as the role demanded.

The members observed that the pedagogical expert group membership and the group of peer developers was very important reflection surface for the local development process. It was important to them to be able to compare and evaluate the pedagogical situation in their own context to the pedagogical goals and actions of the other disciplines.

It was clearly visible in the reflections that the pedagogical group members identified that their pedagogical competence was developed in the process.

The joint and facilitated documentation (e.g., the pedagogical plan), helped the members of the pedagogical expert group to structure and manage the local development process. The pedagogical plan was a tool that guided the work and brought it more visible. These kinds of tools were found to foster learning in the local community of practice.

In addition, the shared documentation in an open online platform helped the members to put the local development plan in a wider context. The members saw that the organised peer feedback and mentoring sessions progressed the local development work.

Overall, the members of the pedagogical expert group experienced that the joint development process ensured the interaction and progression of the local work well.

REFLECTION

According to our experience, the strategic educational development based on co-operative inquiry, situated learning, and communities of practice shows promising results in HEI educational development.

More effort should be placed in community-level pedagogical competence development in HEIs. Many times pedagogical competence development occurs at the individual level and does not necessarily end up as community-level competence hence the enhancement of educational quality and student learning.

Extra attention should be paid to involving students and work-life partners in educational development actions and processes. The quality of participation should be ensured to avoid only nominal participation for instance in working groups.

The process of pedagogical development as a form of a pedagogical expert group tends to increase pedagogical competence both at the individual and community levels.

This development work gives new insight into strategic institutional-wide educational development work, organising, and implementation at the HEIs.

In the first place, the research evaluates the new approach chosen for the process of strategic educational development and gives an important research base for the development work.

Reflections on strategic pedagogical development under the COVID19 pandemic

COVID19 pandemic hit the world during the research and development actions described above in the paper. The effect of the pandemic on education naturally brought new dimensions to the pedagogical discourse. We reflect here shortly on the effect of COVID19 on pedagogical development ideas, and new research needs that came up during the process.

Since 2020 after several periods of lockdowns due to the COVID19 the pedagogical strategies have changed to guide hybrid learning models in HEI (Luukka 2021). There is a great deal of concern today about the resilience of both students and teachers in an ongoing pandemic. Students' anxiety, exhaustion, and depression have increased and motivation and ability to study have decreased in higher education in Finland.

Under this ongoing COVID19 pandemic, the strategic pedagogical development should find solutions for the next questions:

- What kind of pedagogical solutions could help students' ability to study in the current situation?
- What kind of support for students could help them recover from the ongoing and coming post-COVID process and
- What kind of leadership/management solutions and skills does the ongoing and coming post-COVID process needs?

We suggest the questions above for further research on the strategic educational development of the post-COVID era.

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THE UNIVERSITY-INDUSTRY COLLABORATION IN THE VIDEO-SUPPORTED LEARNING

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ABSTRACT

In the video-supported collaborative learning a joint pedagogical vision of educators and education technology companies could provide clear alignment for product development and usage benefiting various fields of knowledge-intensive work-life. A user-driven understanding about the process of learning and teaching via video-based collaborative teamwork can benefit the companies striving to meet the needs of customers in the emergent and changing digital environments. The collaboration between universities and the industry is increasingly perceived as a vehicle to enhance innovation through knowledge exchange. However, this collaboration is not without challenges. This study investigates the significant factors of university-industry collaboration in the context of video-supported collaborative learning. To answer the research question which factors are significant in initiating, maintaining, and developing video-supported collaborative learning practices in the university-industry collaboration qualitative research was conducted. The data included the observation of the workshops for education experts and teachers' and company representatives' interviews. The study suggests that collaboration is a process that needs, for example, common goal, commitment, the presence of the participants, dialogue, and the facilitation of social interaction including digital tools and forums to reflect and discuss the experiences. The university-industry collaboration at the organizational levels, as well as the individual level of participating managers, teachers, and students, is essential. Collaboration should not be considered as a static path; the collaboration needs to be continuously evaluated based on objectives formulated by the participants.

INTRODUCTION

Video-based e-learning and knowledge building are 21st century approaches; the modernization of European higher education institution (HEI) calls for a workable pedagogy and skilled teachers to take on the up-to-date video-supported collaboration solutions for creative teamwork in online environments. However, most teachers do not use video tools in a way that contributes to developing conceptual thinking and problem-solving skills as relevant work-life competence of the knowledge worker (Hobbs, 2006; Van Gog, Verveer, & Verveer, 2014). The same holds for pedagogical knowledge of designers in educational technology companies. This indicates that education and educational technology companies lack pedagogical models and structures to promote learning from and with videos (Krauskopf, Walshe, & Harvey, 2012; Krauskopf, Zahn, Hesse, & Pea, 2014).

Above also indicates the need for collaboration between HEIs and educational technology companies. The university–industry collaboration has existed for a long time, but activity increased significantly during the last decades. Universities are fulfilling their third mission of societal interaction by collaborating with private, public and third sector organizations. In addition, the ongoing changes in the business and operating environments require companies to innovate at a fast pace to deliver new products and services in order to meet the demands of users. The advantages of collaboration have been recognized in the previous literature, yet many organizations still find it difficult to initiate, maintain, and develop such collaboration (e.g., de Wit-de Vries, Dolfsma, van der Windt, & Gerkema, 2019; Rybnicek & Königsgruber, 2019; OECD, 2019; Rantala, 2019). Hence, the aim of this study is to investigate which factors are significant in initiating, maintaining, and developing video-supported collaborative learning practices in the university-industry collaboration.

The empirical context in this qualitative study is from the research and development project called ViSuAL. The ViSuAL, Video-Supported Education Alliance, was a co-operation of six HEIs and six educational technology designers co-creating an evidence-based pedagogical model for video-supported collaborative learning. One of the aims of the project was to build university-industry collaboration model in the context of the video-supported collaborative learning. The data for this study is collected during the model building process.

THEORETICAL BACKGROUND

The HEIs are playing a key role in generating the knowledge, innovation and human capital required to increase European competitiveness in a knowledge-based economy. In order to tackle the challenges involved, universities require modern

approaches towards research and innovation. One of the strategies is the university-industry collaboration (Mora, Detmer, & Vieira, 2010; Rantala, 2019; Laitinen-Väänänen, Parjanen, Hyypiä, & Küüsvek, 2020).

The university-industry collaboration has been accepted to generate advantages to participants, but it is not without challenges (Bruneel, D'Este & Salter, 2010). There are several barriers, for example, different organizational logics, structures, and goals for activities may hinder collaboration (Villaini, Rasmussen, & Grimaldi, 2017). Differences between different sectors can lead to separation, fragmentation, and disconnection, but also to learning, innovation, and cross-fertilisation if handled properly (see e.g., Kimble, Grenier, & Goglio-Primard, 2010; Parjanen, 2021; Kislov, Walshe, & Harvey, 2012). Because of that, the collaborative learning is needed during university-industry collaboration. Collaborative learning is thus an activity that takes place both in education, in working life and in between those. Collaborative learning is about seeing, for instance, how individual work connects with larger work communities. Connections in education or working life can be avenues for information, resources, and new ideas to be exchanged (Hyypiä, Parjanen, & Melkas, 2020).

University-industry collaboration could be described as an open innovation process. In the open innovation process, organizations use ideas and knowledge of external actors in their innovation activities (Laursen & Salter, 2006). The search for new product or service ideas and solutions to existing problems goes beyond the organization's boundaries (Chesbrough, 2003). For example, the technology users (teachers and students) could be active participants in the innovation process. It is important to make students' perceptions explicit and take them into account when designing teaching processes, in order to better observe and understand, for example, innovative uses of technology (Hyypiä, Parjanen, & Melkas, 2018). This kind of user-driven innovation processes are often interpretative - the goal is to discover new meanings via interaction and continuous dialogue among people and organizations with different perspectives and backgrounds. The process is ongoing and open-ended. (Lester & Piore, 2004.)

Griffiths and Guile (2003) described four models for co-operation between HEIs and companies. In the most advanced co-operation models, knowledge and skills are resituated, which means reviewing current activities from a new perspective and discussing new ways of acting together. When co-operation continues and develops in a more advanced direction, trust between partners increases and mutual aims can be defined, and the co-operation can then be labelled a partnership. A partnership aims to offer new solutions to new problems, which no organization can overcome alone. (Häggman-Laitila & Rekola, 2011.) Ståhle and Laento (2000) call collaboration in its best, as strategic partnership. The partners of strategic partnership are seen to set common aims and goals. Strategic partnership is based on

commitment, and it is seen usually as a long-lasting relationship. (Laitinen-Väänänen & Vanhanen-Nuutinen, 2013.)

METHODOLOGY

The empirical context of the study

The empirical context comes from the project called Video-Supported Education Alliance (ViSuAL). ViSuAL was a co-operation of six HEIs and six educational technology designers co-creating an evidence-based pedagogical model for video-supported collaborative learning (Table 1). In the long run, ViSuAL will contribute to meeting the modernization needs of European HEIs in advancing digital skills for learning and teaching. Due to the practical nature and provision of workable practices for transforming education, the teacher will embrace the experimentations carried out in ViSuAL in local level and spread it through their institutes. The insights gathered during the co-creation process have an impact on the innovation capacity of the companies in partnership with their stakeholders, customers and the HEIs as the researchers, facilitators, and design partners of the companies. (More about the project and the participants see e.g., https://visualproject.eu/).

Table 1. ViSuAL project partners and aims.

Project partners		**Aims and objectives**
Higher education institutions	**Educational technology companies**	• To develop, test and validate pedagogical models and practices for video-supported collaborative learning. • To integrate the created pedagogical model and practices into the teacher education and professionalization to capacitate future HEI teachers. • To create, test and validate concepts for experimentation based pedagogical co-creation in partnership of education technology designers, pedagogical researchers, teachers, and their students.
Aeres University of Applied Sciences Wageningen, The Netherlands JAMK University of Applied Sciences, Finland University of Tartu, Estonia LUT University, Finland Universidade de Evora, Portugal Swiss Federal Institute for	Iris Connect Ltd, United Kingdom Flowbox Ltd, Finland DiSEL21 Oy, Finland Bloco Gráfico, S.A, Portugal Nordic Simulators Ltd, Finland	

Vocational Education and Training, Switzerland		• To provide scientific evidence on the effect of video-based communication tools on the professionalization of teacher trainees to support the validation of the pedagogical models. • To provide an assessment tool for evaluating the impact of video-supported collaborative learning on professional development.
Associated partner: EAPRIL European Association for Practitioner Research on Improving Learning		

The data collection during the model building process

One of the aims in the ViSuAL project was to build a collaboration model between HEIs and education technology companies. The data for this study is collected during this model building process including the observation of two workshops, teachers' and education technology company representatives' interviews and written comments received both from companies and higher education actors during the model building process.
The concrete kick-off for the ViSuAL project group for visualizing the model was organized in November 2019 in Tartu during the project meeting. The aim of the co-creation workshop was to hear each project partner's voice and support their co-creation process and to activate them to reflect on their previous experiences and experience during the ViSuAL project. As a result of this workshop, the first version of the model's visualization was produced.

After the Tartu meeting, a group of project participants (including the authors of this article) took the leading role in preparing the model. The small group collaborated and met online several times during the model building process. The group prepared interviews for six video-technology providers. The purpose of the interviews was to define the factors of the successful collaboration between education technology companies and HEIs from the company's perspective. In addition, 25 higher education teachers' interviews about the experiences of using videos in teaching were conducted. Interviews were transcribed and analyzed by applying thematic content analysis (Tuomi & Sarajärvi, 2003). These preliminary findings from the interviews were used to instruct and orientate participants of the second co-creation workshops.

The second co-creation workshop was organized online in May 2020. The workshop aimed to hear all the project partners' opinions and comments on the visualized

version of the model and create and produce ideas for revisions and amendments collectively. Eighteen participants joined the online workshop, one from each company and one or more from each HEI. At the beginning of the workshop the main outcomes from the teachers' interviews and company interviews were presented to give the participants an overview and orientate them to the present situation.

Next, the leading group work really started. They met online, discussed, and reflected together several times. They read again through the interview data and started more deeply to analyze and interpret it. In addition, notes and comments from both workshops were reflected together in terms of finding the basic factors that would describe the preconditions for the collaboration. As a result, the model of university-industry collaboration was generated (Figure 1).

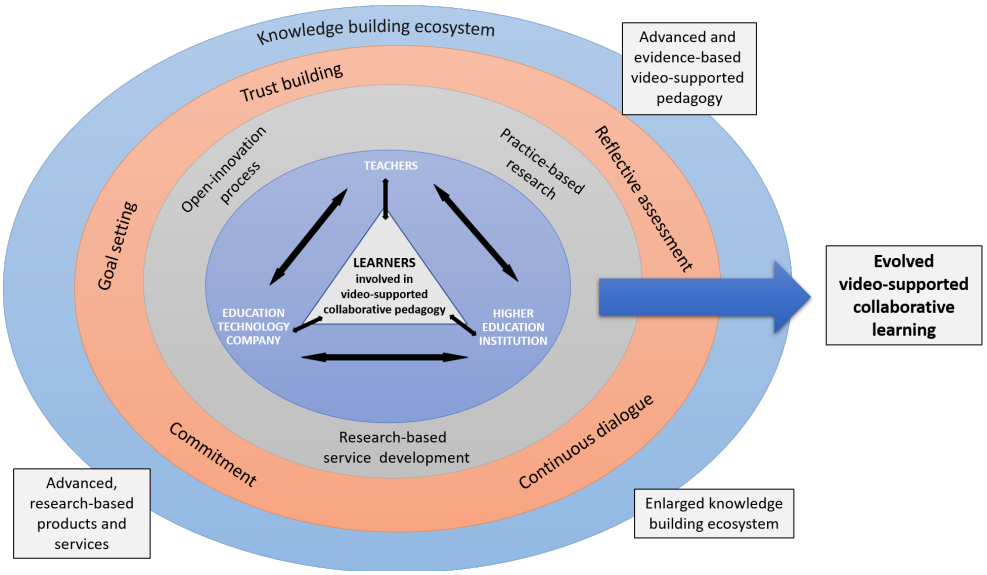

Figure 1. The university-industry collaboration model in the context of video-supported learning (see also Laitinen-Väänänen et al., 2020).

RESULTS

This study investigates which factors are significant in initiating, maintaining, and developing video-supported collaborative learning practices in the university-industry collaboration. In the model (Figure 1), especially the factors mentioned in

the red circle *trust building, commitment, continuous dialogue, goal setting, and reflective assessment* are considered important in the university-industry collaboration. The knowledge building ecosystem refers to the understanding that the collaboration between partners builds each partner's knowledge and the networks have similarities with the ecosystem way of working. The collaboration could also be described with the concept of an open innovation process, a research-based service development and practice-based research. These are crucial in opening the possibility for both HEIs and companies to receive added value from the collaboration.

According to the results of this study, the collaboration process is an iterative process, which asks for time, trust, and open communication. Establishing a partnership is both an essential and time-consuming issue in university-industry collaboration. At the beginning of the collaboration, the participants do not necessarily know each and their expertise and there is need to learn from each other in order to be able to jointly develop the innovation. The absence of social proximity may cause challenges in collaboration, which may be seen as lack of commitment to participate or even withdrawing from collaboration in the middle of the process. This also raises the question of how to motivate the participants to take part in the ongoing collaboration and this should be taken into account in the planning stage of the collaboration. An ideal situation is where all participants perceive the benefit from the collaboration. In addition, it should be noticed that the benefits are different; the companies seek business opportunities and user knowledge to enhance their products and services, and the universities are interested in pedagogical and learning benefits.

What is important is to be able to have dialogue and reflect during the collaboration. Innovation is always also a communication process. Communication, particularly when taking place across professional boundaries, needs particular care. Innovation emerges as a kind of synthesis of several points of view. This leads often to the problem of how to fit together different perspectives, in this case educational and business perspectives. Different perspectives can cause misunderstandings between partners. For example, those sending communications may be clear about the message they are transferring, but the receiver interprets the information differently. The receivers will understand the message from their perspective. These kinds of interpretive or communicative barriers can hinder collaboration. Collaboration can only emerge if all participants take part in the process of communication and interpretation. Related to the data (Table 2), the communication was considered essential and the need for communication channels of different kind including also face-to-face communication. Face-to-face communication enhances trust between partners and resolves possible conflicts.

In the beginning it is important to communicate and truly listen to each other trying to find shared language and joint understanding. This needs for verbalizing and sharing the expectations from both sides. Without a common language and concepts,

it is difficult to engage in a combination and exchange of knowledge. To the extent that participants' concepts are different, they keep participants apart and restrict their ability to gain access to other and their information. In this kind of situation, there is a risk for misunderstandings. According to the data (Table 2), this was seen clearly between teachers and IT experts. The teachers did not have the needed knowledge to use video technology and the IT experts' language use and concepts were not always understandable.

If both partners are not equally involved in the setting of the goals, there is a risk that the goals remain unclear. If partners have common goals, they have to reflect on the ways to reach it. The continuity is seen important in the partnership. To show the impact, the indicators need to be agreed together. In university-industry collaboration, it is very important to consider both the duration of the project and the mobility or changes of the persons involved in the project. Particularly, from the perspective of start-up companies three years can be quite long time to reap the desired benefits from the project. Moreover, from the perspective of personnel change, joining a project during the last year of the development process can be quite onerous for both parties. Naturally, people who leave in the middle of collaboration, for example, by changing their jobs, take them meaningful skills and knowledge that has already been achieved.

The collaboration process should not be considered as a static path; the process needs to be continuously evaluated based on objectives formulated by the partners and other stakeholders. According to the data (Table 2), reflective assessment was considered as an important way to evaluate the collaboration process. The reflective assessment is a process through which partners can experience assessment as a part of the collaboration, rather than as a separate evaluation.

Table 2. Overview of significant factors in the university-industry collaboration.

The university-industry collaboration model factors	**Referenced quotations from the data**
Knowledge building ecosystem	"In the future, technology plays a major role in education, but even more important is the substance of education; how and by what means, and how effectively in a pedagogical sense, the teaching and learning situations can be offered." "…Higher education institutions are seen as an important customer for companies, but difficult to reach."

	"We [the whole ViSuAL project/ collaboration] have the opportunity to create something that would add something new to the overall teaching practice – which would hopefully really lead to much wider implementation. And therefore, a much stronger impact on teaching and learning which we … believe in."
Trust building Reflective assessment Continuous dialogue Commitment Goal setting	"… trust has been built all over the project, all over the meetings, all over the interactions…" "… I would like us to ensure that the concepts and language we speak are also open to our target audience without interpretation." "… sit down to discuss what sort of goals the project should have and preferably, have the goals as realistic and concrete as possible". "One of the richnesses of this project is the fact that we are evaluating the experience before and after we are capturing [it]."
Open-innovation process Practice-based research Research-based service development	"…which means that there has been some perspective-taking, perspective-bringing or even perspective-sharing, we could say, and I mean coming from two different worlds, two different cultures." "The goal of the company is naturally to gain such knowledge of their own product or service during the project..." "When management and IT are committed and support the educational staff, everything looks much brighter in terms of collaboration." "…then we end up having just maybe a few practitioners within the institution who are obviously – if we think about the adoption curve of different kinds of innovators – early adopters, risk-takers who are willing to try something new, but when it comes to the actual proper

	integration within the whole team and structure, facilitation is lacking." "It was important since we've ended up collaborating a lot between us and it was fruitful sharing ideas and knowledge."
Teachers Higher education institutions Education technology company	"This is teamwork. It has to be the technology provider along with teachers and the university. For me, the university helped a lot by making the bridge between teachers and the technology provider." "…now I feel that if I had been the only teacher here without my colleagues, I would have been really lonely." "The biggest problems tend to lie in the relation between the HEI's IT department and the educators, that is, the people who do the most important educating work. The teaching staff may say that they need a specific tool or software, but the IT people may say that it is not possible…" "The biggest challenges are related to the hardware and software: 'to facilitate the proper and functional use of the technologies in a worthwhile and functional manner'".
Learners involved in video-supported collaborative pedagogy	"The university's technical services were a fundamental support for the development of the project, as they promoted activities with students with technological means that we did not have in the classroom and introduced the students to new ways of working in groups, presenting them with a set of new tools." "The company should build a closer dynamic with the users. It could be a simple online chat. In this situation, which is an experiment, with a product that might have different flaws and needs constant feedback from the developers …"

	"Students reacted positively to using videos in their teacher training and felt that there was increased support at the workplace while using the [company's] solution…"

CONCLUSION

The university-industry collaboration generates advantages like in this study advanced, research-based products and services, advanced, evidence-based video-supported pedagogy, enlarged knowledge building ecosystem and evolved video-supported collaborative learning. However, the collaboration should be handled properly. At the organizational level of relevant institutions as well as the individual level of participating managers, teachers, and learners are indispensable. The premise for a successful collaboration is a commitment and clear view of all partners what they wish to accomplish. Common goals and means must be clear when the collaboration set in motion. Collaboration helps create networks on the basis of the collaboration and they in turn enable further exploitation at a later stage. In addition, the prevailing cultural differences between university and industry, if we acknowledge and accept them, they may be an enriching experience.

Due to the Covid-19 crisis, digital and distance learning has taken a huge leap. Digital learning practices ask for platforms and tools to promote studying and interaction taking place during the learning process. HEIs in needing those tools will collaborate with companies providing such utilities. From the company perspective, in further developing their products, companies need HEI's management commitment and IT's understanding, users' feedback and in that teachers and students are an important source. In order to achieve the goals of both, cooperation and close interaction together with research are needed, so that what is learned can be shared and transferred to other environments.

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WORKING ON GLOBAL CHALLENGES: A PRE-UNIVERSITY STUDENT EXPERIENCE IN ONLINE PROJECT-BASED LEARNING

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ABSTRACT

Problem- and project-based learning (PBL) are learner-centered, inquiry-based approaches where learners work in small groups to develop solutions to complex, real-world problems. The purpose of this research was to explore Northeastern University's "Global Challenge" model for engaging early admission students in a fully online, asynchronous PBL environment designed to acclimate them with experiential learning at Northeastern. We explore two questions: (1) To what extent did students perceive that specific features of our model and its enactment supported their learning and collaboration in teams? (2) To what extent did students perceive that the course prepared them to apply specific collaborative and academic skills in future coursework?

Students in the PBL courses were asked to complete a mid-point course survey and an end-of-term survey. Both surveys asked questions about the extent to which various types of activity, materials, feedback, and other communications supported learning and motivation across the stages of the project. Findings suggest that the online PBL courses motivated pre-university students and helped them increase their readiness for university-level solving of real-world problems through inquiry and analysis, working collaboratively in teams, and self-directed learning.

INTRODUCTION

Northeastern's Global Challenge, a fully online project-based learning course model, arose in response to constraints imposed by the pandemic and a political context in which domestic and international students could not learn in residence. These courses were structured around complex, global, interdisciplinary problems that were derived from faculty research topics (e.g., systemic racism, antibiotic resistance, immigration justice). Co-designed by faculty members and learning

specialists with expertise in online and PBL pedagogies, the course activities and environment were intended to help pre-college students develop specific academic and collaborative learning skills, in addition to knowledge in the content areas being studied. The courses, which ran during the Spring 2021 semester, were facilitated by PhD students with disciplinary expertise, who had completed an intensive training program for teaching the online Global Challenge courses. These courses, which were extensively documented and studied, constitute a next-generation model for experiential learning.

The Spring 2021 courses were the second iteration. The first iteration was delivered In Fall 2020, with first year college students as the audience. A pilot study of those courses revealed that while students developed research skills and gained knowledge about the project topics, there was a need for additional scaffolding in the course design, more peer-to-peer interaction, and more explicit steps with iterative feedback for the project deliverables. These findings informed the second iteration of the courses, which were offered to secondary school students admitted to Northeastern University under the Early Admission (pre-university) program.

The purpose of this study was to explore how final year secondary school students who have been admitted to Northeastern University experienced learning, motivation, and community in the online Global Challenge courses, and how they perceive this experience to have prepared them for their upcoming university courses. The research questions addressed in this study include: (1) To what extent did students perceive that specific features of our model and its enactment supported their learning and collaboration in teams? (2) To what extent did students perceive that the course prepared them to apply specific collaborative and academic skills in future coursework?

LITERATURE REVIEW

Project-Based Learning

Project-based learning (PBL) is "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic (real-life) questions and carefully designed products and tasks" (Buck Institute for Education, 2003, p. 4). In this model of PBL, a problem is the pedagogical base of the curriculum and features include ongoing self-reflection and self- and peer-assessment.

PBL and other experiential approaches can lead to deep, engaged learning. Such approaches have been found to ignite learner motivation and engagement (Bransford, 2000), facilitate knowledge acquisition and retention, promote transfer of learning to other contexts (Bransford, 2000), foster development of personal and professional skills, such as teamwork, communication, organization, and planning

(Wurdinger & Carlson, 2010), and increase career readiness and self-efficacy (Dunlap, 2005). However, the quality of the learning that comes from experiences may vary widely, depending on many factors related to both the learner and the learning environment.

PBL differs from more traditional approaches, and prompts learners and educators to assume different roles (Wurdinger & Carlson, 2010). For example, PBL educators step back from being the authority or expert in the course, and instead focus on creating a learning environment and facilitating the learning process. Specifically, the teaching in this context consists of scoping and defining relevant projects with (sometimes) external project sponsors, providing resources, and interacting with students responsively in the form of feedback and coaching. Learners in PBL work in teams to define and schedule their work, connect course concepts to their experiences, construct knowledge, monitor their progress and learning processes, and seek help as needed. They develop their work iteratively, with frequent feedback from peers, the educator, and external project sponsors.

Online Learning

Definitions of online learning are complex and often consider the use of technology, the element of time - synchronous or asynchronous, and terms often used interchangeably. As a result of their systematic review of the literature on online learning from 1988 to 2018, Sing & Thurman (2019) defined online learning as "education being delivered in an online environment through the use of the internet for teaching and learning. This includes online learning on the part of the students that is not dependent on their physical or virtual co-location. The teaching content is delivered online, and the instructors develop teaching modules that enhance learning and interactivity in the synchronous or asynchronous environment" (p.302). The Learning Experience Framework (Boettcher & Conrad, 2021) highlights the four elements that make up a structured learning experience - the learners, the instructor/mentor, the content knowledge and skills that guide the learning outcomes, and the environment or context where the learning occurs. These elements can be used to guide the design and delivery of online course experiences.

METHODS

At the mid-term and at the end-of-term of Spring 2021, all students enrolled in a Global Challenge course were asked to complete an online survey in Qualtrics. The survey links were shared with all students in the project courses (n=48) and in each case were available to them for approximately two weeks. Students were prompted to enter a unique identifier so that individual respondents could be matched and compared across surveys. There was a 50% response rate to the mid-term survey (n=24) and a 42% response rate to the end-of-term survey (n=20). Nine students responded to both surveys.

The mid-semester survey included 12 closed-ended questions with the option for the students to provide additional details with optional comment boxes. There was also one open-ended question These questions were grouped into categories of course design, connection and sense of belonging, motivation, and learning support. The end-of-term survey was composed of a very similar set (for comparison) of 12 closed-ended questions, again with the option for the students to provide supplemental comments. The questions were grouped into categories related to: (1) the perceived helpfulness of the learning activities and communications, (2) the perceived learning (knowledge and skills), and (3) advice for future students.

The multiple-choice item responses were analyzed with basic descriptive statistics. The open-ended item responses were analyzed and categorized to help explain the responses to multiple-choice responses.

RESULTS

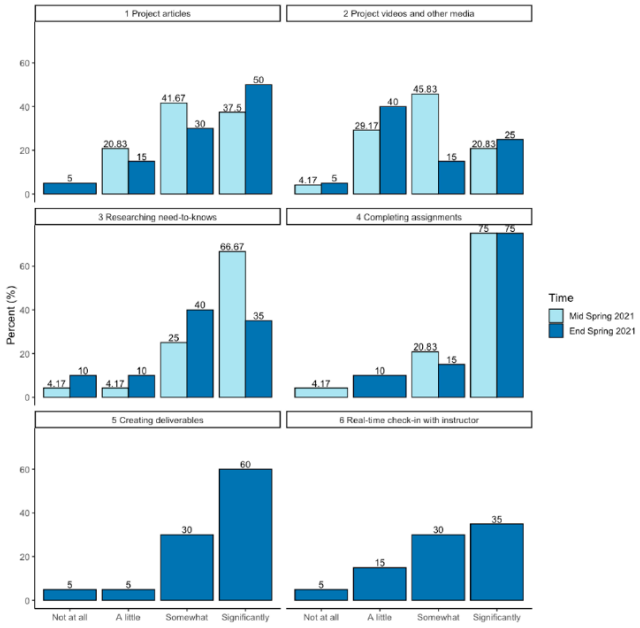
Perceived Helpfulness of Specific Activities and Communication

Our first research question aimed to examine the perceived helpfulness of specific activities and communication for learning and collaboration. The survey results aligned to this question include the helpfulness of specific activities, helpfulness of teamwork supports, helpfulness of peer and educator feedback, and project work and knowledge acquisition.

Students were asked to indicate the extent to which each of several kinds of course activities (articles, video, and other media, researching need-to-knows, completing assignments, creating deliverables, and real-time instructor check-ins) were helpful to them. Of the activities included in the survey, completing activities, and creating deliverables asynchronously were viewed as most helpful at both the mid-term and the end-of term, with 90% of students indicating that these activities were "significantly" or "somewhat" helpful at both points (Figure 1). Only 65% of the students identified real-time check-ins with the instructor as either "significantly" or "somewhat" helpful. When juxtaposed with student responses indicating that having real-time conversations and feedback are valuable, it seems that while real-time communications may be desired, more learning takes place through asynchronous work.

Figure 1

Perceived helpfulness of course activities



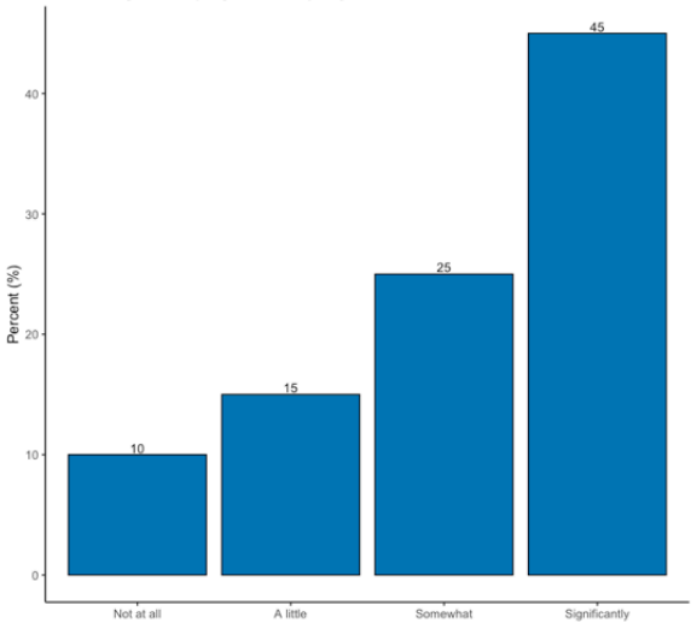
Two of the comments that support the significance of the activities and instructor check-ins are as follows:

> *"I found all of the readings and supplemental assignments to be very helpful for my learning, and the instructor was always here to support me."*

> *"I think the integration of these aspects has made me achieve success through the project. It is a gradual process and highly efficient."*

On the end-of-term survey, students were asked about the extent to which the teamwork support tools were helpful, including templates for a team agreement, a team assessment, and a project plan. 70% of the respondents indicated that the tools were either "significantly" or "somewhat" helpful (Figure 2).

Figure 2
Perceived helpfulness of teamwork support documents



Regarding the team agreement template--which included some suggested roles and prompts to decide on appropriate message response times and what to do if someone did not do their work on time--the results were mixed. Some students reported that this template helped their team get organized and divide the work efficiently, while others found it less than helpful, because they wanted to customize the roles. They also noted that their processes evolved
during the course, making the original plan obsolete.

However, the project plan and assessment templates were consistently viewed as helpful. Students reported that these tools helped with planning, organization, and accountability within their teams. One student noted that as the level of planning went up, so did the quality of the work.

> *"I loved the project plans and it helped me personally hugely to have a specific plan that ensured time management. The team agreement served as a good general guide but was a bit oversimplified and formulaic."*

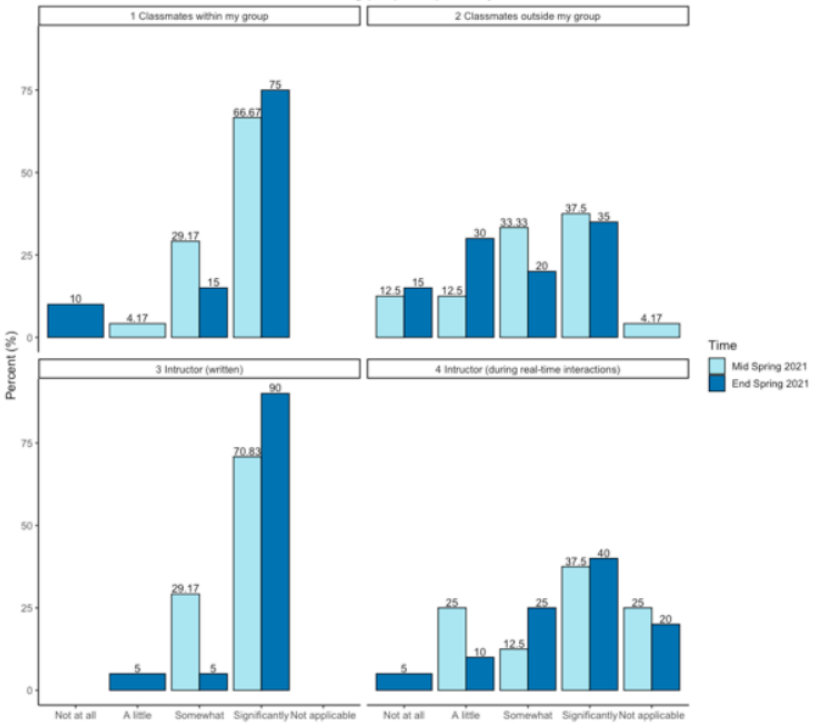
> *"They were helpful in organizing our work and it was easy to share the work and make sure everyone was doing enough."*

Students were asked what type of feedback was most helpful for improving their work. Survey results show that students valued the instructor's written feedback the

most (95% “somewhat” or “significantly” helpful), with group mates’ feedback the second most valuable (90% “somewhat” or “significantly” helpful) (Figure 3).

Figure 3

Perceived helpfulness of peer and instructor feedback



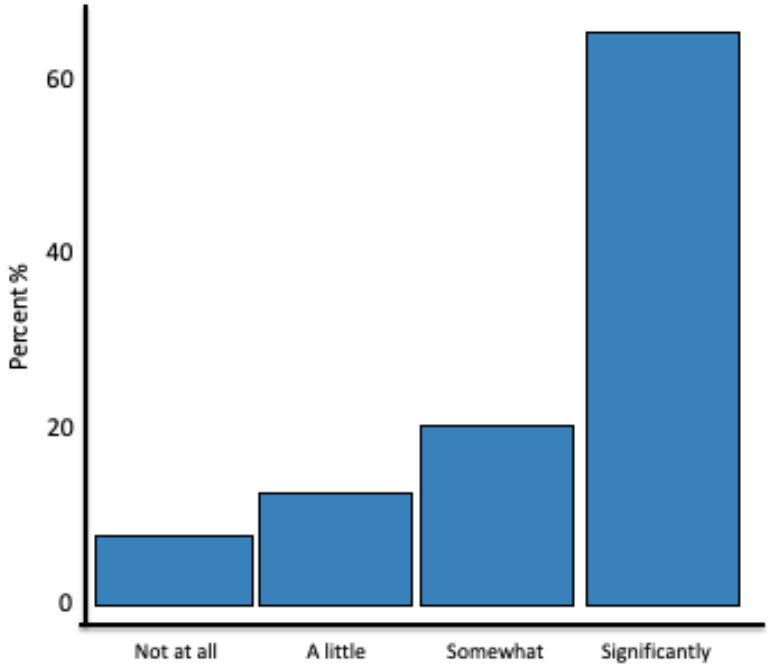
Comments indicate that some of the feedback from peers outside the group lacked clarity or was challenging to digest due to the text-based nature of it. However, they did appreciate the diverse perspectives that they gained through this process. While some comments indicated that students prefer receiving feedback in real-time discussions, responses to the multiple-choice question suggest that this mode was not necessarily as effective.

> *“I loved every chance to engage and compare thoughts.”*

> *“Peer feedback was incredible. Also, the instructor gave us written feedback and notes over zoom which was also very helpful.”*

Another survey question asked students to what extent their project work helped them to increase their knowledge about the course topic. 85% of the students reported that their knowledge about the course topic increased somewhat or significantly (Figure 4).

Figure 4
Perception of increased knowledge about the course topic



The comments linked to this question indicated that all aspects of the course - and in particular the integration of them - supported their learning.

> *"I found all of the readings and supplemental assignments to be very helpful for my learning, and the instructor was always here to support me."*

> *"I think the integration of these aspects has made me achieve success through the project. It is a gradual process and highly efficient."*

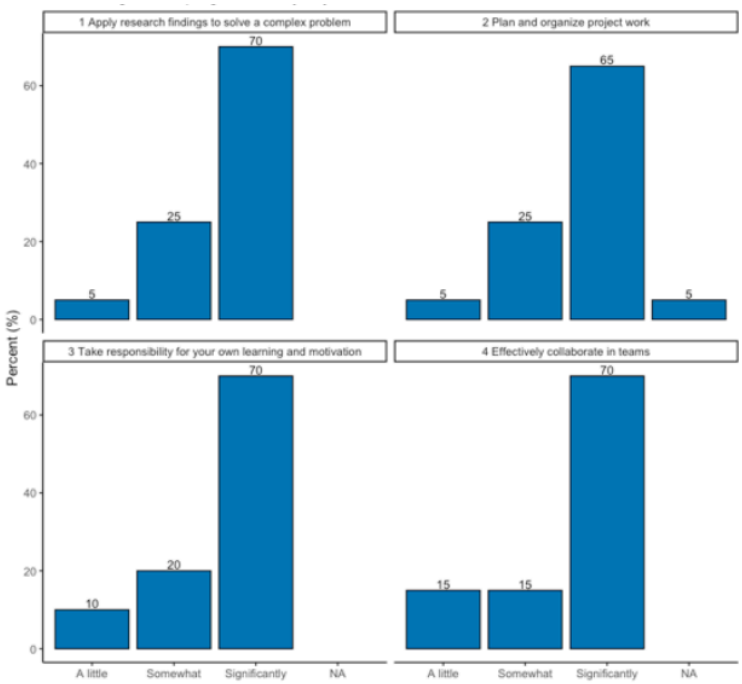
Application of Specific Collaborative and Academic Skills Through Project Work
Our second research question was focused on how students perceived that they could apply specific collaborative and academic skills that they gained through the project work to future courses.

Students were asked about the extent to which their experience in the project course prepared them for specific types of coursework in the future. Responses indicate that

students believe the experience prepared them well for each of the four types of coursework that we asked about (Figure 5).

Figure 5

Perceptions for Preparation for Future College Courses



In open-ended responses, students reported that they gained confidence, knowledge of how to take a college course, and skills in teamwork, problem solving, project planning, and working efficiently.

> *"I think I developed the most skills working within a team and solving problems because those were newer experiences for me. I have already practiced a lot throughout high school with organization and motivation."*

> *"I learned more about researching and applying research at a college level. Some things, like diversifying sources or even in-text citations have not been heavily stressed in my high school experience so that was a learning curve that I appreciated."*

> *"With the research and plan toward my project, I can understand more about how to finish my projects in a comprehensive perspective and finish them in high efficiency."*

Finally, students were asked what advice they would give to future students in these courses. The most frequently mentioned suggestions were to stay ahead of the work, communicate with groupmates frequently, and plan and organize time. Several students also mentioned the importance of understanding what a proposal is, how to write it, and keeping each section in mind as you are writing.

> *"Make sure you meet more often than you think you should, it is definitely easier to split up group work into a few days rather than just doing it all at once."*
>
> *"I would say figure out where you're going with your section 3 as early as possible. We changed course/honed in as we went and as a result were always playing catch up."*
>
> *"Make sure to keep up with your personal deadlines you set for yourself and make a plan for when you are going to complete each assignment. Also, expect to change all your proposals in order for them to flow altogether. When choosing ideas, make sure to think about how you will be able to relate future sections of the proposal together."*
>
> *"Having a hard time in a group work is common, but just remember that everyone in the group is trying their best for a good result, so it is important to not give up easily when problems appear."*

CONCLUSIONS

Our research indicates that students who completed the global challenge courses perceived that the skills and experience gained can be helpful to their future studies at the university level, particularly in the areas of research and analysis and teamwork. In addition, students were motivated by the course topics and accountability to their team members. These findings suggest that leveraging ill-structured real-world problems is a viable approach to engaging and supporting motivation and learning and fostering development of academic skills in pre-university students. However, to be effective, the learning environment must be carefully designed to support the project workflow (rather than weekly content modules frequently seen in more traditional courses), and to scaffold teamwork and course navigation. Further, we found that to be effective, facilitators need not only disciplinary knowledge, but also specialized knowledge in online teaching and PBL. Thus, institutions investing in this approach must develop a system for supporting the development of instructor-facilitator capacity to support project-based learning and team-based group work.

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SELF-DIRECTED LEARNING COMPETENCIES - A KEY TO SUCCESS IN ONLINE LEARNING

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ABSTRACT

Announced by M. Knowles (1975) and developed by the other scientists, self-directed learning competences, are more and more important in XXI century and especially in online education. Here even more than in a contact students need to know how to organize and manage their learning. They need self-directed learning competences. As well as teachers need to know how to develop those skills for the students, how to organize studies for self-directed learners and how to prepare the qualitative online courses. That was the main research questions.

Research methods: content analysis for theoretical background and the questionnaire of students and educators for the gathering of empirical data.

Empirical research showed that those students who had developed self-directed learning competences are more successful than others. As well as the educators - those who had self-directed competencies overcome all online teaching challenges easier, and those who had experience in online teaching and didactical knowledge and skills how to prepare qualitative online courses were more successful and felt less stress and had less problems in online teaching.

The main conclusion is the need to develop self-directed learning competencies for students and for educators as well as didactical competences of educators in preparing online courses.

SELF-DIRECTED LEARNING COMPETENCIES IN THE CONTEXT OF ONLINE EDUCATION

In its broadest meaning, "self-directed learning" describes a process by which individuals take the initiative, with our without the assistance of others, in diagnosing their learning needs, formulating learning goals, identify human and material resources for learning, choosing and implement appropriate learning strategies, and evaluating learning outcomes." (Knowles, 1983, p. 18). The operational definition most used in defining self-directed learning includes that it consists of a complex of

attributes, values and interests, and creates the likelihood that adult learners are capable of self-directing their learning (Merriam et al., 2007; Wang & Cranton, 2012). So, announced by M. Knowles (1983) and developed by the other scientists (McKain, 2019; Brookfield, 2013; Kazlauskiene at al., 2014; Poceviciene, 2019; and etc.), self-directed learning competences, are more and more important in XXI century and especially in online education. One of the most valuable features of online education is that students are able to reach the course and study it in any suitable for them time, place and duration, without direct and synchronic contact of educators. On the other hand it's obvious that to study independently, even in a distance and in asynchronic way students need to know how to organize and manage their learning and time, how to motivate themselves and etc. In other words, they need self-directed learning competences. As well as teachers need to know how to organize studies for self-directed learners, how develop those skills for the students and also how to prepare the online courses in such purpose and in general what are the main guidelines and the criteria for qualitative online course in high education.

The research questions:

- What factors are the most important for the success in online learning process for students and for the educators?
- What factors are the most important for the success in online teaching process for educators?
- What competences need educators for the organization of qualitative studies in high education?

Research methodology

Theoretical and empirical research methods were used: content analysis for theoretical discourse analysis and questionnaire of students and educators with the purpose to clear up what was their experience in online teaching and learning process, what factors and competences helped them to achieve the success and what they learned from their experience as well as what challenges they had, what didactical competences they have and need that to prepare qualitative online course. **Research scope:** 94 full-time and 76 part-time students of sciences and social sciences, and 38 teachers working with full-time and part-time students.

Research results

Content analysis of theoretical discourse enabled to confirm theoretical background for self-directed learning competencies' place and importance in online teaching / learning process (Brockett, Hiemstra, 1991, Candy, 1991, Pocevičienė, 2014, 2019, Kazlauskienė, Gaučaitė, Pocevičienė, 2015, 2016, Kazlauskienė, Masiliauskienė, Gaučaitė, Pocevičienė, 2010, 2013, Knowles, 1983, Melnikovas, 2017 etc.). Empirical research showed that those students, who had developed self-directed learning competences (for example, such as abilities as time management, self-motivation, self-control etc.), are more successful than others overcome all the

challenges of online learning (*Studies during quarantine*, 2020). As well as the educators – those who had self-directed competencies and knew how to organize and how to develop self-directed competences of their students – overcome all online teaching challenges easier than those who had not. Also those who had experience in online teaching before the pandemic, and those who had didactical knowledge and skills how to prepare online courses or adopt contact studies for online version also were more successful and felt less stress and had less problems in online teaching and learning.

Table 1
Online Learning Experience

Kind of activities	**Percentage**
Mostly in contact:	
Practical placement	**59 %**
Practical activities (labs, practicum etc.)	**65 %**
Completely in a distance	
Consultations	**88 %**
Mid-term exams	**84,7 %**
Final exams	**90,5 %**
Lectures (in social sciences)	**60, 6 %**
Practical activities (social sciences)	**40,1 %**
Mixed manner	
Lectures (in sciences)	**38,7 %**
Practical activities (sciences)	**24,1 %**

As it‘s obvious from the analysis of the table is seen that majority of teaching/learning activities during the quarantine because of the Covid-19 pandemic were organized constantly in a distance, except practical activities for students of sciences. Indeed it‘s understandable, especially keeping in mind that in applied universities more than a half of studies are orientated to practice.

Survey of students and educators with the purpose to clear up:

- what was their experience in online teaching and learning process,
- what factors and competences helped them to achieve the success,
- what they learned from their experience in online studies,
- what challenges they had studying online,
- What didactical competences they have and what competencies do they need that to prepare qualitative online course.

Also the links among success in online studies and the self-directed learning competencies were investigated. Self-directed learning is understandable as learning through which a person:

- identify learning needs on its own initiative,

- set goals,
- planning to learn,
- creates or chooses learning environments and tools, learning strategies, etc. that are suitable for oneself,
- self-evaluate achievements and own progress. (Pocevičienė, 2014, 2019, Kazlauskienė, Gaučaitė, Pocevičienė, 2015, 2016, Kazlauskienė, Masiliauskienė, Gaučaitė, Pocevičienė, 2010, 2013, Knowles, 1983 etc.).

Table 2
Students Experience in Online Teaching/Learning Process

Students Experience	**Percentages**
Did not achieve success at all	**6,7 %**
Not successful at the beginning, but quite good later	**19,7 %**
The same as in auditorium	**18,2 %**
Maybe even better than in auditorium	**32,8 %**
Was very successful	**22,7 %**

Analysis of the results confirm that majority of students were successful (the same as in auditorium or even more) studying in a distance. And only 6, 7 % of them had issues to overcoming the difficulties of teaching/learning online.
It enabled to analyse their experience deeper looking for the factors, on one hand, which enabled students to achieve success, and, on the other, what were the reasons of fall of others. With this purpose the questionnaire was divided into two parts: factor of success and factors of failure.

The results of the survey are presented in two figures.

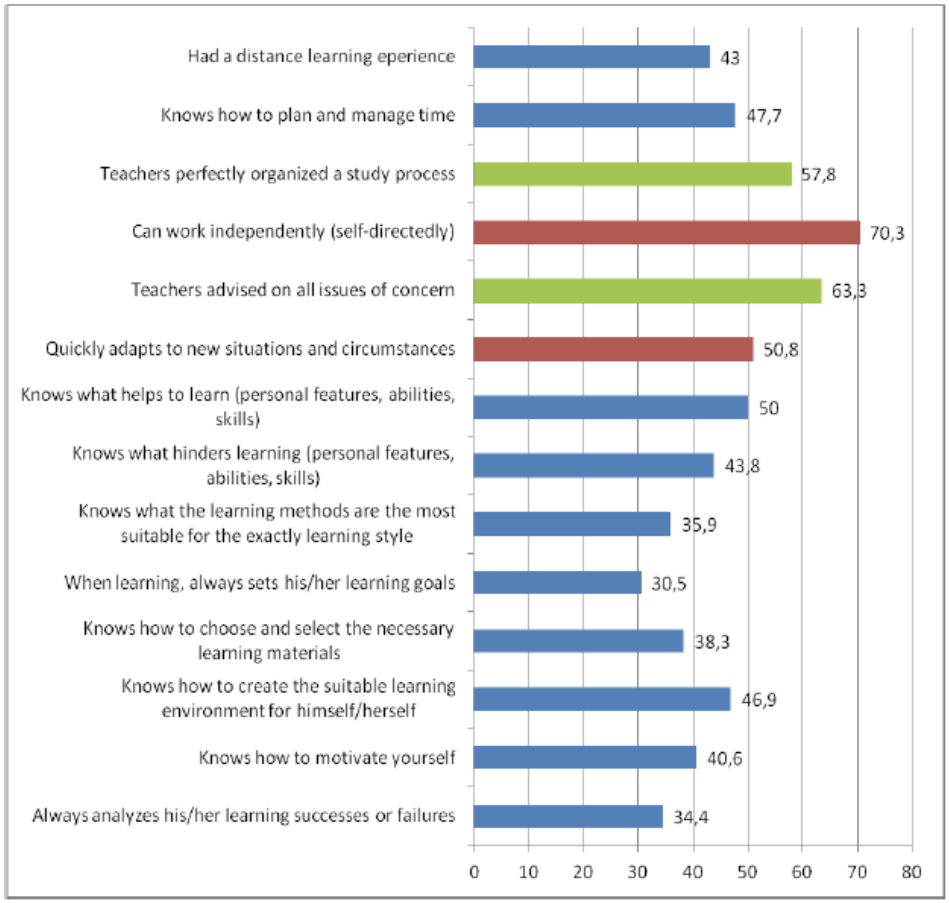

Figure 1. The factors that enabled to achieve success in online education

According to the figure it's obvious that the most relevant factor of achieving success is ability to work independently that indeed means self-directed learning competencies. In other words, it means that even according to the students' opinion, those who has developed self-directed competencies, those are more successful also in online teaching/learning process.

No less relevant in this process are also teacher's competencies, especially their academic support for students (63,3 % of students said that "teachers advised on all issues of concern) and their educational competencies (teachers perfectly organized the study process – 57,8 %).

The relevance of self-directed learning competencies for successful studies is confirmed analyzing the separate abilities which indeed are the abilities of self-directed learning.

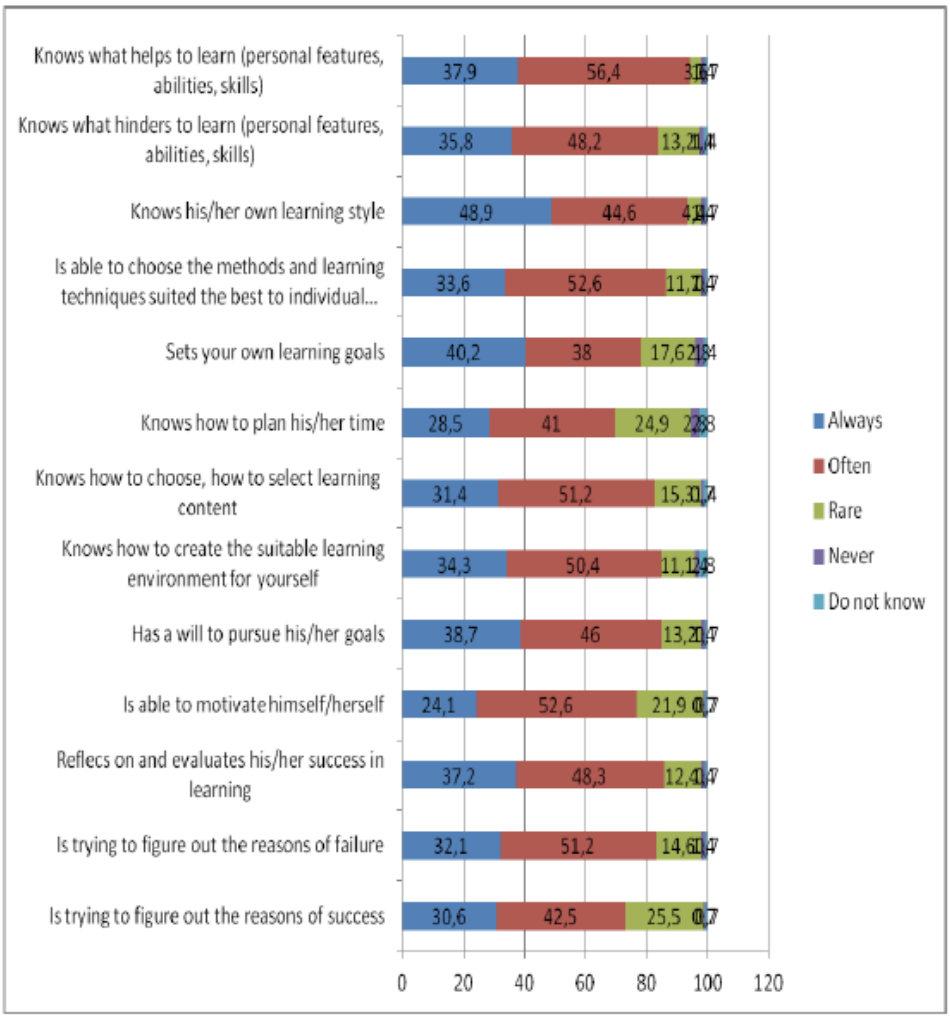

Figure 2. Students' opinion about their abilities of self-directed learning competence

The best developed abilities, according to the opinion of students, are the knowledge about themselves as a learners (for example, always: "Knows his/her own learning style" – 48,9 %; often: "Knows what helps to lean (personal features, abilities, attitudes) – 56,3 %). Also they confirmed that they have abilities how to create the suitable for themselves and their learning style environment, to choose appropriate learning methods and techniques suited the best to their individual features as learners and as human beings.

The most problematic abilities, according to the opinion of respondents, are ability to figure out the reasons of success, ability to motivate them, manage their time or, more exactly, the priorities and so on. The factors which had negative influence on success in online teaching/learning process are presented in figure 3.

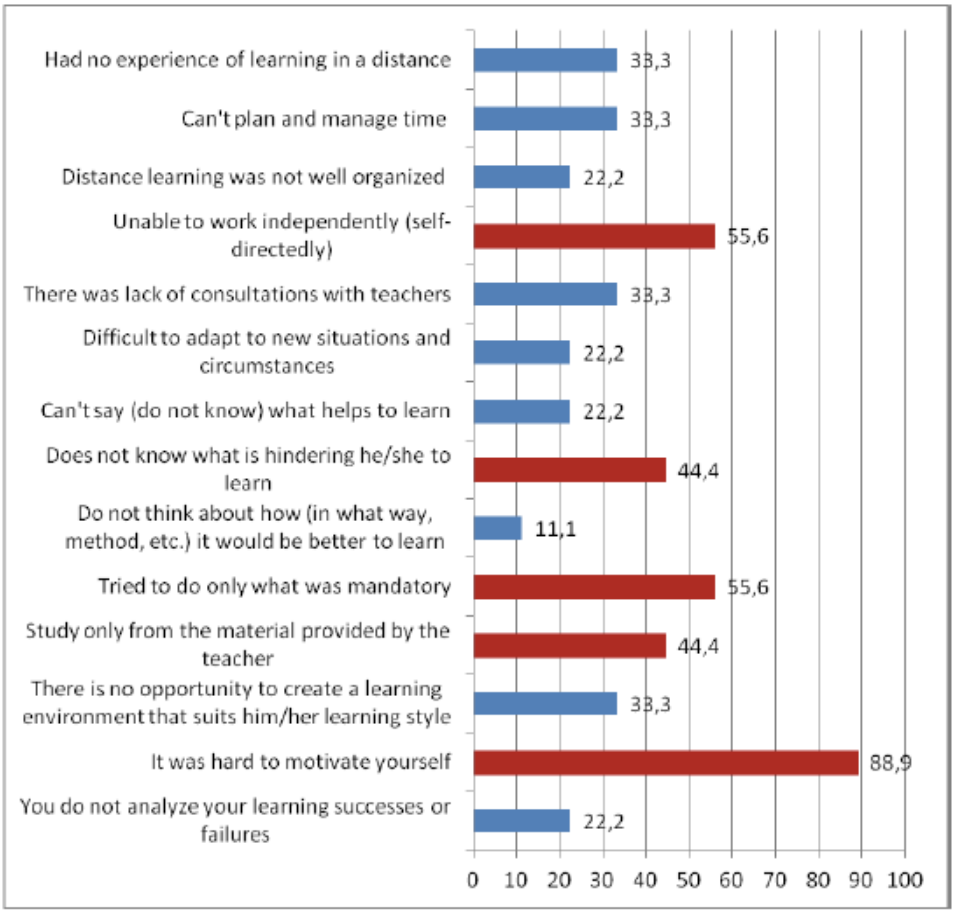

Figure 3. The factors that did not allow achieve success in online education

The most influencing factor here, according to the students themselves, is hardness to motivate themselves (88,9 %). More than a half of students recognized that reasons of their failure was their not active involvement into study process ("tried to do only what was necessary" – 55,6 %) and lack of self-directed learning competencies (55,6 %).

It's obvious that for the best quality of any process all the partners should be active and involved. Teaching/learning process is not the exception, because of this reason it's mandatory to analyse teachers' opinion and their experience in online education during the quarantine because of Covid-19 pandemic.
In our survey teachers' were asked to evaluate their experience and explain what the changes were done in their teaching process if they were done at all. The absolute majority (84,4 %) of teachers said, that they made changes in their teaching process. What changes were done is seen in the figure 4.

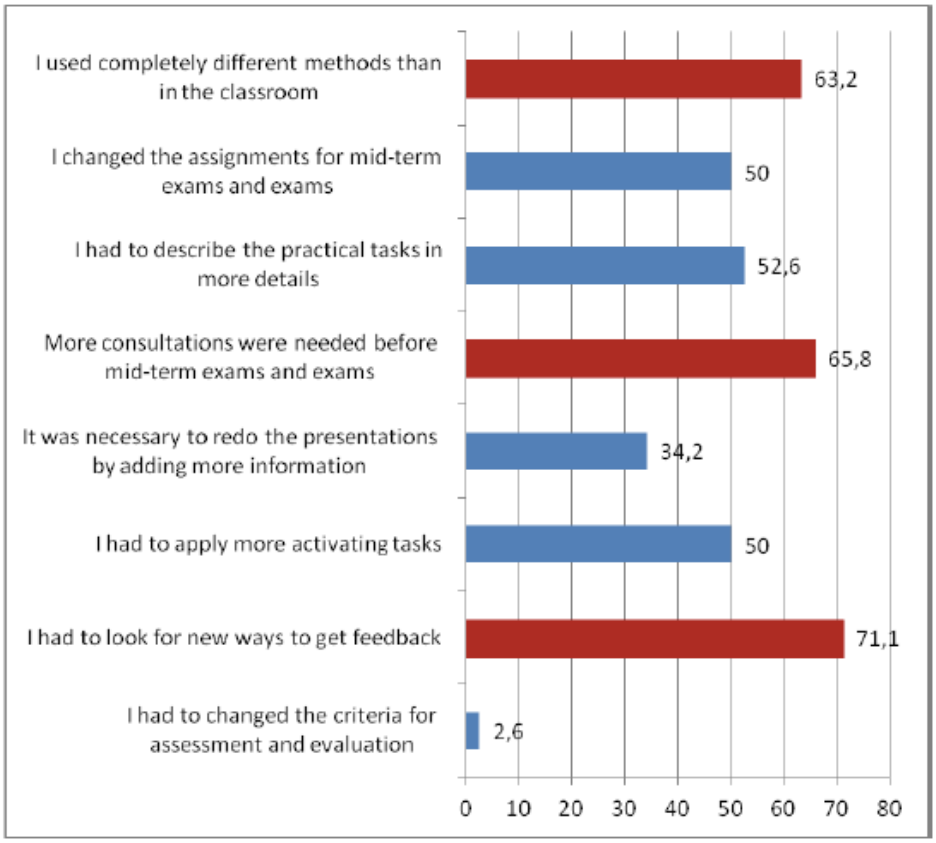

Figure 4. Changes were done in teaching process organizing studies online

According to the results of the survey, the biggest changes were done in communication among students and teachers: new ways to get feedback (71,1 %), more consultations before mid-terms exams and exams (65,8 %) as well as new – different than in the auditorium – teaching and learning methods (63,2 %).

To assess the experience was useful not only for better understanding what happened, but also to know how to organize online teaching/learning in future, because even from the answers of our respondents is clear that distance education has its future.

Table 3
Respondents Opinion about Online Teaching/Learning Process in Future (%)

Respondents	Would you like to continue distance learning even after the pandemic?			
	Yes	Partially	No	No opinion
Teachers	**46,7**	**46,7**	**6,6**	**-**
Students	**68,6**	**-**	**16,1**	**15,3**

As it is shown in the table absolute majority of teachers and majority of students saw the opportunities to continue online education also after the quarantine and pandemic. In what activities it would be possible is seen in the Table 4.

Table 4
Respondents Opinion about Online Teaching/Learning Process in Future (%)

Respondents	Kind of activities online		
	Remotely only	Contact only (in the auditorium)	Both remotely and contact
Lectures	**47**	**4**	**44**
Workshops	**12**	**37**	**46**
Lab works	**12**	**46**	**37**
Internships (also in companies, organizations)	**9**	**54**	**32**
Preparation and defence of term papers	**36**	**8**	**51**
Consultations	**47**	**3**	**45**
Interim settlements	**69**	**-**	**26**
Exams	**65**	**2**	**28**
Preparation and defence of final theses / projects	**31**	**12**	**52**

Logically, that teachers as well as students think that lectures, consultations even exams and other assignments could be organized remotely or in mixed manner, but such activities as internships, labs and similar should be organized in a contact way.

Conclusions:

- It is necessary to develop self-directed learning competencies for students and for educators, because it's impossible to develop in students what educators are not developed in them
- To develop educators' knowledge and skills in preparation online courses, because online courses have their own, unique didactical demands in comparing with contact education, their strengths and weakness, threats and possibilities. And educators need to develop their didactical competences in online education. This is even more important for high education because quite a lot of educators have no educational background and professional competences. They can be good specialists in the area they teach, but lack special educational competences.
- The results of the research encouraged creating the courses for non-formal education to students and educators. The main purpose of the courses is to gather knowledge and to develop skills of self-directed learning competences. As well as the seminars for educators (one about the developing of self-directed competences and another about the most important didactical aspects of online courses) were prepared and organized.

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A PHOTOVOICE PROJECT ON THE SELF-REGULATION OF TEENAGERS: FROM SELF-REGULATING TO REGULATING TOGETHER THROUGH DIALOGUE.

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ABSTRACT

This study concerns explorative research into stimulating self-regulation among young teenagers from a social-constructivist and emancipatory approach to learning and learners. We develop an interaction tool that challenges and supports young teenagers and their teachers in (1) conversations and reflections about self-regulation in the classroom and (2) the co-creation of a learning environment which fosters self-regulation. Using the Photovoice methodology we give the teenager a voice as fellow researcher in the development of this interaction tool. The same participative approach is carried over in the developed interaction tool. Inspired by the concept of 'socially shared regulation', the design centres learning together, directing together, and designing together. We are testing the instrument that emerges from this in various schools.

INTRODUCTION

Education research, policy, and practice all emphasise the importance of self-regulation. The conceptual frames used for this, however, are highly diverse, as are the terms used: self-regulation, self-direction, executive functions, self-regulated

learning, ownership in learning, etc. Consequently, there are many questions among researchers, policy makers, and teachers regarding the conceptual boundaries and clarifications, the place of self-regulation in the curriculum, and the concrete support you should offer as a teacher

In this research, we start from the challenge of encouraging self-regulation among young teenagers in a classroom context. After all, our education system often relies heavily on the self-regulation of teenagers, more so today with the regular use of remote learning due to the covid-pandemic. This requires the teenager to achieve certain learning objectives independently and consequently also self-regulated. We see that teenagers often find this self-regulated learning difficult and that they risk losing their motivation. We also listen to the concerns of teachers who wonder if teenagers are ready for this and who wonder how they can stimulate the self-regulation of teenagers.

In the context of encouraging self-regulation, teachers predominantly focus on teaching pupils self-regulation skills, often framed in lessons on 'learning to learn'. In the past years, several models, (teaching) methods, and concrete materials have emerged which can support them in this. These methodologies often start from a strongly directed approach that is gradually weakened. This mirrors the witticism 'you can't self-regulated learn self-regulation'. However, we wonder whether a more participative approach would connect better with the way young teenagers function and with an emancipatory view of learners. How do young teenagers 'themselves' interpret the self-regulated work and what need for support do they want to achieve targets or learning objectives? In other words, can we develop a methodology that allows young people participate in directing their learning and offer them the necessary support?

YOUNG TEENAGERS INTERACTION, REFLECTION AND SELF-REGULATION

Steinberg (2015) describes the teenage years as 'the age of opportunity'. In this paragraph we describe some typical traits of this promising time of life and what this means for the interaction, reflection, and self-regulation of and with them. We focus specifically on the age group ranging from 10 to 14-year-olds (young teenagers).

From a child's brain to an adult brain

The teenage brain is developing and very plastic. This means that new connections can be made very quickly, as is the case with young children. It allows teenagers to often think very flexibly and creatively. The teenage brain is going through major changes. The main change is that unused connections in the thinking and processing part of your child's brain (called the grey matter) are 'pruned' away. At the same time, other connections are strengthened. We call these processes 'pruning' and

‘myelenisation’. This is the brain’s way of becoming more efficient, more like an adult brain (Crone, 2008; Van Camp et al., 2015; Medina, 2018).
The parts of the brain that govern reflection and self-regulation are located in the prefrontal cortex, the part of the brain that is the last to mature. These structures continue to develop till the age of 25 (Steinberg, 2015). This makes it difficult for teenagers to direct themselves. They are often impulsive (Medina, 2018). *”Teenagers follow their instincts. They see and react. What is still in development is the little word that has to come between: seeing, thinking, and reacting.”* (Adriaenssens, 2006, p34). Teenagers can achieve strong cognitive accomplishments, but they need support in managing their emotions, thoughts, and behaviours. In the context of self-regulation, it is therefore important to support reflection and metacognition in teenagers (Debacker et al, 2021). This can be done by modelling and making explicit (De Smul et al, 2018) but also through providing scaffolding (Donggil & Dongho, 2020) for this with the use of methodologies which help them to control impulsive reactions, which encourage them to think, and which support them in verbalising their thoughts.
The challenges that teenagers face with regard to their developping self-regulation, don’t negate that they like having and taking responsibility for what they can. Research shows that focussing on ownership and responsibility with teenagers works. Deci & Ryan (2012) confirm this in their own research into the power of autonomy, togetherness, and competence to motivate teenagers in an educational context.

The social-emotional development of the teenager

Developmental psychologists mark the teenage years as a time when the importance of peer relationships increases sharply. Because teenagers are going through a period of large changes, they need peers with whom to associate and compare themselves (Wentzel, 2017).
We also see that the need for social recognition is very high during teenage years. This is confirmed by developmental psychologists and neurological research also proves that the impact of acceptance and positive feedback is larger for teenagers than for children or adults. This is in part because the reward centre (nucleus accumbens) is very sensitive in teenagers. The recognition or positive feedback from peers appears to be even more important in this regard than those of parents or teachers (Crone, 2008; Crone, 2012).
This makes the use of the teenagers’ need for social comparisson and recognition a powerful tool to stimulate the development of teenagers. This means making time for (guided) interaction, even in the classroom. When doing this, it is important that you recognise the social-emotional vulnerability of the teenager and adapt your style of communication. *”Communication is difficult and yet most people only really realise that they have difficulty communicating when they talk to teenagers. (...) They let you know whether or not you’re really communicating. (...) You need to really*

communicate with teenagers or they will, literally or figuratively, leave." (Delfos, 2016, p.22) During interaction with teenagers, it is important that safety, equality, and connectedness are centred. Adopting the perspective of the other and trying to understand what they are saying has to be the starting point of the interaction (Beerten & van Waterschoot 2020; Laevers & Heylen, 2013). You can model and explain this attitude. *Turning to an example is inherent in the identity development of young teenagers (just consider youth idols). Children and young people learn most behaviours by seeing and emulating their surroundings.* (Adriaenssens, 2006).
Self-regulation and learning in teenagers can also be viewed from the social development that is central to this period by starting from a social constructivist approach to learning and self-regulation. Co-creation, the joint creation (of meaning), is central to this approach. We find a social constructivist approach to self-regulation in the recent concept of 'socially shared regulation' (Hadwin et al., 2018). Only a little research has been done into the implementation of this theoretical concept in practice.
Starting from this information about the functioning of young teenagers, how can we work on self-regulation in class? Where are their strengths and needs? How exactly can we provide the support that will lead to more 'self-regulation'?

STUDY DESIGN

The following study concerns a Practice-oriented Scientific Research project that runs from September 2020 to August 2022. It concerns an explorative research, both though the *participative* and *constructivist grounded* approach and through the social constructivist approach of self-regulation as *'socially shared regulation'* and the interaction tool inspired by it developed for *young teenagers* and their teachers.

Research goal and research questions

Prior research confirms the importance of interaction, appreciation, participation, and social learning for young teenagers, as well as the supporting role of metacognition and reflection in self-regulation. The goal of this study is to determine how we can encourage the *self-regulation* of young teenagers by using these insights. In doing this, we explicitly aim to start from the *language* that *young teenagers* use about self-regulation themselves.

The research question central to this study is: *'How can we – in cooperation with young teenagers and their teachers – design an interaction tool that challenges them (1) to talk about and reflect on self-regulation together and (2) to co-create a learning environment that encourages self-regulation?'*

We address the following sub-questions with this in mind:

A. *What does the literature say about interaction, reflection, and self-regulation in young teenagers?*
B. *What are the words and images used by teachers and young teenagers to define self-regulation?*
C. *How can we relate these words and images to the literature on self-regulation?*
D. *How can we design an interaction tool inspired by the words and images of young teenagers and based on insights on interaction, reflection, and self-regulation, to challenge and to support?*
   (I) the interaction and reflection on the topic of self-regulation and
   (II) the co-creation of a learning environment that improves self-regulation.

Research method

The study has 2 phases. In the first phase (research year 2020-2021) we conducted a literature review (research question A) and conducted a qualitative participative study using *photovoice* (research questions B and C). In the second phase (research year 2021-2022) we *have developed* an interaction tool to stimulate self-regulation in young teenagers (research question D) based on the theoretical insights generated in phase 1. Finally, we *are testing* this tool in practice.

The interaction-tool that we developed consists of (1) a *theoretical framework* regarding self-regulation, (2) a *theoretical framework* regarding encouraging self-regulation in a class, and (3) a *(teaching) method* that pushes young teenagers to interact, reflect, and co-create in the realm of self-regulation. The theoretical frameworks provide teachers and pupils with a frame of reference to deepen the interaction, reflection, and co-creation and will strengthen metacognition and self-regulation in the process. The method offers the teacher concrete handholds to stimulate the process of interaction, reflection, and co-creation among young teenagers in a classroom context. The underlying insights are explained to the teacher which strengthens the teacher's insight into the development of (self-regulation in) young teenagers and the encouragement of reflection and self-regulation in class.

In order to develop the theoretical frameworks, we chose a qualitative approach from Constructivist Grounded Theory (Charmaz, 2005) in which the theoretical framework is iteratively constructed through literature review and concepts based on empirical material. We used the Photovoice methodology to collect this empirical material. Photovoice collects information from an *'emic perspective'*. This means that the research starts from information coming from the target group itself and not from information from prior research. This allows for an unprejudiced start and gives new insights and perspectives a chance to develop (Wang & Burris, 1977). To do this, both young teenagers and their teachers were actively engaged in highlighting what self-regulation means for them by taking pictures about it. Giving a voice to a

group of people through Photovoice goes much further than interviewing them starting from a photograph. The teenagers also remained involved with the analysis and reporting of the data. In this way, Photovoice supports the *empowerment* idea that also has an important value in this research into and especially for young teenagers and their teachers.

We started with a literature review to develop a (teaching) method. Based on this study, we put forward a number of design principles. These principles then guided the development of a concrete method for the teacher.

We further tested the developed interaction-tool, the theoretical frameworks and (teaching) method, by way of a professionalisation course.

Photovoice in order to design a frame of reference for 'self-regulation'

We developed a frame of reference for self-regulation for young teenagers and their teachers based on the language they themselves use. We used *Photovoice* to do this; a participative and constructivist grounded research method in which participants (in this case the teenagers and their teachers) take pictures based on a research question in order to share their perceptions on the topic. In the first research year (2020-2021) we got to work as researchers with two classes in a primary school and one class in a secondary school. In total, 63 pupils and 7 teachers participated in the Photovoice process. We worked with the pupils in groups of 4 to 6 pupils. The process with the teachers was done by team, separate from the pupils. The Photovoice process incorporates 6 phases (Emmers, 2019): (1) preparation phase, (2) opening phase, (3) active phase, (4) decoding phase, (5) linking back the results of the analysis to the participants, and (6) reporting of the conclusions by the participants.

In the opening phase (1) pupils got to know Photovoice and were encouraged to take up the role of co-researcher. Then the pupils got to work (2). Each pupil took five pictures to answer the question *'what do you do to achieve your goal'* or *'how do you take charge of your learning'*. The pupils then selected two pictures which they provided with a story in small groups of 4 to 6 pupils. In the decoding phase (3), pictures with a story were given a code. The qualitative analysis consisted of the thematic structuring of the subjects of the pictures and stories. We linked this structure to the frameworks and theoretical concepts from the literature review. The frameworks of Zimmerman (as described by Thomas et al, 2020) and Laevers (2018) proved themselves to be especially useful for this. The linking back phase (5) involved testing and adjusting our analyses and interpretations with the participants. Finally, the results were reported (6). We formulated the participants' answer to the research question in the puzzle *'Directing Together through Dialoque'*. It gave us the pupils' and teachers' answer to what self-regulation means to them in their own

words. This allowed the puzzle to be used as a frame of reference to discuss self-regulation with pupils, as a joint language for interaction, reflection, and also later co-creation involving self-regulation.

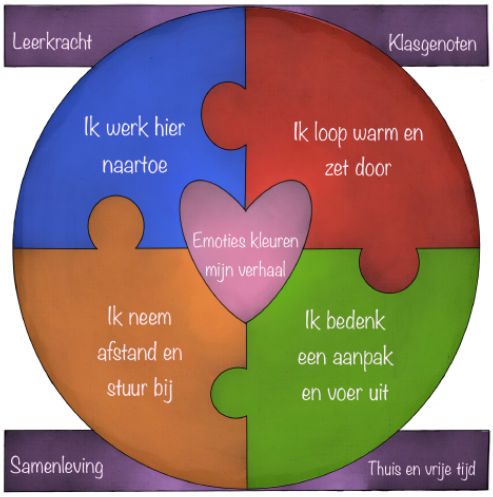

Figure 1: puzzle Directing Together through Dialogue (UCLL, Education & Development)

Photovoice to design a frame of reference for 'encouraging self-regulation'

After completing the Photovoice process, there was a further qualitative analysis of the empirically acquired material, both the pictures and stories and the conclusions formulated by teachers and pupils based on the process. In this analysis we hoped to get a view of variables in context which have an impact on self-regulation, and which can also be influenced in order to stimulate the self-regulation of young teenagers. This analysis led to a selection of six variables, which were further refined and adjusted based on conversations with experts. We entered discussions with the panel of experts that assist and evaluate the project and with external experts during a roundtable conversation at the EAPRIL conference 2021. The result of this inquiry is a description of six parameters which teachers can emphasise to greater or lesser extent in function of the needs of pupils. With the concept parameter we created a tool to explore and develop changes in the learning environment flexibly in conversation with pupils. In other words, it is a frame of reference to foster the process of co-creation in service to a learning environment that offers opportunities for self-regulation.
These parameters are:

- goalsetting
- pressure

- structure
- choice
- challenge
- togetherness

Literature review to develop a method for the teacher

We consulted scholarship on interaction, refection, and self-regulation in young teenagers. We consulted sources from communication science, pedagogy, developmental psychology, and neurocognitive sciences. Based on this literature review, we prioritised the following principles for the development of a method to stimulate interaction, reflection, and self-regulation in young teenagers in the classroom.

- Focussing on metacognition and reflection
- Focussing on equality and safety
- Focussing on autonomy, connectivity, and competence
- Focussing on the social competence and social needs of the teenager

A method was developed for the teacher in line with these four design principles. The (teaching) method provides a structure and goals linked to Dorian De Haan's (2012) phases of 'exploring', 'connecting', and 'enriching'. By selecting the phases 'exploring', 'connecting', and 'enriching', we succeeded in integrating the above principles into the (teaching) method. In exploration and connection, the emphasis is on an open dialogue in which metacognition and reflection are central. Pupils and the teacher learn to know themselves and the other better through conversation. The 'directing together through dialogue' puzzle provides a shared language and becomes a touchstone for the pupils' own self-regulation. Enriching, inextricably tied to exploring and connecting, emphasises dialogue between pupils and teacher and between pupils themselves in looking for challenges and enriching the learning environment.

Figure 2: explorng connecting enriching (UCLL, Education & Development)

Solid support from the teacher is crucial in order to bring a group of young teenagers collectively to metacognition and reflection. In the (teaching) method, teaching strategies are proposed to achieve this.
In the context of *'exploring'* and *'connecting',* we work with Photovoice (Wang & Burris, 1997) and Socratic dialogue (Poppelmonde et al., 2001). We clarify the supporting role the teacher can play here using an 'interaction guide' and 'rules of conversation'. We based the development of these materials on Clement (2016), TGI (Cohn, 1997), and Adriaenssens (2006).
In the context of *'enriching',* it's important that the teacher focusses on modelling, explaining, and visualising. Here, we started from De Smul et al.'s (2018) insights into implicit and explicit, and direct and indirect instruction.

Testing in practice

The interaction tool (frames of reference and teaching method) is now being tested in practice in the first two years of two secondary schools and the final two years of five primary schools. The involved teachers take part in a professionalisation course consisting of 3 study days, 2 coaching moments, and 1 evaluation moment. Throughout the professionalisation course, data is collected from teachers through reflections, surveys, and a focus group interview. Based on the resulting data, the interaction tool will be adjusted.

The project concerns an explorative study. Follow-up research will be necessary to test the design with a large group of teachers and pupils in order to measure the impact of the method, with a possible focus on specific groups.

FIRST CONCLUSIONS AND REFLECTIONS

In young teenagers' pictures and stories about self-regulation, several facets of self-regulation were highlighted that are overlooked or placed differently in the traditional models and theoretical frameworks. This led us to some conclusions and reflections, alongside an adjusted frame of reference on self-regulation. Also the process of Photovoice which we guided ourselves as researchers, offered us interesting reflections and questions about having and facilitating (reflection) discussions with young teenagers. We will describe and situate some of these reflections and conclusions from the research data and research process in the following paragraphs.

Self-regulation out-of-the-box

The pictures and stories we received from pupils often concerned emotions and *regulating emotions.* In their stories about self-regulation, pupils often discuss how

they need and appreciate the warmth and proximity of a teacher, parent, friend, brother, sister, coach, or pet. Pupils also discuss how they look for and create rest and how they motivate themselves. The affective component of self-regulation received a lot of attention, more than say the cognitive component which centres learning strategies. This doesn't entirely correspond to how the affective component is integrated in conventional models of self-regulation. In many of these models the affective (or motivational) component is named (Zimmerman, Laevers, Boekaerts), but this is often more of a 'mention' within a model that predominantly stresses (meta)cognition. It is consequently unsurprising that, in practice, teachers give this component little explicit attention. This was also confirmed in the pictures and stories of the teachers, where we mostly received examples of the cognitive and metacognitive components of self-regulation. In a focus group interview with the teachers in question, they confirmed that they recognise the importance of the affective component, but that they devote less explicit attention or instruction to it in their support of self-regulation.

Pupils often referenced experiences *outside of the school context* in their stories and pictures. They learn a lot from these out-of-school experiences, also regarding self-regulation. In discussion, the teachers indicated that they got to know their pupil better through these out-of-school stories. They found it interesting to hear them talk about themselves and were surprised to learn how much self-regulation they already had. This offered them new information with which to discuss self-regulation with pupils and sometimes gave a new perspective on a pupil. Quote from a teacher: *"I absolutely hadn't expected this picture from M. I didn't think she had that much perseverance and had no idea that she trained for dancing that much (4 times a week!)."*

In their stories, pupils also name the strategies they use to achieve their goals. Starting from a concrete picture can help pupils to better describe how they go about learning. A number of stories neatly link up with the strategies put forward in effectiveness research, like *making a plan, alternating effort and relaxation, splitting up tasks, repetition,…* However, a number of stories also illustrate strategies that are not recommended by research, like *using a lot of colours, marking texts, studying everything at once and taking a long break, eating and drinking sweet things, studying in the (busy) kitchen, studying with music…* These strategies appeared to be meaningful to the pupils and they were often recognisable to other pupils. Quote from a sixth-grade pupil: *"I always use a lot of different colours. My desk is actually full of colours (she points to the picture). Some people think it's crowded and messy, but that's what makes me happy and then I enjoy learning more."*

How much SELF is self-regulation?

Self-regulation in school is often defined as the *independent* use of (meta)cognitive and motivational strategies by pupils to guide *their own* learning. Self-regulation in school takes place in a context in which goals, criteria for success, required results

or norms, and even ‘preferred strategies’ are predetermined by others. By naming effective self-regulation strategies, what good self-regulation is, is decided for the pupil. Subsequently, the pupil’s distance from this ‘ideal’ is assessed, together with how the teacher can guide the pupil toward it in order to, once the pupil can do so him*self,* allow the pupil to do so him*self.* The pupil’s self-regulation is strengthened along the way by the powerful learning environment which the teacher develops for the pupil. We question whether this can really be called *self-regulation*.
In this project, we investigate whether more *self* is possible for young teenagers, including in the context of education. We do this firstly by allowing young teenagers to determine for them*selves* what self-regulation means and how they are self-regulated. In this we try not to put forth an a priori standard. We want to start from their stories, and their strengths, and not from not meeting our standards. In their stories, young teenagers show that they are (already) self-regulated in many ways. Using pictures, they can describe this well themselves. Their stories also show that what works for one pupil often doesn’t work for another at all. Furthermore, our research suggests that predetermining what works for every young teenager runs counter to the actual goal of *self-regulation*. Namely, figuring out for yourself what you want, what works for you, when and why, and being able to make your own choices based on that. We especially want to create opportunities for teenagers to practice this. Don’t predetermine, but actively involve them in the design of a learning environment that supports and encourages their self-regulation. Build a learning environment in which certain things are still expected, but not without any input about how. This absolutely needs to be guided. In this project, we study this support by letting the pupils and teachers get to know various forms of self-regulation through discussion and reflection. The ‘framework for (encouraging) self-regulation’ offers an opportunity for more meaning and depth in this process. Examples of effective self-regulation strategies also offer inspiration and challenge. Together with teachers, we are currently investigating how this works in a classroom context.

Photovoice discussions were the basis of the design of our interaction tool. We determined that pupils came to a better understanding of themselves and their self-regulation through these discussions (1) because they were encouraged/challenged to tell their story themselves and (2) because they were encouraged during the discussion to see their story in relation to the stories of others. *A pupil will, for example, listen to the story of an enthusiastic fellow pupil about how he keeps trying, even if it’s difficult and it fails every time. This pupil can then wonder whether he could also persevere like that, whether or not he recognises that story. A pupil might have considered himself persistent, but have to revise that perspective after hearing this story.*

We determined that Photovoice wasn’t about the individual story of each pupil as much as it was about a co-story. What do we learn from each other and together from these stories and converations about self-regulation? And how can we continue

’writing’ this story about self-regulation together? During the reporting phase, pupils reached one joint answer to the research question. They did this by looking for what connects them in the different stories. In this study, in keeping with a social constructivist approach to learning, we view self-regulation as a concept and process that receives meaning within a social context. Collectively giving meaning to self-regulation like this is central to the interaction tool that we developed. We are now investigating how this co-story about self-regulation can develop into enriching the learning environment together.
In bepaalde bestaande methodieken rond zelfsturing wordt eerder vertrokken van een individueel begeleidings- of reflectiemodel naar meer zelfsturing. We nemen in de testfase van ons onderzoek ‘socialy shared regulation’ als centraal uitgangspunt: in de klas samen de verantwoordelijkheid nemen over mekaars zelfregulatie via samen-sturing.
During the Photovoice discussion, not only was the meaning of self-regulation determined together, but pupils also took up responsibility for each other’s self-regulation together. We found that pupils regulated each other. The term for this in the literature is ’socially shared *regulation’* (Hadwin et al., 2018). We believe the power of this collective process is insufficiently used in classroom contexts. In some existing methods about self-regulation, the starting point for increased self-regulation is an individual guidance or reflection model. In the testphase of our research we take ’socially shared regulation’ as a key starting point: collectively taking responsibility for each others self-regulation in class through: regulating together through dialogue. Pupils and teachers share responsibility for designing a learning environment that supports their way of self-directing and that further challenges and supports their self-regulation. Research into cooperative work confirms that directing (learning) together lead to more involvement and participation from pupils, which leads to stronger results. We are now investigating, together with teachers, how this process of co-direction takes shape in classes, what the experiences of teachers and pupil are, and which factors help and hinder its realisation in a classroom context.

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EVIDENCE-INFORMED TEMPLATE FOR GOOD PRACTICES OF EDUCATIONAL INNOVATION WITH TECHNOLOGY

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ABSTRACT

In higher educational institutes, much time and effort is invested in the innovation of learning designs with educational technologies. To see a return on investment, it is important to work in an evidence-informed manner by incorporating both scientific and practice-based evidence to guide design decisions, and by generating new evidence by systematically evaluating innovations. Research has shown that the use of good (or best) practices can be instrumental when trying to support innovations in practice. For practice-based knowledge to be informative in a different context, and for the outcomes to be scaled up to support a broader field of application, the knowledge output needs to be both transferable and generic. Good practices presenting knowledge about successful innovations appeal to practitioners and support the transfer of practice-based research into practice. Still, research into the use of best practices shows that often times important information is left out in the presentation of the example, making them less effective. The use of a template can remedy this problem. In this paper, we present an evidence-informed template to describe good practices of evidence-informed educational innovation using technology. We discuss the development of this template, how it can be used by educational professionals and we reflect on the experiences with participants that experimented with this template in our workshop at the EAPRIL conference.

INTRODUCTION

In higher educational institutes, much time and effort is invested in the innovation of learning designs with educational technologies. To see a return on investment, it is important to work in an evidence-informed manner: using knowledge from educational sciences as well as expert knowledge from practice in the innovation process will improve the chances of successful and sustainable implementation of the educational innovation.

However, not every educator is experienced in working in an evidence-informed way, for example because they cannot keep up with the evidence or they are lateral-entry teachers. Meanwhile, research shows that good or best practices can be instrumental in (scaling up) educational innovations. As such, there is a need for worked examples of ways in which we can improve our practice of educational innovation.
In this paper, we present a comprehensive template to describe evidence-informed ways to innovate learning designs using educational technology. We propose applying this template to describe good (or best) practices in order to enable the transfer of that practice to new contexts, and making it scalable to eventually benefit more learners.
In the next section, we describe our perspective on 'evidence-informed practice', what types of evidence we consider to be valuable to utilize in practice and three different perspectives on how evidence reaches educational practice. Next, we elaborate on why good practices can be useful in evidence-informed practice and how they should be described to be used effectively. Finally, we present the template we developed and reflect on the experiences of using the template, including those in the workshop we organised at the EAPRIL 2021 conference.

EVIDENCE-INFORMED EDUCATIONAL INNOVATION

Research by Hollands and Escueta (2019) shows that when decisions are made about the adoption of educational technology, or the upscaling of (small scale) innovations, less than twenty percent of practitioners use high quality evidence from scientific research literature. Most of the time only local 'evidence' is used, such as a professional's own experiences, those of colleagues, or a small set of data from local IT systems.
Structured knowledge from scientific studies is generally easily found and shared, but is not that frequently taken up by professionals in practice (Mahroeian & Forozia, 2012). Because concept and theory development are emphasized over use in practice when research findings are disseminated, this knowledge will be difficult to access by professionals to apply in practice-based applications.
Using no evidence at all or low-quality evidence in an innovation process increases the risk that the intended (and expected) results will not be met, since evidence will be lacking to (1) guide the choices made in the innovation process, and (2) on the intended – and achieved – effects of the innovation. Innovations with educational technology will be less effective (and less efficient to implement) when the inclusion of insights from existing (scientific or practice-based) research is not part of the design approach (Davies, 1999).
Concluding, when it comes to innovating our education with technologies it is paramount to work in an evidence-informed manner. Some people use the terms 'evidence-based' and 'evidence-informed' interchangeably. We prefer to use

evidence-informed as it emphasizes that evidence is not the only factor influencing the innovation process in educational practice. The definition proposed by Nelson and Campbell (2017, p. 129) of evidence-informed practice (EIP) reflects this strongly: 'EIP must be seen as the integration of professional judgement, system-level data, classroom data and research evidence.'

Types of Evidence

The term 'evidence' can be considered a little bit vague, which is why we give several examples of types of evidence we consider valuable in educational practice below. Of course, each of these types of evidence can be used in different ways in the innovation process. To innovate in an evidence-informed way, we need to base our innovation process on *practice-based evidence* (knowledge of successful innovative implementations) as well as *scientific evidence* (the underlying theoretical working mechanisms) (Nelson & Campbell, 2017; Nevo & Slonim-Nevo, 2011):

- *Practice-based evidence*, describing 'what works where and for whom', relating successful implementations to contextual factors. Examples of such evidence are context analyses, research into co-design, (didactical) usability studies, field studies, formative evaluations, prototyping, agile design methods, study data and good practice descriptions;
- *Scientific evidence* describing 'what works and why' substantiated with underlying theories. Examples of such evidence are (systematic) literature reviews, qualitative studies, empirical (lab) studies, summative research, and effect studies.

It is recommended to use various types of evidence in a single innovation process (evidence triangulation). One reason is that innovations which have been proven effective in highly-controlled scientific research will not automatically be effective in a specific context in practice. To adjust the innovation to the local circumstances in the implementation process, practice-based evidence (perhaps developed along the way) is just as important. On the other hand, evidence which has been developed through practice-based research is not automatically transferable nor generic, which is necessary for such evidence to be informative in a different context, and for the outcomes to be scaled up to support a broader field of application (Andriessen, 2016). Finally, it is recommended to not only base decision in the innovation process on evidence, but to also generate new evidence by evaluating the innovation and its effects systematically (Davies, 1999).

How Evidence Can Reach the Educational Practice

Evidence from research on innovations with educational technology can reach educational practice through three approaches;

1) research dissemination,

2) research valorisation,
3) research propagation (Froyd et al., 2017).

Seymour (2002) describes a dissemination approach as communicating to others about a successful initiative, after which the awareness and evidence of effectiveness will automatically lead to systemic adoption of the innovation. Of course, we know this is too optimistic and a mere dissemination approach does not tend to lead to adoption of innovations in practice (Henderson & Dancy, 2007; Yerushalmi et al., 2007), for instance because the approach does not consider customization of the innovation to (better) fit a local context, which in turn gives rise to barriers hindering adoption.

A valorisation approach (Benneworth & Jongbloed, 2010) incorporates activities to ensure that scientific knowledge adds value to society, for example by making scientific results openly available and accessible for utilization by people or companies outside academia. Sometimes, a valorisation approach also includes co-production of knowledge with non-academic stakeholders. However, valorisation is also sometimes framed as commercialisation, e.g. by initiating start-up companies that further develop and market promising prototypes developed in research projects. Unfortunately, the above approaches do not lead to systemic adoption of innovations to improve educational practice, e.g. because just a few non-academic stakeholders from a single context were involved in the co-production of knowledge, which hinders adoption in contexts that differ.

Froyd et al. (2017) argue that the propagation paradigm has the potential to produce better results than the dissemination and valorisation approaches. They characterize the propagation paradigm by an emphasis on both *fit* and *efficacy* of the educational innovation being developed. Such innovations are developed by a diverse team of stakeholders from different contexts, engaged early and often, with a focus on learning through engaging with potential users and adopters to promote successful implementation. The efficacy of the innovation, customized to fit the implementation context, is supported by both scientific evidence (explaining the efficacy of the innovation in general and relating it to a theoretical framework) and practice-based evidence (describing the customization to the local instructional system in terms of contextual affordances and barriers) (Froyd et al., 2017). A promising way to disclose practice-based evidence is by describing good practices, since they pay attention to the observed efficacy of the locally implemented innovation as well as the fit that was made.

GOOD PRACTICES OF EVIDENCE-INFORMED EDUCATIONAL INNOVATION

Findings from practice-based research can be recorded and communicated through good or best practices. The use of good or best practices can be instrumental when trying to support innovations in practice (Alwazae et al., 2015), especially as viewed from the propagation paradigm. Mostly the terms good practice and best

practice are used interchangeably, but in some definitions one may only call a practice a best practice when it has been proven to work better than other practices. In this paper, we choose to use the term *good practice*.
Good practices of evidence-informed educational innovation can describe a variety of types or aspects of evidence-informed ways of working, for example:

- How **existing knowledge** is made useful for (translation to) practice;
- How one can **identify** which practical **knowledge**/expertise for innovating is **missing;**
- How one can generate **new practical knowledge**/expertise;
- How one can realize **effective** educational design;
- How one can conduct student evaluations **with (scientific) reliability;**
- How one can establish the **effectiveness and efficiency** of innovative educational designs;
- How one can thoroughly think through our Blended Learning designs and make **supported** considerations;
- How to **scale up** innovations and make them **sustainable**.

Why Should We Use Good Practices?

Professionals in education are often missing tools and strategies for effective translation of theoretical and conceptual knowledge to local practices, limiting the return on research investment (Froyd et al., 2017). Good practices represent knowledge about innovations in a way that appeals to professional, since they offer insights into how an innovation fits into a local context, how affordances of the context were utilized and how barriers were broken down. Unfortunately, our practical experience is that not many professionals are actively using good practices to inform and substantiate their innovation process, possibly because they are not aware of their existence. In contrast, The IT sector has a long tradition of describing and using good practices, especially in software development, because they acknowledge learning from other professional's efforts will save time by 'not re-inventing the wheel' (Gamma et al., 1995). Using good practices to share knowledge about innovations is effective (Alwazae et al., 2015), since they:

- Pose **recognizability**: professionals will likely recognize their own context in the description of the innovation itself, the process, the stakeholders engaged, the barriers encountered and/or the success factors for implementation;
- Have the potential to offer **inspiration**: describing an evidence-informed educational innovation, and especially the way in which it improved practice, can make professionals enthusiastic to try a similar innovation with the hope of achieving the same results;
- Help increase the **self-efficacy** for innovation: reading about a successful innovation process by a peer in a similar institute can stimulate the professional's belief in their own capacity to develop similar practices;

- Aid to **demystify** the term ‘evidence-informed practice’: a comprehensive description of an authentic evidence-informed practice will help professionals to get a clear and realistic picture of the different types of evidence-informed educational practice.

Still, research into the use of best practices shows that often times important information is left out in the presentation of the example, making them less effective (Alwazae et al., 2015). The use of a template can remedy this problem.

How Should We Describe Good Practices?

Alwazae et al. (2015) state that too often important information is missing from good practice descriptions, which impedes their use. Because low quality or incomplete descriptions hinder the understanding of the practice, adoption and transfer of that practice will not occur (Dani et al., 2006; Limam Mansar & Reijers, 2007). Professionals that actively use good practices sometimes have a hard time finding and selecting relevant good practices they can use (Simard & Rice, 2007) and/or solid guidelines to record a good practice are missing (Shull & Turner, 2005).

Three attributes of effective descriptions of good practices are (Aggestam & Persson, 2010; Simard & Rice, 2007): (1) the intention of the developed case is described so that the value of the practice for the own practice can be assessed, (2) the approach or step-by-step plan adopted in the local context is described so that the feasibility in the own practice can be assessed, and (3) indications are included on how to apply the practice in other contexts.

To improve the effectiveness of good practices, Alwazae et al. (2015) have identified those elements that should be present in a description of good practices. For example, they included a category of elements that describe the requirements needed to apply the practice in a new setting, such as the goal, the means, the skills, the costs, barriers and barrier management. To facilitate the development of comprehensive descriptions of good practices of evidence-informed educational innovation using technology, we propose the template presented in this paper.

THE TEMPLATE

A template in general contains a set of predefined elements that guides the process of describing, as well as the resulting description of, a good practice. Using a template enforces completeness and clearness of a description and as such can facilitate the development of high quality descriptions of good practices (Alwazae et al., 2015). Templates for good practices can be used in different contexts and organisations; here, we use it to describe good practices of evidence-informed innovations using educational technology.

Below, we present our template. We believe in ‘practice what you preach’ and as such, we developed the template in an evidence-informed way. We have distilled

the necessary categories from the publication by Alwazae et al. (2015) and adjusted them in such a way that we can collect examples of evidence-informed practice.
The insights which are now reflected in the template are, for instance, that good examples should be action-oriented and solution-oriented; they are rich with context and thus recognizable; and they can spark conversation about transferability of the practice. Some of the categories, like 'Type of support for evidence-informed practices' and 'Evidence-informed ways of working' are specific for our own particular purpose of collecting examples of evidence-informed practices, but most elements can be used for collecting good examples of innovations in general.
Furthermore, we used literature about innovations in education using technology to better formulate the instructions and questions which are helpful in filling out the template. For example, we used an overview of how educational technology can be designed in an evidence-informed way by Price and Kirkwood (2014), and the book by Seel et al. (2017) about designing education based on evidence from scientific research.
This template contains evidence-informed elements for a concise and appealing description of good practices. During development of the template, we continuously had to navigate between concision and completeness. If someone would be interested in additional information, this should ideally be available upon request, which is why contact information for a professional involved in the good practice is included in the template.
On the website of the Dutch Acceleration Plan, different versions of the template can be downloaded: in Dutch and in English, PDF-versions and editable versions for Microsoft Word: https://www.versnellingsplan.nl/en/Kennisbank/template-for-good-practices-of-evidence-informed-educational-innovation-with-it/.

Table 3: Template Elements with Instructions for Users.

Element	**Instructions / questions**
Title	Title of the good practice – Attractive and concise
Goal	Describe why working in this evidence-informed manner is important; what is the benefit of working this way?
Target audience	Which target audience (community of practice) is likely to be interested in this good practice?
Type of support for evidence-informed practices	How is evidence-informed practice supported? Is this a good practice in which a practical instrument is used for support, is it a description of a working method without an accompanying tool, or a description of a realised innovation? (Please note: if the educational innovation has been realised in an evidence-informed way, please also describe the work method.)
Category	What theme(s) fit(s) this good practice best? Is this an example (or combination) of: • Valorisation of existing knowledge/evidence?

	• Creation of new (practice-based) evidence? • Dissemination of knowledge within or between institutes.
Summary - Issue (problem/ opportunity) - Solution - Quality	What was the issue (question/wish) that induced (the development of) this good practice? ... What (type of) solution was developed? ... What makes this a *good* practice? ….
Context	In which context is the good practice set? (Please elaborate on the relevant aspects of the context on the development, and the success, of this good practice.
Approach	What characterizes the approach / work method? (For example, describe a step-by-step plan: activity 1,2,3).
Evidence-informed way of working	In which phase(s) of the innovation process was an evidence-informed practice adopted? A suitable five-phase model is ADDIE: Analyze, Design, Develop, Implement, Evaluate (Branch, 2009).
Evidence	If existing evidence was used in this good practice: what (type of) evidence was used? Scientific evidence? Practice-based evidence? … What new evidence did this good practice yield? … What was the result of this good practice within the context / for the student? ...
Stakeholders	Who was involved in this good practice? What roles and/with what competences?
Tools & instruments	Which technology, techniques and methods were utilized?
Challenges	What challenges had to be overcome? How can these challenges be tackled?
Success factors	Which factors have contributed to the success (and to tackling the challenges)?
Contact	Is a website available with more information about this good practice? Who can be contacted for more details?
Sources	References to any cited sources in the description of this good practice.
Optionally	*What other institutes also apply this evidence-informed practice?*

REFLECTIONS AND EXPERIENCES

We have developed an evidence-informed template for good practices of evidence-informed innovation with educational technology. This template provides a structure for the systematic and detailed description of these good practices to share practice-based evidence with the goal of scaling-up the innovation and transferring it successfully to different contexts.
In our online workshop at the EAPRIL 2021 conference, we presented the template to the participants and we offered a hands-on experience for them to get familiar with using the template to describe an educational innovation practice from their own professional context. All three workshop participants were lateral-entry teachers enrolled in a Master's programme.

Goal of the Template

The participants expressed the value they saw in the template mainly in terms of support to capture 'what works where for whom and why' in a specific educational practice. Furthermore, they observed another potential affordance of the template, i.e., to facilitate and guide further improvement of an existing practice.
We believe the template indeed can serve other purposes than the one we envisioned. For example, we agree with the participants of the workshop that the template can facilitate the process of assessing and improving existing educational practices, since it may bring to light which elements of the practice can potentially be improved or need extra substantiation. One way to improve an existing practice could be to use the quality criteria as presented in (Alwazae et al., 2015, pp. 255, Table 1). These criteria are very extensive and therefore we decided not to include all of them in our template.

Usage of the Template

The participants of the online workshop helped us to discover a convenient and effective approach to use the template in the process of describing a good practice. The person involved in the practice has extensive knowledge about the innovation, the process and the educational context, but will probably not be familiar yet with the template and its usage. However, both authors had – as co-developers of the template - extensive knowledge on the (elements of the) template and evidence-informed practice, but little knowledge on the specific educational practice of the participant. To get the most out of the workshop, one of the authors interviewed the participant describing their own practice, while the other author took notes of what was being said in the most appropriate section of the template. The interviewer asked probing questions to extract as much (tacit) knowledge as possible from the interviewee. The advantage of this approach is that the professional describing the good practice can tell their story without having to stick to the pre-defined order of

the template's elements. The disadvantage of this approach is that it requires three people simultaneously working with the template. In future work, different compositions and role distributions could be evaluated in terms of effectiveness and efficiency of filling out the template for a given good practice.

Concluding remarks

In this paper, we present an evidence-informed template to describe good practices of evidence-informed innovation using educational technology. As mentioned before, for concision purposes, we have not included all elements of good practices as presented in (Alwazae et al., 2015). One such excluded element is the estimation of time needed to introduce and implement a practice in another context. In future work, we wish to develop implementation guidelines and supporting materials to aid professionals that plan to apply a good practice in a new context.
Furthermore, evidence-informed ways of working have the potential to stimulate the continuing professional development of educators willing to innovate, since it may help to explicate tacit knowledge or working mechanisms, and create awareness of blind spots for improvement. Moreover, access to appealing descriptions of good practices of evidence-informed innovation can increase awareness of the added value good practices have in professional practice. How evidence-informed practice and continuing professional development can be – or potentially already are – integrated in educational practice is an interesting question to explore in future work.
Of course, using this template is only one way to support the development of evidence-informed practices. We believe this template facilitates a transition from a dissemination approach to a propagation approach. We cordially invite readers with different suggestions for approaches to achieve this transition to contact the authors.

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LEARN TO THINK: DEVELOPING A CROSS-CURRICULAR TEACHING METHOD TO ENHANCE CRITICAL THINKING IN THE FIRST STAGE OF SECUNDARY EDUCATION

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ABSTRACT

Especially in times of fake news and populism, critical thinking is a key skill for students to master. In the ongoing "Redeneerling"-project[1], a cross-curricular teaching method is developed aiming to stimulate the critical thinking skills of students through dialogue, focusing on argumentation skills, recognition of logical fallacies, and analysis of sources. Following the principles of education-design research, the "Redeneerling"-teaching method is developed and evaluated in different cycles in cooperation with interdisciplinary Teacher Design Teams. The goal of this practical research project is to formulate the design principles of the cross-disciplinary critical thinking approach. In addition, we aim to identify the teacher's attitude towards the teaching method. Interviews and observations allow us to discuss how some critical thinking skills are easier implemented into specific school subjects than others. The discussion includes the role of visualization and vocabulary necessary to link these skills across different subjects. Preliminary findings show how teachers appreciate the approach as it helps them to stimulate argumentation and reflection among students.

[1] The term 'Redeneerling' is a creative compound of the Dutch words for reasoning (*redeneren*) and pupil (*leerling*).

INTRODUCTION

In a so-called 'post-truth'-era (Peters, 2018), critical thinking is crucial to properly handle and interpret the constant flow of information. Therefore, critical thinking has been labelled as an indispensable 21st century skill (Saavedra and Opfer, 2012). However, tackling critical thinking and reasoning skills across subjects is challenging (Mulnix, 2012). As critical thinking is a broad concept, we focus on *(a) argumentation skills, (b) recognition of logical fallacies and nuance, and (c) source analysis*. The challenge is to help teachers focus on these skills in their classes. The use of *dialogue* where both teachers and students engage in a shared inquiry encourages students to use reasoning skills (Alexander, 2006; Hemberger, Kuhn, Matos, & Shi, 2017; Kuhn & Crowell, 2011; Resnick, Asterhan, & Clarke, 2018). However, having a dialogue with equal input from teachers and students can be challenging for the teacher. To overcome this challenge a teaching method is developed to be used in the first grade of secondary education (grades 7-8). The aim is to provide teachers with tools to stimulate critical thinking in students.

THEORETICAL BACKGROUND

What is critical thinking?

Critical thinking as an umbrella concept for three kinds of reasoning

Although the importance of critical thinking is broadly emphasized (Davies & Barnett, 2015), the concept appears to be rather fluid and covers different meanings. More specifically, different pedagogical perspectives can be identified on what critical thinking entails: the philosophical-logical, psychological, and critical pedagogical perspective (see Davies & Barnett, 2015; Rombout, 2021). Based upon insights by these different perspectives, a useful conceptualization of critical thinking in three domains has been constructed (Rombout, 2021, see also Barnett, 1997). The first domain, *critical thinking as critical reasoning (or logical thinking)*, refers to skills that lead to a well-considered judgement of what is true and reliable, such as identifying logical fallacies. The second domain, *critical thinking as critical judgement and action*, covers the judgment of what is the right thing to do and act upon this judgement. This domain concerns moral, ethical, and political judgment. The third domain, *critical thinking as critical self-reflection*, refers to questioning one's reasoning.

Focus upon three categories of critical reasoning

In this project, we focus upon the domain of critical reasoning (logical thinking). In other words, we aim to learn students to reason independently, to carefully gather reliable information, and evaluate and analyze the arguments. In this domain, we focus on three categories of logical thinking: (a) *argumentation skills*, (b) *recognition of logical fallacies and nuance*, and (c) *source analysis*. Within each of

these three categories, we focus upon two particular skills. To build and analyze arguments (a), students learn to identify, correctly use, and understand the implications of "if-then" arguments and the conjunctions "thus, because, but, and unless" (De Maeyer, 2016). With regard to recognizing logical fallacies and to nuance (b), students learn to recognize and identify vague terms and false dilemmas. To provide students with tools for source analyses (c), they learn about the authority argument and learn to pose the question 'what wins the source?'.

Critical thinking: a skill as well as an attitude

We want to note that critical thinking is interpreted as a skill as well as an attitude[2]. The goal, thus, is to stimulate reasoning in the classroom and strengthen a positive attitude towards critical thinking, in students and teachers. In other words, the aim is that students find critical thinking important (*attitude*), as well as they are able to think critically and identify misconceptions in the specific lesson contents (*skill*). Therefore, teachers need to assess critical thinking as an important skill to master for students (*attitude*), as well as understand reasoning skills (*skill*). Teachers need to be able to couple the knowledge on reasoning with their own lesson content (cfr. Pedagogical content knowledge). We content that deploying on both critical thinking as a skill and attitude has a reinforcing effect.

A cross-curricular approach and the need for teacher teamwork

Developing complex skills such as reasoning requires long-term, regular stimulation (Hattie, 2008; Timperley, Wilson, Barrar, & Fung, 2007; Torff, 2019). Multiple opportunities for students need to be provided to work with key concepts in different contexts. A cross-disciplinary approach encourages students to make the transfer from one subject to another, as well as from school to everyday life (Halpern, 1998). However, such an approach asks for a meticulous collaboration of teachers. The complexity and expectations of the teaching profession call for teamwork (Struyve, 2019). Indeed, a shift has occurred from the teaching profession as characterized by isolation and individuality towards a team effort (Louis, Marks, & Kruse, 1996). Teachers are expected to build bridges between the classroom and the world as well as to be more of a didactic expert rather than a subject expert (Sassenus, Boderé, Van Gasse, and Van Petegem, 2018). Professional learning communities can act as an instrumental resource, with teachers sharing expertise, knowledge, and teaching materials (Struyve, 2019).

Teaching critical thinking through dialogue and systematic explication

According to educational research, effective instruction on reasoning meets the conditions of explicitly and reflectivity (e.g., Khishfe & Abd-El-Khalick, 2002;

[2] Thus, we do not focus on critical thinking as an act, which is a vision that underlies the second domain of critical thinking ('critical thinking as critical judgement and action').

Abell, Martini & George, 2001). Explicit instruction on central concepts and strategies regarding critical reasoning in combination with practicing is a proven method (Abrami et al., 2015). Students learn and use reasoning skills better and faster when awareness of the skill is sparked (Sun, Slusarz, & Terry, 2005). When a teacher helps to make a skill explicit, the student will more quickly master complex skills, such as reasoning skills.

Dialogue has been identified as an important means to enhance critical thinking (Davies & Barnett, 2015) and reasoning skills specifically (Kuhn & Crowell, 2011). Various forms of dialogue can be distinguished, ranging from the exploration of prior knowledge (Balck, Temmerman, Robberecht, Sermeus & De Schrijver, 2018) to philosophizing (Gellens, Deweerdt, & Enckels, 2018). In all these forms, a dialogue is successful if students listen to each other and the teacher, analyze arguments, recognize fallacies, and articulate and substantiate their own thoughts. Although the use of dialogue is not always anchored in the teaching practice, most teachers have a positive cognitive attitude and high willingness to experiment with didactic methods to stimulate the learning in their students (Bodere et al., 2019).

RESEARCH QUESTIONS

The following research questions guide our study:

RQ1: Which *design principles* must the teaching method meet in order to stimulate critical thinking skills in students by engaging in dialogue?
RQ2: What is the *attitude* of teachers about the teaching method and what are the *contextual factors* that facilitate or hinder successful implementation in classrooms?

RESEARCH DESIGN

Educational design research

The project deploys an *educational design research* (EDR) *methodology* to develop a cross-disciplinary teaching method and materials. In consecutive cycles, the didactic material will be developed, tested, evaluated and adjusted (Plomp & Nieveen, 2007). The feasibility and usability of the material are evaluated and theoretical implications are explored. To create the teaching method, *interdisciplinary Teaching Design Teams* (iTDTs) are established (Crow & Pounder, 2000; Handelzalts, 2009) to stimulate cooperation. The result is a *Redeneerling*-method, containing detailed example learning material and a manual for developing new material. This project specifically develops a cross-disciplinary teaching method in which dialogue is key in different courses throughout the

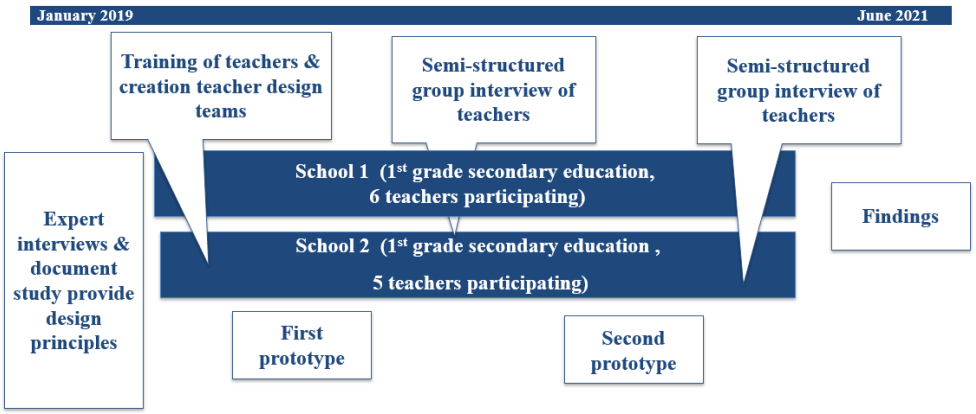
academic year. The method also describes conditions for a successful implementation. The timing and method of the project are illustrated in figure 1.

Intervention and multimethod design

The research uses a qualitative approach to answer the research questions. Expert interviews and document study are used to answer **RQ1**. Semi-structured (group) interviews (Brenner, 2006) with teachers are used to answer **RQ2**. (Interviews were aimed to assess the clarity, readability, usability and feasibility of the method, as well as the perceived impact in later cycles. Insights into the strengths and weaknesses of each version of the Redeneerling-method lead to the development of a new version of the method. The interviews were guided by a topic list and mainly conducted in an online teams-environment. Notes of the interviews were coded and analyzed using qualitative content analysis (Elo & Kyngäs, 2008).

This project is implemented during a *one-year-intervention* in two Brussels secondary schools with an ethnically diverse population. Students from the first stage of SE (grades 7-8) receive the intervention in different school subjects. Teachers and students received information about and training on critical thinking skills. We organized a training for the teacher design teams. The goals were to exchange experiences with regard to teaching critical thinking (explore), learn about critical thinking and reasoning fallacies (educate), discuss and develop learning material for critical thinking (develop learning material), and provide feedback to each other's material (teacher feedback). The goal is to get teachers to see opportunities in their own course material (e.g., Akerson, Abd-El-Khalick,& Lederman, 2000). As indicated above, the research culminates in a manual for teachers to develop new material, some detailed example material as well as implementation guidelines.

Figure 1. Methodology and timing



RESULTS

The research yielded some general insights on the cross-curricular approach and the use of dialogue. Teacher interviews suggest that explicit and cross-curricular attention help students to develop critical thinking skills. The research confirmed that the use of *dialogue* encourages students to use reasoning skills. However, having a dialogue with equal input from teachers and students can be challenging. Teachers find it difficult not to explain everything. The willingness of teachers to give pupils the responsibility for their learning process is associated with fear of letting go of control (see also Boderé., 2019).

With regard to the design principles *(***RQ1***),* our research suggests that the teaching method must meet a number of conditions. First, the application of a cross-disciplinary approach to teaching critical thinking skills helps teachers to cooperate and allows students to be continuously exposed to similar reasoning strategies in different subjects. Second, student mistakes in the classroom provide opportunities to focus on critical thinking. Teachers can respond to reasoning mistakes students make in the classroom and purposefully elicit confusion about arguments, providing a chance to help students reflect about their arguments. Third, a thorough training of teachers is necessary, in order to refresh their understanding of the reasoning and dialogue skills. Fourth, questioning student responses allow students to reflect and address their reasoning skills. Fifth, similar vocabulary and visual support to illustrate the different reasoning skills need to be used across different subjects. Unity facilitates students' understanding (e.g., the recurrent use of key signalling words such as 'but' or 'unless'). Graphical visualisations were appreciated by teachers to support the learning of critical skills
With regard to the attitudes of teachers **(RQ2)**, teachers showed enthusiasm and motivation to implement the method and showed appreciation for the cross-disciplinary approach. However, creating the optimal context is crucial to also translate the enthusiasm into actions. This is expressed in two ways. First, support from the principal in the form of practical assistance (e.g., adjust timetables) act as a stimulator. Second, hands-on guidance in the development of the lessons from the researchers seems necessary.

DISCUSSION

Critical thinking is an essential skill and attitude in the 21st century (Saavedra and Opfer, 2012). New attainment targets, with a focus on cross-curricular goals, from the Flemish government (Vlaamse Regering, 2018) makes this research project timely. Although teachers are already committed to work on critical thinking, questions can be raised about how to implement these skills in their existing lessons. How could a teacher educate, stimulate, and strengthen critical thinking in his/her

students? This research shows that focusing on a cross-curricular, dialogue-based approach to critical thinking appears promising.

During the research process, we gradually adapted and fine-tuned the didactic approach to best suit the level and subject matter to students in the first stage of secondary education. The input and creativity of the teachers were essential in this process, which again shows the benefits of working with an Educational Design Research method in collaboration with teachers. Overall, working with interdisciplinary teacher design teams allows to develop adequate learning material. The developed materials and teaching method can guide and support teachers across the region in their adaptation to the new curriculum. The cross-curricular approach facilitates the transfer from one subject to another, as well as to everyday life. Training critical thinking together with the course content is also a time-efficient strategy.
However, this approach asks for a meticulous collaboration of teachers, which is also often not well established in Flanders in comparison with other countries that participated in the TALIS studies (De Wilde, 2016; OECD, 2014). Flemish teachers spent less time on teamwork and dialogue with colleagues than their European counterparts. Interdisciplinary learning communities is not yet an embedded practice in the work force, although this research showed how teacher diversity is an added value in developing teaching material. However, the teacher design teams substantially relied on the support from the researchers. Questions can be raised upon what support and conditions are necessary for a good learning community to function independently. Guidance from the principal to facilitate teamwork and structural anchoring of teamwork in the teacher's timetable would help to create an optimal context for learning communities (see also Boderé et al., 2019). In addition, as this research project relies heavily on the active involvement of teachers, the corona lockdown substantially influences the effective implementation of the teaching method in the school context. The pandemic shifted the focus of teachers and led to reduced cooperation. The usefulness of collaboration must be made clear in order to motivate teachers (Struyve, 2019), especially because professional learning communities could stimulate the collaborative (subgroup) culture in schools that positively affects teacher well-being and efficacy (Meredith et al., 2017).

Another question that can be raised is about the generalisability of critical thinking skills (e.g., McPeck, 2017). Does critical thinking consist of general principles which can be applied across courses, or is subject knowledge required for critical thinking? In other words, is critical thinking a generic skills that students can use across different courses or is it a domain-specific skill and is subject knowledge a precondition for critical thinking (Ten Dam and Volman, 2004)? Key is, however, that critical thinking in both cases needs to be infused in different courses and coupled with existing knowledge. Anyway, a shared language of critical thinking in a school is paramount in order to make connections across courses (Rombout, 2021). When students learn how critical thinking is infused across courses, critical thinking

can become a disposition - a natural recurrent tendency for students to think critically.

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TEACHERS' COACHING BY THE COACH IN THE SCHOOL CONTEXT

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ABSTRACT

This research aims to respond to three questions: during the coaching in a school, how the process of teacher's coaching is going? how the process of teacher's coaching is related to the coach's individual characteristics? how the process of teacher's coaching is related to the characteristics of the school context?

To that end, an embedded multiple case study (Yin, 2003) was conducted with two coaches who each coached a team of teachers in a school. Data collected through interviews, observations, and literature were analysed using the mixed coding method (Miles & Huberman, 1994; 2003, Van Der Maren, 1996).

The results documented aspects of the two coaches' coaching process: complex, dynamic, oriented, precise, and agentive. It showed an interrelation between the coaching process carried out and, above all, the conceptions of the coaches and their perceptions of the school context. Finally, the results showed the role played by the school principal in the coaching process.

The results show how important it is for the coach to control his coaching process in relation to the teachers and the school principal. Better collaboration can lead to better engagement on the part of teachers.

INTRODUCTION

To ensure quality education for students, several teaching systems, including the Quebec system, promote the professional development of teachers. For example, the Public Education Act requires teachers "to take appropriate measures that enable [them] to achieve and maintain a high degree of professional competence" (Official Publisher of Quebec, 2018, art. 22.6). The professionals who can coach teachers in this process are the pedagogical advisor who replace the inspectors since the abolition of these positions in 1964 (Lessard & Des Ruisseaux, 2004). However, coaching teachers by the coaches in schools is difficult to achieve in certain cases (Boutet & Villemain, 2014; Cartier & Bélanger, 2012; Conseil supérieur de l'éducation, CSE, 2014; LeBlanc, Dumoulin, Garant & Larouche, 2013; Mané & Lessard, 2007). This problem manifests itself, inter alia, through the implementation of intuitive coaching practices (Mané & Lessard, 2007) and its extent can be justified by the low rate of teachers who benefit from coaching (CSE, 2006). Among the factors that can influence the emergence of this problem, there is the lack of definition of the role of the coach, their limited number in school boards, and the lack of training recognized for them (CSE, 2014).

CONCEPTUAL FRAMEWORK

To address the issue of teacher's coaching by the coach in the school context, a conceptual framework based on theoretical models (Butler, Schnellert & Cartier, 2013; Butler & Cartier, 2018) and empirical research (e.g. Butler, Schnellert & MacNeil, 2015) in the field has been developed. As shown in figure 1, coaching is considered as a complex and dynamic process of thoughts and practices oriented towards the achievement of specific goals, favoring the agency of teachers and related to the individual characteristics of the coach and to the characteristics of the school context (Raoui, 2019).

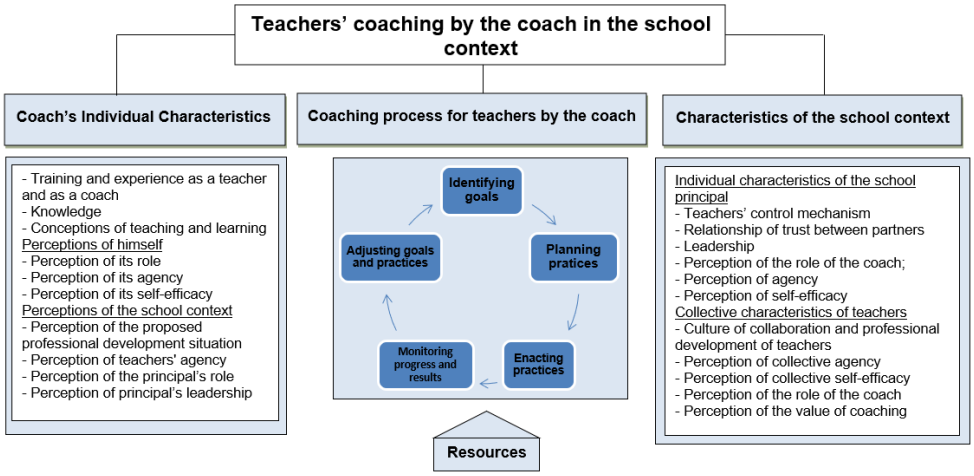

Figure 3: Conceptual framework of teacher's coaching by the coach in the school context

In the following, the phases of the coaching process are presented followed by the definition of the aspects of orientation, precision, dynamism, complexity, and agency of the coaching process.

- Identification of coaching goals: the targets that the coach tries to achieve by coaching teachers. This definition is based on the definitions of Bandura (1991), Butler (2005), and Wolters, Yu, and Pintrich (1996). According to Butler (2005), goals play a central role in self-regulatory models since the whole process is goal-oriented. Wolters, Yu, and Pintrich (1996), on the other hand, said that "goals represent the very specific purposes that individuals are striving for in a specific setting" (p. 212). According to Butler and Schnellert (2012), the identification of goals may be preceded by "defining problems or expectations" (p. 1207).

- Planning of coaching practices and material resources: "predict the choice of actions to be taken and their order of execution" (Cartier, 2008, p. 21).

- Enacting coaching practices: real coaching actions presented by action statements such as doing one-on-one interviews, presenting to a small group, presenting to a large group, etc. (Knight, 2009).

- Control of progress and results: the analytical observation that the coach makes of his coaching practice and the results achieved. This definition is based on Butler's (1998) definition of control that allows to "generate internal feedback about the success of their efforts" (p. 682).

- Adjustment of goals and coaching practices: the action of modifying the goals set at the beginning and the coaching practices that are implemented after noting the few expected results (Butler and Schnellert, 2012).

The oriented, precise, dynamic, complex, and agentive aspect of the coaching process can be observed from the linking of the phases carried out through the process (Bandura, 1989; 1991; 2000; Butler and Schnellert, 2012; Butler, Schnellert and MacNeil 2015; Cartier, Butler & Bouchard, 2010).

- The oriented aspect of the coaching process is first identified in the coherence of the goal with the identified problem or the desired ideal situation and then in the alignment of planning, enacting, control, and adjustment to this goal. Butler and Schnellert (2012) talk about goal-directed action.

- The precise aspect of the coaching process is highlighted in a formulation of clear and achievable goals in the short or medium-term (Bandura, 1991; Butler and Schnellert, 2012; Cartier, Butler & Bouchard, 2010).

- The dynamic aspect of the coaching process is observed in the way in which its components manifest themselves through various cycles of actions and their change in a situation and between different situations during "the realization of an event in time" (Cartier and Butler, 2016, p. 7).

- The complex aspect of the coaching process can be observed in the variety of goals pursued and practices, the hierarchy of goals into sub-goals, the number of targeted components related to the teacher (e.g. number of phases of the teaching process), the variety of resources mobilized as well as in the number of goals whose achievement of results is monitored. According to Bandura (1991), for there to be an achievement, goals must be achievable, prioritized as short-term goals so that they are not only there to serve broader goals, but are meaningful to the individual and demanding in order to generate effort.

- The agentive aspect of the coaching process is observed through the goals and coaching practices implemented. Goals may take into account the needs expressed by teachers or be imposed on them with or without prior consultation. Practices, on the other hand, can promote teachers' expression and engagement in their own learning and teaching process or be of a directive nature, i.e. be based on standards to be integrated and applied. This definition is inspired by Bandura (1989; 2000) and Butler, Schnellert, and MacNeil (2015).

RESEARCH QUESTIONS AND METHOD

The three questions that this research aims to respond to are: during the coaching in a school, how the process of teacher's coaching is going? how the process of teacher's coaching is related to the coach's individual characteristics? how the process of teacher's coaching is related to the characteristics of the school context? To that end, an embedded multiple case study (Yin, 2003) was conducted with two coaches (Sophie and Joelle) who each coached a team of female teachers in a school.

Data collected through interviews, observations, and literature were analysed using the mixed coding method (Miles & Huberman, 1994; Van Der Maren, 1996).

RESULTS AND DISCUSSION

The Results of Question 1

The results obtained described the orientation, precision, dynamism, complexity, and agency of the coaching process of the two coaches each in a different school.

The oriented, precise, and dynamic aspect of the coaching process

The coaching process was oriented towards achieving specific goals. For example, when Sophie identified the goal of "teachers having a better understanding of assessment frameworks", she planned, implemented, and monitored practices that aimed to provide and present the content of the evaluation framework documents from which teachers had to learn. The role that goals play in the direction of the coaching process confirms the importance given to goals in the conceptual framework of this research. As Butler (2005) notes, goals play a central role in self-regulatory models of learning as the whole process is goal-oriented. Cosnefroy (2009) adds that "the goal directs attention to activities relevant to achieving the goals set and, as a result, makes it possible to distinguish priority pipes from parasitic behaviours by which one should not be distracted" (Cosnefroy, 2009, p. 99). The role of goals has also been confirmed by research with teachers. Butler and Schnellert (2012), for example, found that teachers begin a complex and dynamic process as soon as they set goals for themselves during professional development activities. In addition, according to them, the good quality of this process is related to clearly defined goals.

The dynamic aspect of the coaching process was noted in the emergence of some new objectives and targeting others during more than one coaching meeting. This is in line with Cartier and Butler's (2016, p. 7) observation that "when an event occurs over time, this dynamic process manifests itself through various cycles of actions [that evolve and change in a given situation and from one situation to another] ".

The complex aspect of the coaching process

A variety of goals and coaching practices ass noticed in the presence of goals and practices that were intended to support the learning process, the teaching process, and the characteristics of the teachers. In addition, one of the two coaches had a goal and practices that aimed to learn about the practices of teachers. This result first distinguishes the goals of supporting the learning process from those that targeted the teaching process. Results regarding the presence of practices to coaching teacher learning and teaching are consistent with other research that has documented the complexity of coaching practices, without making this distinction (*e.g., Bean et al.,* 2010). The presence of goals related to the learning and teaching process of teachers testifies to the quality of the coaching provided. Thus, according to Butler and

Schnellert (2012), teachers' learning is certainly fostered by reflection on their practices, but they specify: "richer gains may be experienced if teachers deliberately embed engagement in self-and co-regulated practice within cycles of teacher learning level inquiry" (Butler and Schnellert, 2012, p. 1216). In addition, the result on the presence of goals and practices to coaching the characteristics of teachers is in line with the results of research on the professional development of teachers. Indeed, according to Butler *et al.* (2004), changing practices requires a change in the conceptions on which complex and contextualized decisions can be based. In addition, it is important to support teachers' theoretical conceptions and not only their practical knowledge (Butler, 2005). The results obtained in this study show how coaching can focus not only on teachers' conceptions but also on their perceptions. This observation is a contribution of this present research to the field. This addition is important because it allows the personal history component of learners to be taken into account in understanding their learning process as considered by the self-regulated learning perspective in which this thesis fits (e.g., Cartier and Butler, 2016).

In regards to the number of targeted teacher-related components, the results show that the coaching process of the two coaches can support certain components of the teachers' learning process, their teaching process, and some of their characteristics, without covering all the others. This lack of systematic coaching for all phases of both processes may explain the unsatisfactory results achieved. Indeed, like Butler, Schnellert, and Cartier (2013) mention, it is important to consider the phases of the teacher learning and teaching process for meaningful professional development. In addition, the lack of coaching for the identification of learning goals by the teacher can affect the quality of the coaching offered. Indeed, Butler (2005) points out that the teacher's interpretation of the goals pursued plays a key role in the quality of his or her engagement in the learning and teaching process. This last result is in line with the results of Butler and Schnellert (2012) who found that teachers accompanied in their research need more support in identifying goals and aligning learning practices and strategies with these goals. The lack of systematic coaching for all phases of both processes and all the characteristics of the teacher can be explained also by the limited time that can be allocated to each school. Indeed, budget cuts have led to a reduction in the number of pedagogical advisors on school boards, which can affect the quality of their work (CSE, 2014).

The agentive aspect of the coaching process

Despite the presence of an objective that could promote the agency of teachers, the coaching process that targets coaching for the learning process of the teachers of the two coaches allow very little agency. Indeed, apart from "asking to read", Sophie's coaching practices allowed teachers little control over their learning. They may even be very little engaged in their learning process since the practices mainly required following and listening. In Joelle's case, this was mainly seen in the presence of many more explanations than questions, which does not promote an agentive learning

process. Indeed, as the conceptual framework of the study states, teachers' collaborative learning and teaching process are fostered when they perceive that they have control over their professional learning (Butler, Schnellert, & MacNeil, 2015). The lack of the agentive nature of the coaching process that supports the learning process in the two coaches can be explained by the lack of time suffered by the coach. Pedagogical advisers must work in a significant number of schools (CSE, 2014).

The Results of Question 2

The results of the present study described the interrelationship between the coaching process and several characteristics of the two coaches who participated in the study.

Previous training and experiences, and acquired knowledge

A consistency was noted between the coaching process of the two pedagogical advisers and their past training and experience and their acquired knowledge on the other. For example, the two coaches have set goals that are consistent with their past experiences, which may mean that they draw on these experiences to coach the teachers. According to Atteberry and Bryk (2011), the pedagogical advisor brings with him, in the coaching, expertise resulting from his training and past experiences. The varied knowledge of the two coaches is in line with the observations of Lessard (2008) and Verdy (2005) according to which the pedagogical advisor in Quebec has varied knowledge (field knowledge, theoretical knowledge, and consulting knowledge).

Conceptions

The results of the two case studies showed how the coaching process is consistent with their conception of coaching, teacher development, and the role of the pedagogical adviser and the school principal. However, it is the conception of coaching that is linked to the greatest number of phases of the coaching process: the identification of goals, the enacting of practices, and the control of practices and results. For example, Sophie, who supported both the control of teachers' practices, their enacting of learning, and their conceptions and perception of themselves, conceived coaching as a complex act where all these components must be supported. Joelle, for her part, conceived that the role of the pedagogical advisor was mainly aimed at promoting student learning, while she focused on improving the teachers' coaching of the student's learning process. As LaFortune and Martin (2004) explain, the coach engages in the coaching process with his conceptions of teaching and learning that will in turn be transformed by the experience. The contribution of this result is to take into account the conception of coaching and the role of the pedagogical advisor while this aspect was absent from the conceptual framework.

Perception of agency and self-efficacy

Both pedagogical advisers had positive perceptions of achieving their goals and they can decide in their coaching which can explain the quality of coaching offered. According to Butler, Schnellert, and MacNeil (2015), people's engagement in change initiatives depends as much on their perception of having control in identifying the goals to be achieved and how to achieve them, as on their perception of competence to achieve those goals. The positive perceptions of self-efficacy and agency observed in the two coaches can be explained by the long experience they have as coaches. Indeed, Duchesne and Gagnon (2013a, 2013b; 2014), and Walker *et al.* (2008) showed that there is a link between perceived self-efficacy and the number of years of experience as a pedagogical advisor. The factor related to the Quebec context that may explain these positive perceptions could be the place that takes nowadays the pedagogical services of school boards, with which coaches are associated (CSE, 2014). This result is similar to that of Héon (2004) according to whom "the coach met say that they have a great autonomy in their work. Although they do not decide on mandates, they attach great importance to the fact that they decide how to achieve the goals set" (Héon, 2004, p. 4).

Perception of the professional development situation and the role of the coach

The coaching process was consistent with the perception that the two coaches have of the proposed professional development situation and their role in it. For example, while Joelle perceived that the coaching was aimed at both mastering the reading program and revising the teachers' reading conception, she supported these two dimensions. Moreover, because her perception of her role was to act as a counsellor rather than being an authority figure, she avoided confronting teachers' ideas despite disagreeing with some of them. This result is coherent with Atteberry and Bryk (2011) which says that the pedagogical advisor demonstrates his commitment according to his adherence to the spirit of the professional development situation. Cartier and Butler (2016) explain it like this: "the relationship between contextual elements and the learning of individuals depends on how they perceive and interpret information in this context" (p. 8).

Perception of teachers

There was consistency between the perceptions of the two coaches and how they identify goals, implement practices, and monitor practices and outcomes. For example, the two coaches were not satisfied with the teachers' learning outcomes, although their perception of the teachers and their practice reflected this dissatisfaction. This result shows the close interrelationship between the phase of the control of the results and the perceptions that the coach has of the accompanied. Constant monitoring of these perceptions is important to avoid quick results.

Perception of the school principal's leadership

There is an interrelationship between the positive perception of the principal's leadership and the coaching process. Specifically, while the two coaches have a positive perception of the school principal, they accepted her request and planned, implemented, and controlled coaching practices consistent with this request. In addition, a performance check that takes into account its role in the professional development of teachers emerges from the analysis of the data. This result confirms the importance given to the school principal leadership in the conceptual framework of the study. Indeed, leadership can promote or hinder the professional development of teachers (Butler, Schnellert, & MacNeil, 2015). This result can be explained by the important place given to principals in recent reforms of Quebec's education system, with principals being called upon to play a central role in the professional development of teachers (MÉLS, 2008). Indeed, "in some school boards, the principal is not only consulted, but it is also he who defines the needs of his school and who directs the pedagogical advisor to respond to them" (Lessard & Des Ruisseaux, 2004, p. 151).

The Results of Question 3

The results obtained in this study show that the interrelationships of the coaching process occur mainly with the leadership of the school principal, the culture of collaboration and professional development of the teachers, and their culture of change. Interrelationships may exist between the coaching process and the learning or teaching process of teachers, but this has not been the subject of this study.

The leadership of the school principal

An influence of the leadership exercised by the two principals was noted. Indeed, in both cases, it was they who requested coaching from the pedagogical advisors, they reported to them the information observed on the problematic situation identified and they informed them of their objective, which was subsequently adopted by the two pedagogical advisers. But there was a variation in the exercise of leadership between the two principals. Only in the case of Joelle's coaching, the director was present at the meeting and she implemented frequent coaching practices. This agrees with the finding of Butler, Schnellert, & MacNeil (2015) according to whom school principals play a leading role in the professional development of teachers; they can coach their learning and teaching process by allowing them access to resources and encouraging their agency. However, in the two cases studied, a rather directive leadership and a lack of perception of agency by the teachers were noted. According to Butler, Schnellert, and MacNeil (2015), it is rather distributed leadership that allows teachers to perceive their agency at school and thus become more involved in their professional development process.

Teachers' culture of collaboration and professional development

The coaching offered was consistent with the teachers' professional development culture noted. For example, while the two coaches had set goals to have the teachers work as a team, very little collaboration was found among the teachers in School 1 while collaboration only in the area of lesson planning was observed among the teachers in School 2. The result of the lack of collaboration, present to different degrees in the two schools, is in line with the findings of Savoie-Zajc *et al.* (2011) that work remains to be done to get teachers to collaborate more with each other. Indeed, the coach often reports resistance on the part of teachers "specially to see other professionals [...] enter their classroom" (Cartier and Bélanger, 2012, p. 52). A culture where there is collaboration at the level of learning and teaching facilitates the coaching of the pedagogical advisor (Atteberry and Bryk, 2011).

Teachers' culture of change

The monitoring of teachers' learning outcomes by the two coaches is consistent with the timid culture of change that the teachers shared. According to Teachers, change was positive in itself, but it should not be imposed or fixed. This result can be explained by factors related to the Quebec context where resistance to change and a culture of isolation remains observed in schools (Savoie-Zajc *et al.,* 2011). In addition, it can be explained by the imposed nature of professional development activities that remain present in Quebec and elsewhere. Indeed, despite the consultation process put in place in all School Boards in Quebec, many teachers believe that their needs are still neglected (CSE, 2014). As Draelants (2007) points out, it is often the pedagogical advisor "who embodies daily the change imposed 'from above' and perceived in a very negative way" (, p. 165).

CONCLUSION

The results of the present research show how important it is for the coach to self-regulate his coaching process in relation to his or her personnel characteristics and those of the school context. Better collaboration can lead to better engagement on the part of teachers. For example, the teachers appreciated that the coach helped them according to their needs (which was not always the case). Thus, results offer to practitioners two cases of fairly optimal coaching. In addition, the way in which these results are presented shows how to plan and analyse coaching in relation to the characteristics of the school context in order to offer better coaching to teachers.

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HOW CAN LEARNING EXPERIENCES BE EXPLORED IN SIMULATION-BASED LEARNING SITUATIONS?

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ABSTRACT

The aim of our research is to investigate what methods can be used to explore learning experiences. In this case example, we describe how we extracted quantitative and qualitative data reflecting learning experiences from simulation-based learning (SBL) situations. Data collection was conducted in the fields of aviation and forestry. After the SBL situation, the students participated in a stimulated recall interview. The transcribed interview data were analysed using data-driven methods. To capture the dynamics in the (neuro)physiological signals associated with varying states of learning experiences, we recorded activity of the autonomic and central nervous systems. When analysing (neuro)physiological data, we focused on extracting reliable signatures reflecting both the state and the reactivity of the autonomic and central nervous systems. Later on, different data types will be integrated and analysed together. The aim of this article is to elaborate the extent to which different data types can be integrated in analysis to produce meaningful information about learning experiences. Our results based on the students' interviews highlight the meaningfulness of the instructor's guidance in SBL situations. We also show that it is possible to extract reliable features from (neuro)physiological signals measured during natural learning situations. These (neuro)physiological features also seem to vary depending on the phase of the simulation. Therefore, we conclude that by including (neuro)physiological

measurements in research designs, it is possible to achieve a more comprehensive understanding of learning experiences. This type of multidisciplinary research is likely to provide novel insights in developing learning environments and guidance.

INTRODUCTION

There is increasing interest in exploring learners' emotions and their role in learning and teaching processes (Damasio, 2000; Rienties & Rivers, 2014; Rowe & Fitness, 2018; Zeivots, 2016). In addition to emotions, the increased understanding of the links between experiences and the related (neuro)physiological states and reactions during learning enables new insights in developing educational practice and research methods. As learning experiences form via complex processes, the integration of different methods and theoretical frameworks could provide a more detailed understanding of the characteristics involved in learning experiences.
In previous studies, varying combinations of (neuro)physiological measures, such as electrodermal activity (EDA) or skin conductance responses (SCR), heart rate (HR) and heart rate variability (HRV), eye-tracking and electroencephalogram (EEG), and experiential measures, such as self-reports, video recordings and questionnaires, have been employed to investigate adult learning experiences. For instance, affective or emotional learner experiences have been investigated in combination with EDA and SCR measurements (Eteläpelto et al., 2018; Hardy et al., 2013). Larmuseau et al. (2019) used a combination of EDA, skin temperature and self-reports to assess cognitive load during learning tasks. In addition to physiological measures, neurophysiological measures, such as EEG, have been combined with eye-tracking and video recordings to understand learning experiences (Giannakos et al., 2019). Multimethod approaches have also been applied in technology-enhanced learning environments with the aim of improving learning experiences and outcomes (Aguayo et al., 2018; Cowley et al., 2013; Girzadas et al., 2009; Wang & Cesar, 2015). The very different methodologies used in these studies highlight the need to integrate standardized research methods and theoretical frameworks when investigating holistic learning experiences.

While the basis for rudimentary (e.g. perceptual) learning is in repetition, the learning of more complex entities often requires the disruption of routines. According to Malinen (2000), meaningful learning experiences, 'fractures', distort familiar and safe lifelines and mindsets and are consequently starting points for a critical and analytic phase with beneficial self-reflection of one's own way of thinking or doing. The experiences ultimately build on the basis of the actions and reactions of our nervous system, which incorporates mechanisms both for learning through repetition and change in perspective via an elaborated change in the mindset. For the ongoing evolving of learning experience, it is likely that our brain and body systems also offer a specific 'tone' contributing to the state of mind that can be more or less beneficial for safe and successful learning experiences.

Simulation-based learning (SBL) as a learning method can be theoretically approached from the perspective of experiential learning (see e.g. Kolb & Kolb, 2017). SBL situations are suggested to be powerful learning experiences due to their authentic nature and connection to emotions and reflections that they stimulate, which are also debriefed as part of a SBL situation (e.g. Bearman et al., 2019; Fromm et al., 2021; Lateef, 2010). Moreover, SBL enables the varying of different elements, such as the difficulty level of learning tasks or the involvement of an instructor.

We explored SBL situations by applying autonomic and central nervous system recording techniques in combination with traditional educational research methods, such as stimulated recall interviews. The SBL context offers an excellent opportunity to scientifically approach experiential learning, as it can be a) controlled according to a specific simulation protocol and enable higher (neuro)physiological quality recordings and b) generates authentic learning experiences. As no detectable features in the (neuro)physiological signals directly correlate with learning experiences, we focus on extracting well-studied characteristics from the (neuro)physiological data that are linked to particular states, such as arousal, stress and attention (Berntson et al., 1997; Klimesch, 2012; Quintana et al., 2012).

In this case example, we describe how we extracted experiential and (neuro)physiological data from SBL situations. Furthermore, we present some preliminary findings regarding self-reported learning experiences and the variation of (neuro)physiological activity during the different phases of an SBL situation.

RESEARCH QUESTIONS

The central research questions of our project are as follows:

- How can learning experiences be measured in natural settings? What methods and technologies can be used to explore self-reported learning experiences, (neuro)physiological activity and reactions associated with these experiences?
- What is an SBL situation like as a self-reported learning experience?
- How can (neuro)physiological recordings be used in investigating self-reported meaningful moments of SBL?

METHODOLOGY

Participants

Data collection was conducted in natural learning settings in the fields of aviation and forestry. The participants were six aviation pilot students, two aviation training instructors, six forestry students and two forestry training instructors, and they formed 12 student–instructor dyads. The students' ages were between 16 and 25. All participants were male. Written informed consent was obtained from all participants before the study began, and the study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the local ethics committee of the University of Jyväskylä.

Procedure

Data collection for a dyad lasted approximately 3.5 hours, including preparations for the (neuro)physiological measurements, the SBL situation and a stimulated recall interview. Each SBL situation was video-recorded to gather detailed information on the timeline and events during the different phases of the simulation.

All SBL situations consisted of three phases—an introduction, the performance of tasks and a debriefing. An instructor guided each student throughout the SBL situation. At the introduction phase, the instructor explained the topic and structure of forthcoming simulation tasks and gave the student general instructions. In addition, the student had the opportunity to ask questions. During the simulation tasks, the difficulty level increased progressively, and after every task the student's performance was briefly reviewed. After all tasks were completed, an in-depth debriefing was carried out where both the instructor and the student commented on and evaluated the student's performance of the tasks. After the SBL situation, the students participated in a stimulated recall interview; this included watching their own performance on the video recording. During the interview, the students also filled out a form where they reported episodes they considered relevant in terms of their learning and described these moments to the interviewer. To gather information about the instructors' pedagogical thinking and conceptions about the SBL, the instructors were also individually interviewed.

As there was an extensive amount of equipment used (e.g. simulators as training tools, various physiological measurement devices), we wanted to know whether the equipment may have caused any disturbance in terms of the learning situation. Therefore, we gathered information about the learners' possible attention to the research setting. Consequently, at the beginning and at the end of the interview, the participants were asked about their general experiences, which gave them an opportunity to reflect on their experiences, the research setting and the measurement

equipment. The participants were also free to give the researchers feedback at the end of the interview.

To capture the dynamics in the (neuro)physiological signals that are associated with varying states of learning experiences, both autonomic (electrocardiogram [ECG]; frequency and phases of respiration) and central nervous system (EEG) activity were monitored throughout the SBL situation. Each dyad was measured simultaneously. Physiological and neurophysiological signals were recorded using the Bittium NeurOne system (Bittium Biosignals Ltd, Finland). EEG signals of all the instructors and aviation pilot students were recorded using a standard 64-channel EEG cap (EASYCAP, BrainProducts GmbH, Germany). As a virtual reality headset was used in the forestry SBL situation, a customized 13-channel EEG cap (neoprene headcap with NG geltrode electrodes and press stud cables, Neuroelectrics, Spain) was used for the forest machine operator students. Together with the EEG, cardiac and respiratory signals were simultaneously recorded using two ECG electrodes placed beneath each collar bone and a flexible piezo-based respiratory belt (Spes Medica, Italy) placed around the participant's lower chest. During the SBL situations, annotations, such as a timestamp at the beginning of each task, were added to the (neuro)physiological data for later temporal synchronization of different data modalities.

Analysis

Each data type was pre-processed and analysed separately. Later on, different types of data will be combined in the forthcoming analysis steps. The integration and synchronization of different data modalities will improve our understanding of learning experiences on several levels, ranging from self-reported experiences to (neuro)physiology.

Video recordings of SBL situations

Video recordings were used to gather information on the timeline of the SBL situation to enable the integration of (neuro)physiological and experiential data. While watching the video recordings, a timeline with relevant annotations related to specific events during the SBL situation was created. The content of the video recordings will be analysed to gather information on the interaction and communication between the student and the instructor during the SBL situation.

Analysis of the interview data

The stimulated recall interview data of each student was examined using data-driven methods. The students' interviews were first transcribed, and all expressed utterances were placed into a table format as a linear continuum of the events. It was important to maintain the temporal order of the events in the SBL situation. The interview questions also followed the SBL structure (i.e. the phases of simulation

from preparation to debriefing), thus further supporting the temporal representation of the SBL events.

The utterances were given content descriptions and a code that described them in terms of the content. To increase the reliability and validity, two or three researchers then independently generated codes for the contents. To reach agreement, each code was jointly discussed. Consequently, thematic entities that emerged during the coding process were generated to describe the main elements of the SBL experiences. For the forestry data, the researchers focused more on a few thematic elements selected in advance, whereas for the aviation data all utterances were utilized to form a more comprehensive description of the SBL situation as a learning experience.

Analysis of the EEG and ECG data

In the analysis of (neuro)physiological data, we focused on extracting reliable, artifact-free signatures reflecting both the state and the reactivity of the autonomic and central nervous systems throughout the SBL situation.

First, the signal quality of the EEG data was visually inspected and electrodes with poor signal quality were excluded from further analysis. Second, artifacts such as eye blinks, saccades and heart beats were removed using independent component analysis. After re-referencing and filtering, the data was converted from time-domain to frequency-domain using Fast Fourier Transform. Finally, measures of rhythmic brain activity, particularly alpha-band oscillations, were extracted from the pre-processed EEG data. ECG data was pre-processed and analysed using Kubios HRV Premium software (Biosignal Analysis and Medical Imaging Group, University of Eastern Finland, Kuopio, Finland), which provides standardized and validated methods for extracting both HR and HRV measures from the ECG signal (Tarvainen et al., 2014). Both time-domain (e.g. mean HR, root mean square of the successive R–R differences) and frequency-domain measures (e.g. frequency components of HRV) will be investigated.

After pre-processing, the data will be analysed using two different approaches—state-based analysis and analysis of continuous signals. In the state-based analysis, the SBL situation is divided into behaviourally and pedagogically distinct phases (e.g. rest, simulation tasks, debriefing) based on the analysis of video recordings. This allows us to investigate the (neuro)physiological characteristics in each behavioural and/or pedagogical state both at the individual subject level and also as a group average. In the data-driven analysis of continuous data, we focus on investigating the time-varying nature of (neuro)physiological signals. This approach enables the investigation of intra- and inter-subject synchrony of the ongoing neural and bodily signals (e.g. HRV−EEG synchrony within an individual, HRV−HRV synchrony between the student and the instructor) during the SBL situation.

RESULTS

It should be noted that the analysis is currently in progress. Therefore, only preliminary findings regarding the stimulated interviews and EEG and ECG data are presented here.

Self-reported learning experiences

Our preliminary results based on the students' interviews highlight the meaningfulness of the instructors' feedback and guidance in SBL situations. This finding is in line with theoretical knowledge of experiential learning in which an open and confidential dialogue between a student and an instructor is one critical aspect supporting learning (see e.g. Schön, 1983). In both aviation and forestry, the role of the instructor was made manifest, for example, through advice, feedback, joint discussion and reflection, which highlights the value and importance of reciprocal interaction in SBL. Instructors might also play a significant role in what aspects of SBL students pay attention to, whether the discussion during learning is focused on technology and its effect on the learning experience or whether the focus is on learning experiences per se. Notably, in the descriptions presented by the students while relating their learning experiences, the instructors appeared to have a significant role in the learning process. However, these are only descriptions of the instructors' actions from the students' perspective and not direct interpretations of the instructors' behaviour, which could be interpreted from the video recordings in the future.

Likewise, simulator features were seen to affect the learners' experiences. The role of technology was indeed emphasized, as tasks were performed with simulators, which is likely to have an effect on students' experiences. For instance, many of the students' meaningful episodes were observations relating to mistakes and successes in performance during tasks, and they were mainly focused on technological issues.

In addition to these thematic elements mentioned above, the influence of simulation technology and experimental setting could also be considered when investigating learning experiences with this kind of multimethod approach because they seem to affect the way the learners experience and verbally describe their experiences during the SBL situation. As expected, many of the students somehow took into account the presence of the measurement equipment (mainly the EEG), and some also mentioned being aware of the researchers being physically present in the room. In relation to their learning experiences, the students stated that at first they were pretty much aware of the ongoing measurements, but when the SBL situation progressed and

tasks became more intensive and challenging, the measurements and the presence of the researchers were more or less forgotten. Overall, research equipment was not considered to play a significant role, as students indicated being fairly focused on the SBL tasks.

EEG and ECG data

Although individually varying amounts of artifacts were observed in the (neuro)physiological signals, the EEG and ECG recordings were successfully performed for all individuals. Our preliminary analysis of the EEG and ECG data shows it is possible to extract reliable and robust features of EEG and HRV signals measured in natural SBL situations. Regarding EEG, the most robust measure seems to be alpha-band oscillatory activity. Moreover, the variability of alpha activity can be associated with varying arousal levels. Indeed, our preliminary analysis of EEG data indicates clear separation between task vs. no-task states. Because ECG forms the basis for the computation of various HR-based measures, they can be used to particularly assess the parasympathetic activity of the autonomic nervous system during the SBL situation. As an example, the variability of the mean HR (beats per minute) during the different phases of the SBL situation is presented in Figure 1. Based on the visual inspection of the HR data, this measure of autonomic nervous system activity seems to vary depending on the phase of the simulation (e.g. rest – task – feedback) both for the instructors and the students; however, more statistical testing is needed to confirm these preliminary findings.

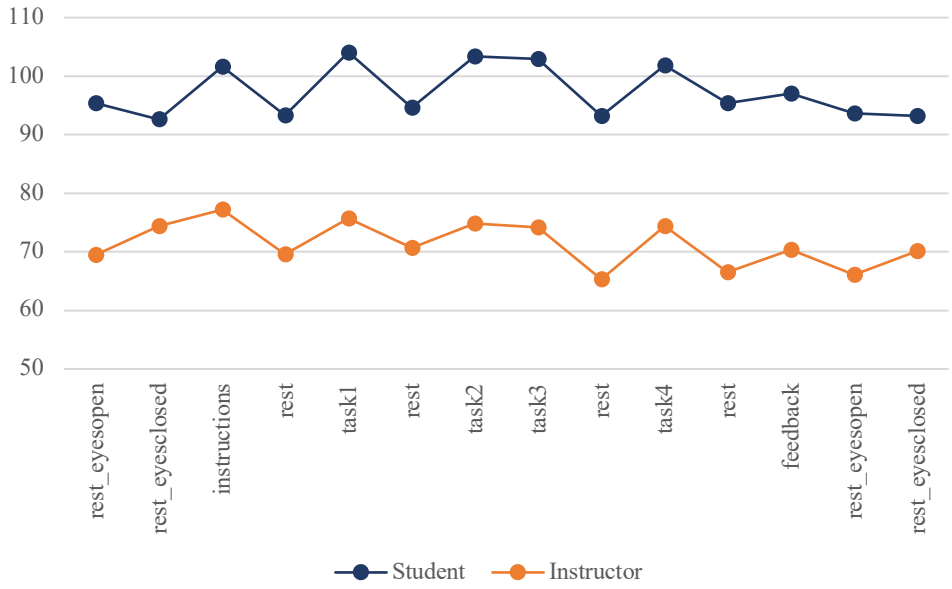

Figure 1. An example of the variability of the mean heart rate (beats per minute) of a student–instructor dyad during the different phases of the SBL situation

DISCUSSION

The aim of our research is to investigate what methods can be used to explore self-reported learning experiences and (neuro)physiological characteristics that are associated with these experiences. Simultaneously, we also respond to the lack of empirical evidence in investigating learning experiences in SBL situations (Silvennoinen et al., 2020). With our multidisciplinary and multimethod approach, we are opening up new possibilities to understand learning experiences by acknowledging that they cannot be understood by exploring each aspect in isolation. Therefore, the integration of various types of data to capture simultaneous changes in both (neuro)physiology and reported experiences is essential to deepen our understanding (Silvennoinen et al., 2020).

As the (neuro)physiological recordings were successfully performed and we were able to extract reliable and robust features of EEG and ECG signals measured in natural learning situations, it seems fair to say that (neuro)physiological measurements can be included in research designs aiming to understand the complex nature of learning experiences more comprehensively. However, conducting

research that combines educational and (neuro)physiological methods is not straightforward. First, the signal quality measured in natural learning settings is typically poorer due to the missing shielding against electromagnetic interference. Furthermore, natural movements related to the simulation tasks and student–instructor interaction (e.g. steering the simulator, talking) may further weaken the quality of the measured (neuro)physiological data. Therefore, advanced knowledge and use of state-of-the-art analysis methods is required to obtain reliable results. Second, due to the complex nature of natural learning situations, the analysis and interpretation of the data is far more challenging compared to experimental designs used in a controlled laboratory environment. Although exploring learning in natural settings involves challenges, modern technology such as lighter and mobile measurement technologies and methods such as SBL enable developing research designs to investigate learning experiences based on their most authentic nature.

Our preliminary results also highlight the influence of the instructor and simulation technology on the individual learning experiences, learning outcomes and interaction. For instance, when seeking to explore a learner's experiences, the impact of the instructor on the course of discussion may be relatively high, which in turn should be taken into account. Moreover, natural learning situations involve instructor–student interaction, but the research setting necessitates that part of the multidisciplinary research team be physically present in the situation. This inevitably changes the dynamics of the interaction, which is important to try to ignore as much as possible. As the impact of instructors on students' learning experiences seems to be relatively high, there is a need to explore the existence and meaning of interaction as a synchrony between instructor and student with different measurement modalities in more detail (e.g. HRV-EEG, EEG-EEG). It is worth noting that combining different types of data is also challenged by different traditions in terms of methodologies and analysis processes. Therefore, experts from each discipline are required to be involved in the analysis processes and interpretation of the findings.

In the future, we need to improve our understanding of how various elements, such as authenticity and features of the simulators and experimental settings, affect learning experiences. When the authenticity of the learning situation is considered, the differences between real situations and simulations need to be taken into account. The authenticity could also be improved by using VR technology, which may provide an enhanced feeling of authenticity through immersion (see Vesisenaho et al., 2019). Furthermore, the degree to which the experimental setting and measurement devices used (e.g. EEG cap, HRV electrodes) affect the authenticity and operability during the SBL situation should be assessed. For some individuals, the experimental setting might feel disturbing, whereas others may almost forget the research instruments and be fully focused on the SBL situation. Therefore, careful planning and implementation of the experimental setting and the use of mobile measurement technologies could further improve the authenticity of the research conducted in SBL situations. This type of multimethod and multidisciplinary

research that takes into account various elements affecting learning experiences is likely to provide novel insights into how learning environments and guidance can be developed to support learning processes in the most effective way.

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CAN YOU EAT NUMBER?
INCREASING MOTIVATION FOR MATHEMATICS THROUGH THE USE OF PHILOSOPHICAL DIALOGUE

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ABSTRACT

Enhancing the motivation of primary and secondary school students for mathematics can be challenging. In this research project we aim to develop a method to stimulate motivation for mathematics by allowing students to participate in philosophical dialogues about mathematics.

The first focus of the research is to formulate design criteria for successfully introducing philosophical dialogues in the mathematics class for students aged 10 to 14. According to the principles of an education-design-research, a method was developed and evaluated through interviews and observations. Secondly, a pre- and post-test allowed to assess the impact of the approach on students' motivation for mathematics. Thirdly, we evaluate the usability of the teaching method by mathematic teachers.

With regard to the design criteria, it appears that combining philosophical dialogues with hands-on activities is promising. These hands-on activities can be performed with low-cost materials. They can be enriched with stories, challenging questions or small experiments that stimulate thought and reflection. Furthermore, the role of the teacher is key, as an authoritarian role may inhibit the dialogue. From the pre- and post-test it appeared that a majority of the students appreciate the approach. The group interview with mathematic teachers revealed that not all mathematic teachers feel safe to facilitate dialogues. Adequate training seems crucial.

INTRODUCTION

Flemish primary and secondary school students' motivation for mathematics is surprisingly low (Wenner, 2001). Students develop fears around mathematic through prejudices and misunderstandings, so-called mathemaphobia (Mo, 2019). This is passed on to the students through education and parents (Lafortune et al., 1999). Also, students are easily frustrated when they must do the same exercises repeatedly (Willis, 2010). The usefulness of the mathematical content is often a big question for students and should be made clear to students more quickly (Bursal & Paznokas, 2006).
In this work we want to address students mathemaphobia using philosophical dialogues. Philosophical dialogue gets increasing attention in education in recent years. In 2002 the VEFO was founded, which stands for the Flemish Network for Contemporary Philosophy education (Galle, 2016). This association aims to give philosophical dialogue a more prominent place in the regular Flemish education. In literature, too, philosophers argue the added value of philosophical dialogue and its potential in education (Anthone & Mortier, 2007; Lipman, 1980). Earlier studies show that the use of philosophical dialogue can increase children and adolescents' critical thinking skills, listening and argumentation skills (Dunlop, 2016; Lipman, 1980). Moreover, philosophizing in class stimulates children's' self-confidence (Daniel et al., 1999).

Research aim and research questions

To enhance students' motivation for mathematics the role philosophical dialogue can play has been studied before (Daniel et al., 2000). There, students were challenged to answer challenging, philosophical, mathematics related questions. Examples of such questions are "What is beyond infinity?", "Is zero something or nothing?". In these approaches, philosophical questions were used as prompts to help students engage in dialogues about mathematics.
In this study, the aim is to develop a teaching method based on philosophical elements in combination with hands-on activities challenging students to couple abstract ideas to everyday practice. Hands-on activities might provide a stimulating context to help students bridge the realms of the abstract and specific. The goal of these lesson activities is to stimulate students' motivation for mathematics. We do not intend to acquire the student to gain new knowledge, but to motivate students and apply existing knowledge in a different context to get a deeper understanding of the topics.

- RQ1: What are the design criteria for successfully introducing a combination of philosophical dialogue and hands-on activities in the mathematics class for students aged 10 to 14?
- RQ2: What is the impact of the teaching method on the students' motivation for mathematics?

- RQ3: How do mathematic teachers evaluate the usability of the teaching method?
-

EDUCATIONAL DESIGN RESEARCH CYCLES

According to the principles of an education-design-research (Plomp & Nieveen, 2007) a teaching method was developed in an iterative manner. It is evaluated through interviews and pre- and post-tests. The design cycles included 1) a try-out during the national Science Day, an extracurricular activity, 2) teacher feedback, 3) try-out during regular mathematics lessons in the first grade of secondary schools and, 4) teacher feedback and 5) online learning activities (caused by the first lockdown of the COVID-19 pandemic). All participants were of ages 10 to 14.
An overall assessment of the students and the impact on the students motivation on mathematics were studied through a questionnaire after following the first try-out. And pre- and post-test were taken just before and following the second try-out. The teacher feedback was gained through interviews with mathematic teachers. These interviews were written out, coded and analysed based on the methods of grounded theory.

Extra-curricular try-out

The first try-out of the new material was on the national Science Day in Belgium, November 24, 2019. During two interactive workshops, around 30 children aged 10-14 year, philosophized about following mathematical questions: *Can you eat the number 2?* and *Can you eat 16/15 of a cake?*. The latter philosophical questions was in a later phase adjusted to *Can you divide everything fairly?* since the original question was too vague.

During the extracurricular workshops at the national Science Day a questionnaire was taken to assess the impact of the approach on students' motivation for mathematics. All participants individually filled in a questionnaire immediately after the workshop. Following questions were asked:

- What is your age? *(open question)*
- How did you experience thinking about math differently?
  closed ended: horrible 1 – 2 – 3 – 4 - 5 super fun
- Would you like to philosophize again about mathematical themes?
  closed ended: never again 1 – 2 – 3 – 4 - 5 for sure
- Did you learn anything new about math? *(closed ended)*
  closed ended: nothing 1 – 2 – 3 – 4 - 5 a lot

Based on the findings of the Science Day the two activities were adapted and written down in an attractive layout.

Teacher feedback 1

The facilitator plays a very important role in guiding a philosophical and hand-on activity. In most cases the facilitator is the teacher of the class group. Therefore, it is crucial to investigate the way mathematic teachers evaluate this method, regarding their role as facilitator.
At the beginning of February 2020 eight primary education teachers at Brussels schools gave feedback on these two activities in a group interview. They were intrigued but noted that such an activity would only be considered if it does not take up too much time and if it is clearly connected to the curriculum.
We added the timing of the different parts and the link to the regular curriculum. In this way the teachers immediately have a time schedule and the underlying goals and objectives of the activity.

In class try-out with control group

The second try-out was during regular lessons in a secondary school in Mechelen, Belgium. Two class groups participated, they had the same specialisation, modern sciences, the same age, 13-14 years, and the same mathematics teacher. During twee weeks, eight mathematic lessons of 50 min were given by a researcher, who was student of the educational bachelor of the university college Odisee. The only difference was the topic of the first lesson. For one class group this included a philosophical and hand-on activity as the start of a new chapter. The philosophical question of this activity was *Can you split everything in 2?* The other class group was the control group where no philosophical and hand-on activity took place.
The impact of the philosophical and hand-on activity on the motivation for mathematics of students is investigated by a pre- and post-test of both the experimental and control group, respectively 19 and 21 students. The pre-test was taken one week before the activity and the post-test three weeks after the activity, for both the experimental and control group. The questions of the pre-test were about student's gender and age, general motivation for school, favourite subject at school, interest in mathematics at school and outside school (in media, a future job). Similar questions were asked in the post-test including: how well the students could remember the lessons of the researcher and their general experience of them. The experimental group had three extra questions about how well the students could remember the hand-on and minds-on activity and how they experienced it, whether they would like to philosophy on mathematical topics again.
There was no need to adjust the format or content of the activities after this intervention.

Teacher feedback 2

In a second feedback round, mathematical teachers of secondary education participated. This semi-structured interview took place in the beginning of March 2020.
Then, six more activities were developed which were evaluated by the same teachers mid-April 2020. The subjects of these activities are all related to mathematical subjects that are in the regular curriculum of students aged 10 to 14, and cover the different mathematical content areas. An overview of the questions and the related mathematics content are given in Table 1. The selected subjects also contain concrete and abstract technical terms that can be used in multiple contexts. This ensures that students can approach the same subject from different perspectives and establish the link to the everyday world.

At home during lockdown

Due to the COVID-19 pandemic, additionally we made of each activity to a short video of two to three minutes. The main aim of this, was to reach students during the general closure of the schools. In these videos are more compressed, but followed the same structure of the class activities. The materials needed for the hand-on part are typically present in a household and are ideally reusable or household waste. The videos are available on YouTube and have been viewed more than 800 times since September 2020, see Table 1.

*Table 4: **Overview of the eight activities with the philosophical questions, mathematical content area and link to the YouTube video (Dutch only).***

	Philosophical question	**Mathematical content area**	**Link to video**
1	Can you eat numbers?	Numbers	https://www.youtube.com/watch?v=nuOQpiRY-3A&t=40s
2	Is 1+1 always 2?	Algebra	https://www.youtube.com/watch?v=m2PF0zgRMl8&t=34s
3	Zero: something or nothing?	Algebra, Measurement	https://www.youtube.com/watch?v=rhHxuQKYdzg&t=64s
4	Full or empty?	Measurement	https://www.youtube.com/watch?v=f0HEeRmXyiY

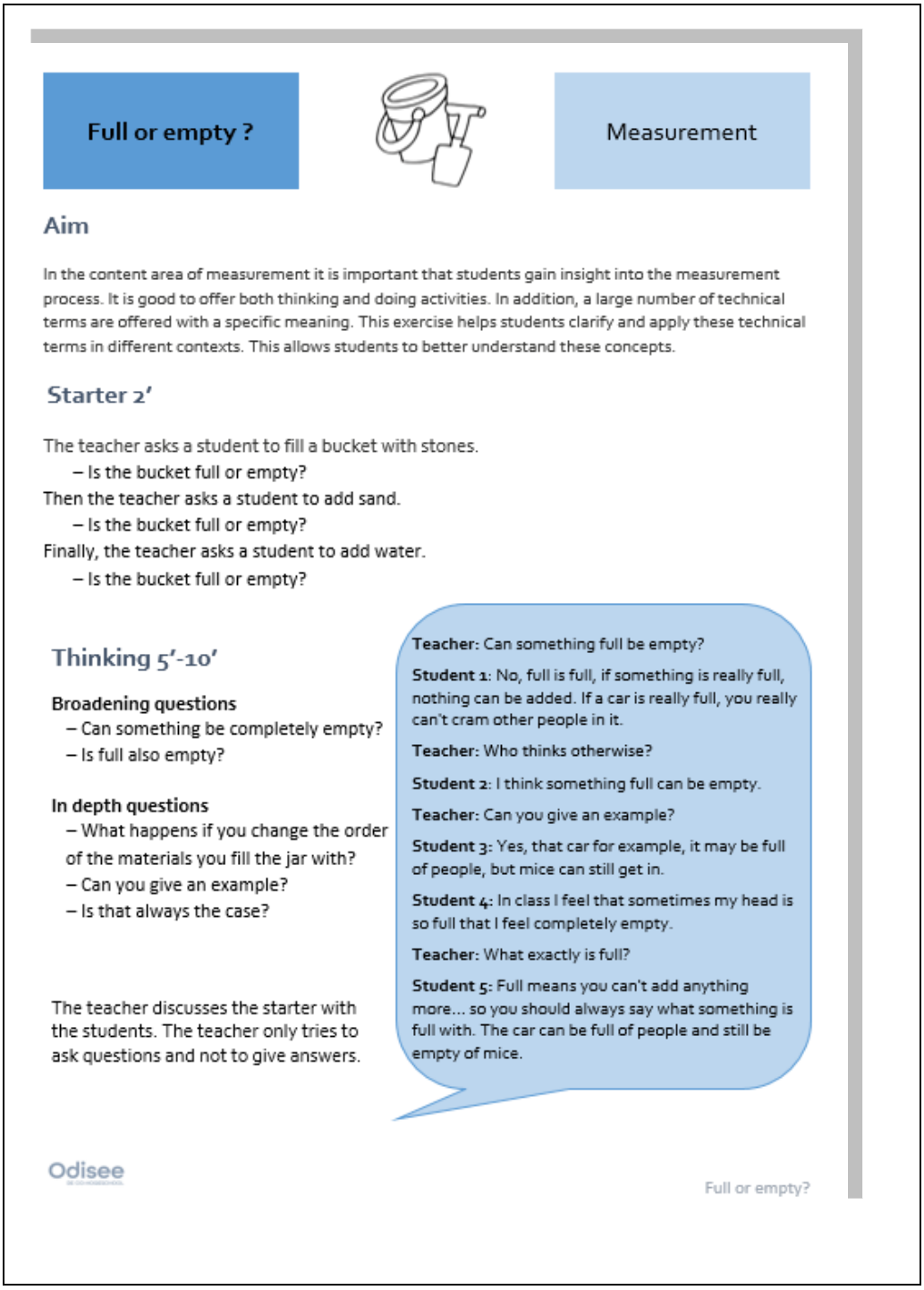
5	Can you divide everything fairly?	Shape and space	https://www.youtube.com/watch?v=78u2jwggLHA
6	Can you split everything in 2?	Shape and space	https://www.youtube.com/watch?v=UQFbrjY4BUM&t=1s
7	Can robots be wrong?	Computational thinking	https://www.youtube.com/watch?v=QH4KAA4WKZc&t=2s
8	Are robots also people?	Computational thinking	https://www.youtube.com/watch?v=3vwCbsu1i0A&t=94s

FINDINGS

Design criteria

(1) Philosophical questions that invite students to give yes- or no-answers are easily implemented. These kinds of questions lead to a quick response of the students. These questions which are grammatically closed, but conceptually open (Worley, 2015). This helps students to engage in an inspiring dialogue about mathematics. (2) An approach which combines the use of philosophical dialogues and hands-on activities is promising as it helps students to couple (minds-on) reflection with (hands-on) actions. (3) Activities can contain stories, challenging questions and small experiments that stimulate thought and reflection. (4) Little and low-cost material helps to carry out the activities. (5) The role of the teacher/facilitator is key, as an authoritarian role may inhibit the dialogue, instead open questions are key.

An example of a philosophical and hand-on activity is given in figure 1 and 2. The activity starts with a small experiment, followed by a philosophical dialogue. To support the teacher, some suggestions for questions are given to keep the dialogue going. Next, the students perform some small experiments themselves. Some experiments are suggested, but note that the students are free to perform their own experiments. In the last part, students retake the philosophical dialogue and add their new insights of the experiments. The blue boxes, figure 1 and 2, contain examples of such philosophical dialogues.



Full or empty ?

Measurement

Aim

In the content area of measurement it is important that students gain insight into the measurement process. It is good to offer both thinking and doing activities. In addition, a large number of technical terms are offered with a specific meaning. This exercise helps students clarify and apply these technical terms in different contexts. This allows students to better understand these concepts.

Starter 2'

The teacher asks a student to fill a bucket with stones.
– Is the bucket full or empty?
Then the teacher asks a student to add sand.
– Is the bucket full or empty?
Finally, the teacher asks a student to add water.
– Is the bucket full or empty?

Thinking 5'-10'

Broadening questions
– Can something be completely empty?
– Is full also empty?

In depth questions
– What happens if you change the order of the materials you fill the jar with?
– Can you give an example?
– Is that always the case?

The teacher discusses the starter with the students. The teacher only tries to ask questions and not to give answers.

Teacher: Can something full be empty?

Student 1: No, full is full, if something is really full, nothing can be added. If a car is really full, you really can't cram other people in it.

Teacher: Who thinks otherwise?

Student 2: I think something full can be empty.

Teacher: Can you give an example?

Student 3: Yes, that car for example, it may be full of people, but mice can still get in.

Student 4: In class I feel that sometimes my head is so full that I feel completely empty.

Teacher: What exactly is full?

Student 5: Full means you can't add anything more... so you should always say what something is full with. The car can be full of people and still be empty of mice.

Odisee

Full or empty?

*Figure 4: **Example of the philosophical and hand-on activity 'can full be empty' part 1.***

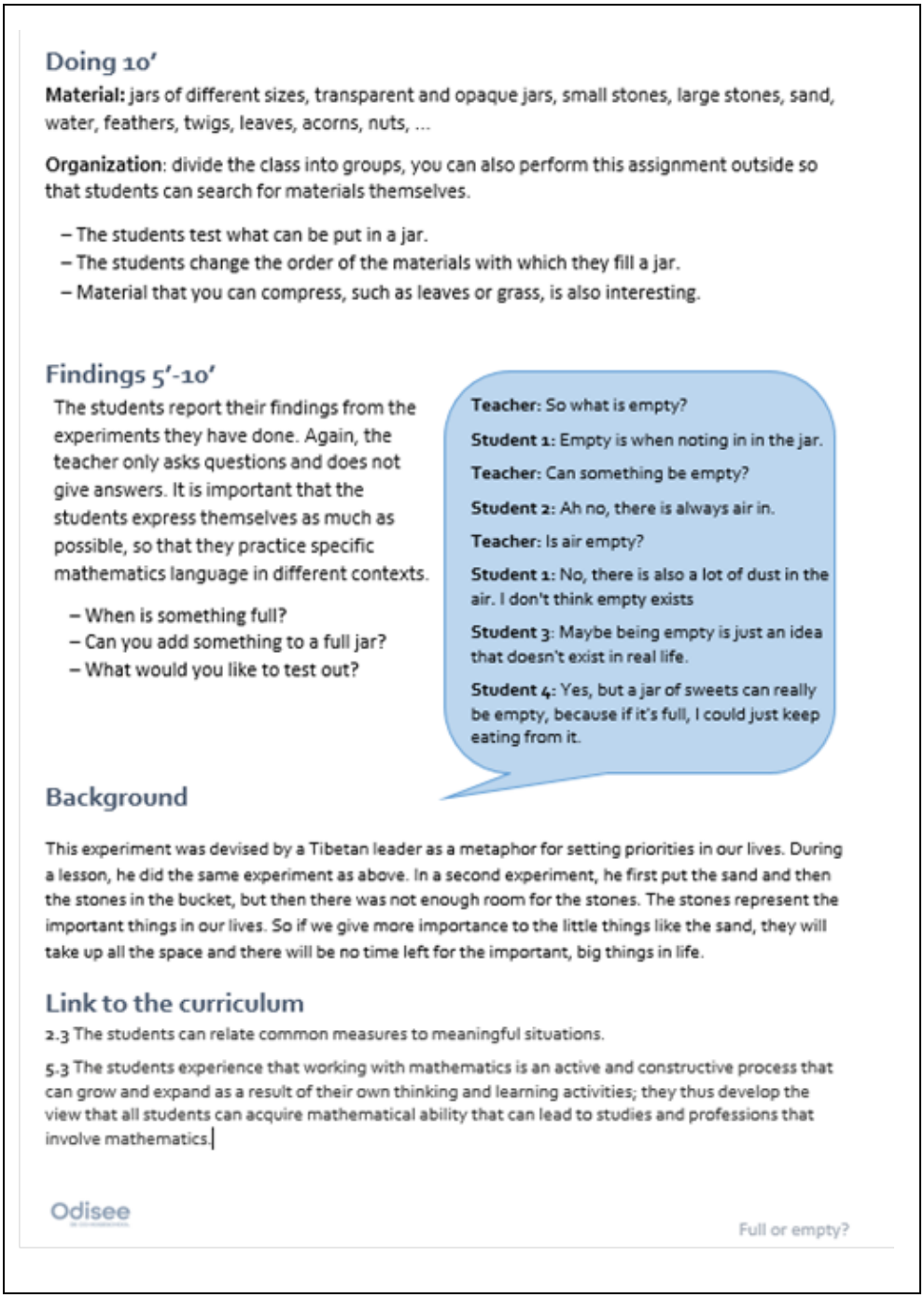


Figure 5: ***Example of the philosophical and hand-on activity 'can full be empty' part 2.***

Student's motivation

Firstly, during the first workshop, some parents joined their children to the philosophical workshop and even took part in the dialogue. The parents were a disturbing factor, since they had an authorial role. In addition, the researcher who facilitated this workshop was not yet trained. During the second workshop, she waited longer for answers after a question, asked more question like "Can the opposite be true?", "Things everybody this?". From the questionnaire it can be concluded that the children of the second workshop had in general a more positive experience of the activity, compared to the children of workshop one.
No one from the second workshop had negative experience of philosophizing about mathematics, in contrary, three children of workshop one, had so. In addition, six an one children found it super fun to philosophize about mathematics, respectively for workshop two and one, see Figure 3.

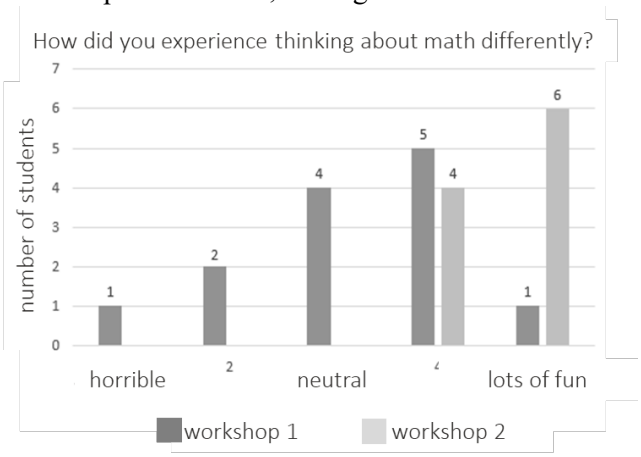


Figure 3: Extra-curricular try-out.

From the pre-test is appears that in general the most favourite subject at school is physical education (31 %). Languages and physical education are the favourite subjects of girl and boys, respectively. There is no relationship between general motivation for school and the student's favourite subject.
Furthermore, the results show that motivation for mathematics is low. Three of the 40 students choose mathematics as their favourite subject and only six students would choose a specialisation with a mathematical focus. However, more than half of the respondents (55%) completely agree with the statement that the topics covered in mathematics lessons have something to do with the real world. It is also remarkable that there are only 8 students who think math lessons are stupid.
To evaluate the effect of the hand-on and mind-on activity, we compare the results of the post-test of the experimental and control group. There is no clear difference in the general experience of the math lessons given by the researcher, see Figure 4.

However, students reported the activity as stimulating, describing that their heads began to fizz and that they began to actively think about mathematics.

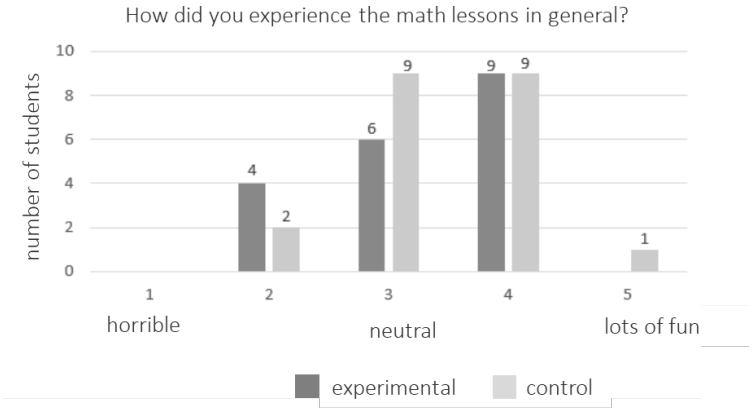


Figure 4: In class try-out with experimental and control group.

The post-test was also used to determine how long students could remember a hand-on and minds-on activity. Over a period of two months, 72% of the 19 students can still remember the think-act activity. In addition, the results show that more than half of the students from the experimental group (55%) liked or really liked to think differently about math. However, the activity has stimulated only 4 out of 19 students to do this again.

Teacher interviews

Teachers reported two major factors that prevent them from using philosophical and hand-on activities themselves. First, teachers expressed concerns on the use of teaching time as they experience a lot of pressure to teach all content of the curriculum. Second, teachers were concerned about the unpredictability of the teaching approach and the chaos that can arise during such an activity. A math teacher with 39 years of experience said "*Mathematics and chaos that's hard to match.*".

CONCLUSION

Around the end of primary school, young people's motivation for mathematics decreases. The purpose of this research project is threefold. First, activities were developed to allow young people to look at mathematics from a different perspective. Second, the impact on their motivation is investigated. Third, we studied the usefulness of this approach where teachers take the role of facilitator in a philosophical activity.

Eight themes were chosen around which thinking and doing activities were created. The philosophical and hand-on activities are closely related with a specific topic in mathematics. Some themes are more abstract, such as the meaning of the number zero, while other themes address very concrete themes, such as robots. For the dissemination of the material we developed both written activities for class activities, and online videos for individual activities.
This practical research allows to introduce a new method in mathematics lessons. Although material was developed that could be integrated into their teaching, some teachers we note open to moderate these philosophical and hand-on activities themselves. Not all mathematic teachers feel safe to facilitate dialogues as described above. Adequate training for teachers seems crucial to apply the methodology and overcome their reluctance. As philosophical dialogue focus on argumentation further positive effects of this intervention might be expected, such as an impact on students' logical thinking skills. This asks for a follow-up study.

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REFLECTIONS ON THE VARIATION OF EVALUATION CHOICES IN A BA PROGRAMME SIMULTANEOUSLY RUN IN FACE-TO-FACE AND ONLINE

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ABSTRACT

Evaluation is a critical question: what should be evaluated and how? With which goal? The predominating orientation of the Bologna reform is to prepare students for the job market in a knowledge economy, which materialises in two lines of action. The first one is related to the goal: students must be ready to integrate the job market right away. The second consists in equipping students to provide them with concrete tools for lifelong professional development. This is particularly important due to digital disruption and changing occupations. To certify students, institutions apply given assessment norms to guarantee the issued diploma's quality. For instance, before the pandemic, an exam could be taken online only if the physical location meets the required standards. The present study documents the variation in the exam design of a Bachelor programme that is made available in two modalities. Authors – the pedagogical advisor and the director of the programme – take the opportunity of insights gained through different exam sessions between January 2020 and January 2022 to set directions for open and resource-rich oriented exams in the future. Student authentication and authorship checking appear to be key variables in open assessment.

INTRODUCTION

Certification is an important issue for higher education institutions (HEIs) and represents a certain responsibility and credibility towards society and the public good (Wall et al., 2014). The pandemic has shown that HEIs had to reinvent the way they organized their exams to still be able to deliver credible certifications.

This study started before the pandemic. It reports the exams that took place in January 2020, as part of a two-modality Bachelor programme in Multilingual Communication, intended for Arabic speakers. The first modality is entirely on-site, for an audience of face-to-face students. The second is entirely at a distance and is for online students exclusively (Class & Halimi, 2019).

Exams in online learning settings must be secure to be institutionally valid. The Safe Exam Browser (SEB) technological infrastructure provides a secure environment that teachers customise for their respective needs. They can opt for a resource-rich exam (Halbherr, 2019) as they can opt for a well-designed multiple choice question exam (Gilles et al., 2005) for instance. Nevertheless, SEB does not solve proctoring issues and the question of the physical space where the exam is taken. Therefore, in January 2020, exams were taken on institutional computers simultaneously at the University of Geneva and in a Swiss representation abroad. This was to have equivalent conditions in both the face-to-face and the online Bachelor.

This study, conducted following a Scholarship of Teaching and Learning approach (Boyer, 1990), takes the form of a reflective report. Its overall goal is to reflect on insights gained about exam designs, before, during the peak and after the pandemic. The study stands for the use of open assessment in translation as one model of many assessment and evaluation models. It would help to set guidelines for the incorporation of open assessment in the certified evaluation modalities to serve students as citizens in a knowledge economy (OECD, 2019). We will discuss the variation of exam designs for the different types of courses and exam sessions for this specific e-Bachelor programme. Indeed, assessing large class courses of approximately one hundred students (e.g., linguistics) or small classes with less than 10 students (e.g., translation) represents both a constraint and an opportunity for exam design and is approached with different strategies. Scale, discipline, and content influence the design which is related to the nature of the pedagogical content, type of questions, and time needed to correct the exams. Unsurprisingly, teachers of large classes opt for Multiple Choice Questions (MCQ) designs and teachers of small classes opt for designs that tend to be resource-rich (e.g., allowing the use of monolingual dictionaries but not of translation memories). Taking the innovation maturity model (Eduvista, 2010-2014) as a backdrop, and within legal obligations, exams for this Bachelor programme were designed at stage 1. In other words, technology was used within current teaching approaches, with the learner completing tasks ranging from memorisation tasks by answering questions, to creative tasks through essay writing to demonstrate mastery and understanding of a given topic.

CONTEXT

The University of Geneva is a face-to-face university and the e-Bachelor degree in question amounts to 180 credits in the European Credit Transfer and Accumulation System (ECTS), to be earned within 3 years (6 semesters). The second year is a Mobility year with credits earned across faculties (e.g., Faculty of law) and universities (e.g., linguistic exchanges).

Three types of courses are offered. The first are transversal courses which are offered to many students of all language combinations. These courses (e.g., Linguistics, Language for Specialized Purposes, Fields of Specialization, Technologies) welcome approximately 100 students. The second type are secondary language courses (e.g., French and English) which also welcome many students, but alternate between seminar-type courses with around 20 students and frontal classes with the whole group (about 40 students). The third type are the primary language courses and translation methodology courses which welcome a small number of students – between 5 and 10.

Faculty members have very different profiles: there are translation practitioners who work in a variety of professional contexts (e.g., international organisations; national organisations) as well as subject-field specialists and academic scholars.

Regarding the course and assessment designs, both variables – course type and faculty diversity - make the e-Bachelor in multilingual communication very diverse. This is why some preparatory work was needed to set up the online version of the Bachelor and train faculty members appropriately. The training included assessment issues and contemporary institutional possibilities (Figure 1). For instance, during the January 2022 session, e-Bachelor students took exams at a distance with video proctoring. In the future, we plan to incorporate resource-rich assessment as a certified assessment modality for given courses.

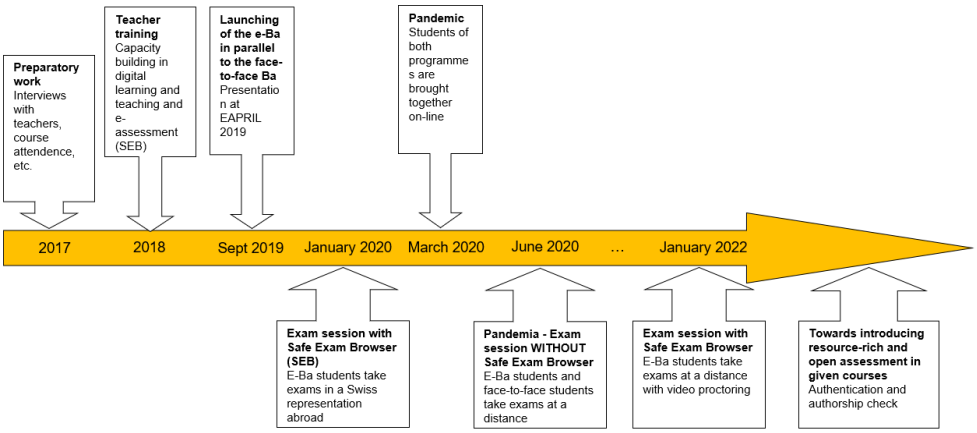

Figure 6: Learning from past exams to design the future

LITERATURE REVIEW

Resource-rich exams

Resource-rich exams share features with authentic evaluation. The issue is to explicitly state where authenticity resides: is it in the task itself? Is it in the way it is conducted? Is it in the way evaluation is performed? Resource-rich exams clarify this point: ”While resource-rich assessment is also committed to authenticity, it is much more specific in its proposition where authenticity matters: the focus should lie on the authenticity of interaction with the relevant technical, semiotic, and social resources of a given practice” (Halbherr, 2020, p. 31).
To take the example of a basic translation task, we would expect that a translator will use appropriate translation memories, glossaries, web searches and/or automatic translation software at the technical level, in addition to linguistic and extra-linguistic knowledge. Depending on the process, the text is then translated or post-edited according to the translation brief. In relation to the year of study, an examination that would stick to this professional practice could not be implemented. On one hand, post-editing, for instance, is not taught in the first year of studies, and translation memories are introduced gradually. On the other hand, students are introduced to information technologies and documentary research and management. The practice is naturally not learned as a whole-task practice but rather in a part-task progressive perspective to avoid cognitive overload (Van Merriënboer & Kirschner, 2013).

Open-book exams, which are close to resource-rich exams, have been suggested in the 1970s and much earlier (e.g. Feller, 1994; Koutselini Ioannidou, 1997; Stalnaker & Stalnaker, 1934), and highlighted two issues with examinations. The first issue was the exam format’s inefficiency, for it does not reflect the students’ actual

knowledge. The second issue was the anxiety-filled testing conditions, and their dissociation from professional life. In a recent report, anxiety is mentioned again, showing how counter-productive it is for well-being and lifelong learning (EuropeanCivilSocietyForEducation, 2021).

To break with this type of misaligned and unfruitful assessment type, Gunness et al. (2021) suggest an assessment framework that promotes self-directed learning and the use of open pedagogies in higher education contexts. Conrad and Openo (2018) promote a conception of evaluation that is an integral part of course planning from its inception, in a constructivist perspective of evaluation - i.e. increased growth and learning for all stakeholders involved. To encourage deep learning (Koutselini Ioannidou, 1997), making the entire pedagogical process transparent, from learning outcomes to assessment through to pedagogical choices made to reach them is important (Dalziel, 2016). This clarification exercise helps with checking whether practices are aligned. Indeed, how could it make sense to teach with active pedagogies and then have a final "closed-book exam" as an assessment? This misalignment has been pointed out for many years (Chiappe et al., 2016) and a call for new practices that are in line with the competence-based approach has been made (Kapsalis et al., 2019).

Translation field

In the translation field, major technological innovations have fundamentally changed how we communicate and translate today. As stated by the Translation Automation User Society (TAUS), *'Soon, robots will check the quality, productivity and even predict the quality of jobs yet to be performed.*' (TAUS, 2017, p. 25). The translation field is definitely growing fast due to technological developments in machine translation (MT) and Computer-aided Translation (CAT) tools, the explosion of digital content (e.g. websites, computer software, video games), and the expansion of new genres of products of translation (e.g. marketing, business communications, pharmaceutical documentation, patient information) (Doherty, 2016). Consequently, technologies are used as a vector of change in teaching and learning by transforming the behaviour of students and teachers (Bates, 2000; Kiraly, 2000). Studies have reported on the changing paradigm in translation teaching, highlighting the use of computer devices which affects the work settings and practices of professional translators, as well as areas, tools and modes of teaching and learning (Ivanova, 2016; Marczak, 2018; TAUS, 2017). Courses are widely technology-enhanced and use a wide array of technology-based activities and computerised resources.
However, there still exists a lack of adaptability to new technologies in terms of assessing students' works. On one hand, a wide and deep debate has been engaged to set quality assessment criteria for human translation (House, 1997; Larose, 1998; Martínez Melis & Hurtado Albir, 2001; Mossop, 2001; Nord, 1997) and machine translation since the 1990s (Koehn, 2005; Papineni et al., 2002; Taylor et al., 2015;

Turian et al., 2003). On the other hand, no such discussions have been conducted about the modes of students' performance's assessment, despite the new forms of training and learning. The conventional approach in assessing students' performance as pertaining to a teacher-centred environment is obviously not sufficient, as described by Kiraly (2003). It is now all the more necessary to discuss the mode of assessment that is adapted to the new forms of work-integrated in translation teaching, given the extensive use of technology-based learning environments and teaching methods. This would enable students to continuously develop the skills that are required in a constantly evolving labour market.

Creativity

To check the alignment amongst elements as mentioned above, a teacher should be perfectly knowledgeable of the different areas addressed by the Technological, Pedagogical and Content Knowledge (TPACK) framework (Koehler et al., 2013) as exemplified with interpreting at a large granularity, for instance (Class & Lombard, 2017, p. 68). This TPACK work should be conducted at a fine granularity at individual course level, and made transparent to all stakeholders for co-creation and appropriation. This demands a lot of upfront work when starting to teach a new topic, as well as an ongoing professional development endeavour to stay updated, connected and ahead of what happens in professional contexts.
Authors who have developed the TPACK framework have also reflected on the construct of creativity, which is more and more foregrounded in education, probably because it is being a major skill expected from the knowledge society (Dubina et al., 2012). Creativity is defined as "a goal driven process of developing solutions that are novel, effective and whole" (Danah et al., 2016; Mishra et al., 2013, p. 12). Authors identified 7 core transdisciplinary skills involved in creativity: (1) observing; (2) patterning; (3) abstracting; (4) embodied thinking; (5) modelling; (6) play; and (7) synthesis (Henriksen, 2018). Observing refers to perceiving and being attentive to information gathered through the five senses, which emphasises curiosity. Patterning refers to identifying a repeating form in content or process. Abstracting refers to grasping the essence of content or process. Embodied thinking refers to kinaesthetic thinking and empathizing. Modelling refers to representing something in real or theoretical ways, to research its nature, composition, or purpose. "Play" is about using knowledge, body, mind, and abilities for the pure enjoyment of using them. Finally, synthesizing refers to organising different "ways of knowing" together, into synthesized knowledge. (Henriksen, 2018, pp. 2-4).

When confronted with a text to translate, creativity is engaged beyond scholarly translation methodology that guarantees professional work, because it takes a creative mind to translate from one language into another. This is more prominent when the source and target languages are very different as is the case with Arabic

and English or French, which are the only used target languages in our e-Ba programme.

Authorship checking

Cheating has always existed and will continue to exist. It is as much an ethical problem as it is a reputational and credibility problem for the institution, towards society. A constructive perspective is to look at it from the angle of responsibility and contract with the institution. As a teaching and learning member, you have the right to benefit from a quality learning and teaching ecosystem as well as plenty of resources of different kinds. In return, you must adopt and act as a responsible scholar, learner, and citizen (i.e., integrity in your academic work).
With growing competitiveness, other elements of pressure, and also without any justification, some are tempted to break this integrity contract, and others actually do it (e.g. Bergadaa, 2015). In a resource-rich, contribution-oriented pedagogy (e.g. Schneider et al., 2019), the focus is on the author: How can one be sure that what is submitted as A's work has actually been produced by A?

Authorship and identity-checking seem to help answer the question (Baneres et al., 2020; Mellar et al., 2018; Peytcheva-Forsyth et al., 2019). Authorship-checking, stylometry (Wikipedia, 2005 - 2022) or author profiling (Wikipedia, 2017-2021), all work towards the same goal: identifying the author of a given piece. This can be performed with the help of artificial intelligence (AI)-based linguistic analysis on an author's corpus to identify patterns and conclude whether the work is by said author or not.
This technique proves to be very useful in translation studies and within any open educational practice focusing on knowledge co-creation. It is also appropriate for a variety of assessment formats, as stated in the conclusion.

THEORETICAL FRAMEWORK

The theoretical framework used on the shared insights, is an extension of the one reported in Class and Halimi (2019, p. 138). The added dimensions are: openness operationalised in the form of resource-rich (Halbherr, 2020) and open assessment (Conrad & Openo, 2018; Gunness et al., 2021), creativity (Mishra et al., 2013), and their application to the field of translation (Figure 2).

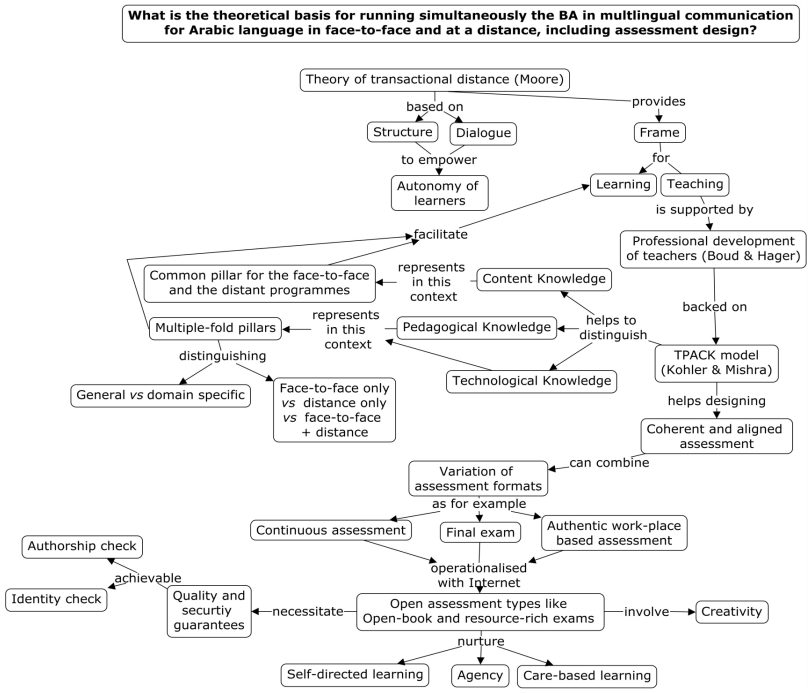

Figure 7: Visual representation of the theoretical framework, extending from Class and Halimi (2019)

METHODOLOGY

Method

The methodology developed to gain these insights is based on a Scholarship of Teaching and Learning (SoTL) approach (Boyer, 1990). It describes the pedagogical advisor and the director of the e-Bachelor programme's reflection on exam designs inspired from the categories defined by Hubball and Clarke (2010, p. 4) (Table1).

SoTL research context	Central SoTL research question	Methodological approach	General outcomes
Reconsidering assessment design in a knowledge society and knowledge economy (OECD, 2019).	To what extent can decisions that have been taken at three different instances – before the crisis, at the peak of the crisis, and towards the end of the crisis – inform us to build post-crisis certifying assessment design?	Reflection is informed by examples of exams and assessments, required technological and human infrastructure, overall administrative organisation and various drawbacks.	Sustainable and aligned evaluation models to assess competencies and knowledge in a caring, supportive, environment that nurtures agency, self-learning and contributes to educating active and responsible citizens in the knowledge society.

Table 5: SoTL methodology inspired from Hubball and Clarke (2010)'s categories

Research question

We look at the Covid-19 crisis as an opportunity for change in terms of exam and assessment designs across courses of the e-Bachelor (Laulusa, 2009). The guiding research question reads: To what extent can decisions that have been taken at three different instances – before the crisis, at the peak of the crisis, and towards the end of the crisis – inform us to build post-crisis certifying assessment design?

PRELIMINARY FINDINGS: SHARING INSIGHTS

For the January 2020 exam session, a variation of exams, potentially related to the nature of courses and the number of students attending those courses is observed. Assessing large class courses of approximately 100 students or small classes with less than 10 students represents an additional constraint on assessment design. The number of students influences the choice of the exam type because of the pedagogical content's nature, type of questions, and time needed to evaluate students' performances. Unsurprisingly, teachers of large classes opt for MCQ designs, and teachers of small classes opt for environments that would tend to be more resource-rich (e.g., allowing the use of monolingual dictionaries but not translation memories). Taking the innovation maturity model (Eduvista, 2010-2014) as a backdrop (Figure 3), and within legal obligations, exams, for the first e-assessment session were designed at stage 1. This is unsurprising because i) when changing media, teachers start usually by transferring the same practice they had with the previous medium; ii) there are several constraints to frame exams that need to be respected.

Stages of the model	Defining technology's role
Stage 5: **Empower** Redefinition & innovative use	Technology supports new learning services that go beyond institutional boundaries. Mobile and locative technologies support 'agile' teaching and learning. The learner as a 'co-designer' of the learning journey, supported by intelligent content and analytics.
Stage 4: **Extend** Network redesign & embedding	Ubiquitous, integrated, seamlessly connected technologies support learner choice and personalisation beyond the classroom. Teaching and learning are distributed, connected and organised around the learner.

	Learners take control of learning using technology to manage their own learning.
Stage 3: **Enhance** Process redesign	Teaching and learning redesigned to incorporate technology, building on research in learning and cognition. Institutionally embedded technology supports the flow of content and data, providing an integrated approach to teaching, learning and assessment. The learner as a "producer" using networked technologies to model and make.
Stage 2: **Enrich** Internal Coordination	Technology used interactively to make differentiated provision within the classroom. Technology supports a variety of routes to learning. The learner as a 'user' of technology tools and resources.
Stage 1 **Exchange** Localised use	Technology is used within current teaching approaches. Learning is teacher-directed and classroom-located. The learner as a 'consumer' of learning content and resources.

Figure 8: Edukata Innovation Maturity Model (Eduvista, 2010-2014)

Teachers usually progress and move on from stage 1 to higher-order stages to take advantage of the affordances of technology (Bates, 2015; Clark, 1994; Kozma, 1994) if the institutional ecosystem supports them and allows them to do so.

It is also important to bear in mind that the market develops much faster than training institutions, and exam formats that are dissociated from professional life have shown their limits - in terms of online proctoring, anxiety, "correction" fatigue, confidence with regard to skills and preparedness for employment, etc.

This is why we advocate for more open ways of designing training and assessment, involving all concerned stakeholders and co-creating together to foreground knowledge, competencies and responsibility in a nurturing, caring (Funk, 2021), resource-rich and supportive environment (Figure 4).

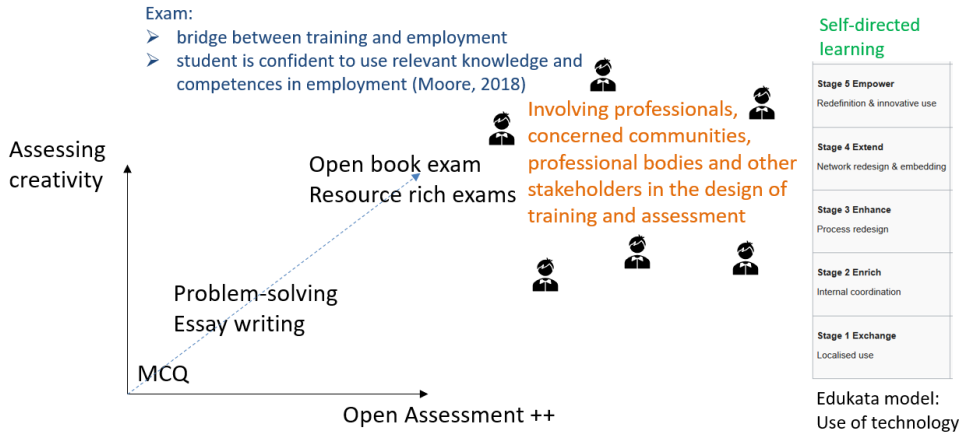

Figure 9: Rethinking the design of training and assessment

CONCLUSION

With the advent of the knowledge society and knowledge economy (Innerarity, 2015; OECD, 2019), and given the importance of the language industry, revisiting assessment in translation is considered to be timely.
Final assessments represent a bridge between the world of training and that of employment. Transitional education shall be designed to bridge the gap between training and employment, exactly in the same way that transitional education has been implemented to bridge the gap between high school and university (Rienties et al., 2012). Considering final assessments as one additional step towards feeling confident on the market and providing formative feedback, have proven to be a nurturing practice (Moore, 2018).

Opening up to multiple forms of assessment could represent brokering activities to actually embody the transitional function mentioned above. The idea would be to weave these multiple forms of assessment from the very first day of learning till certain professional expertise is gained. This should leverage confidence and enable the handling of the multi facets of lifelong learning that are related to the specificities of the evolving translation profession. We think of continuous assessment types, assessments in the professional field, periodical final assessments, arranging multiple coaching types – i.e. the different types of tutoring that have been studied and reported (e.g. Berrouk & Jaillet, 2017; Class, 2009, pp. 86-105) – so that frontiers between higher education and employment become more porous and seamless.

Educating translators to equip them for the knowledge economy and the knowledge society is challenging and needs fast pace adaptation regardless of which forms of assessments are chosen.

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VIDEO-BASED COLLABORATIVE LEARNING: EVIDENCE FOR A PEDAGOGICAL MODEL.

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Abstract

The educational potential of video is a long-lasting, multi-faceted topic, and the affordances of technological advancement have recently revitalized this discussion. However, teachers are still far from competently integrating or becoming accustomed to video-based pedagogy, especially in combination with collaborative pedagogy. To provide teachers and teacher educators with sound principles for implementing video-supported collaborative learning (VSCL), this symposium fosters a teacher experiment, a cross-over analysis on a pedagogical model for effective VSCL, and student feedback in relation with VSCL. The experiment shows students' growing lexical richness and cohesion by working peer feedback on student's video recorded teaching practice. The cross-over analysis shows the evidence for the VSCL-pedagogical model based on data from many other experiments in the European ViSuAL-project. The same holds for the student-feedback analysis. In this symposium we interact about practical experiences in relation with the effective principles of the developed pedagogical model and the experiences of the students.

INTRODUCTION

The modernization of European Higher Education Institutions (HEIs) calls for a workable pedagogy and skilled instructors that will implement video technologies into their practice with the aim of promoting collaborative learning and knowledge building. By doing so, the ViSuAl project aimed at attaining three main goals:

1. Evidence-based hands-on pedagogy to utilize video-supported collaborative learning (VSCL);
2. Hands-on principles for a sustainable HEIs and educational technology designers (ETDs) partnership;
3. Pedagogical design principles and workable pedagogy practices for instructors and ETDs to enhance the use of their products in education.

The chosen methodological approach is that of a design-based research process, which enables co-creative development, as well as testing and validation of pedagogical model and practices.
The project stems from a thorough needs analysis on the topic of VSCL, and a comprehensive literature review (Ramos et al. submitted), which provided the researchers with a framework aiming at developing a prototype of the pedagogical model. This prototype enabled a preliminary cycle of field experiments involving teachers, students, teachers', instructors and ETDs. Collected data from these experiments and their analysis has been employed to improve the prototype of the pedagogical model and the observed practices, which has been corroborated through a second cycle of experiments and the consequent analysis of the reported data. The different data is analysed in three analytic studies which results are presented in this paper. In study 2 data of different experimental international locations are analysed.

Teacher education aims to move students from novice to expert level. In study 1, we analysed student's textual peer feedback on video recordings of their teaching practice. The question was: What is the impact of curriculum literature on the word use in the peer feedback? Secondly, do lexical richness and cohesion as indicators of growing expertise increase in the students' feedback during the course? First, the impact of the curriculum and literature on students' feedback was analysed by semantic network analysis of prominent words. Secondly, the lexical richness and the semantic cohesion of students' feedback and reflections were analysed. Our findings show that students created stronger connections between the prominent words from the literature. The lexical richness and semantic cohesion also increased. This means that students incorporated vocabulary from expert sources and maintained semantic consistency while using the expert vocabulary. This might be seen as evidence that peer-feedback on students' own video recordings stimulates students to become experts in the field of teaching.

The use of video has shown its potential to impact teaching practice, both in teachers' pre-service education and in-service professional development (Ramos et al. submitted; McDonald & Rook, 2015). The combination of video use with more current pedagogical approaches like knowledge building or active, collaborative learning is rarely seen in the classroom.

Teaching is a knowledge-rich profession (Guerriero, 2013) and *teachers regularly evaluate knowledge* in relation to their practice to update their knowledge base, thus

improving their teaching practice. Being an expert is more than knowing a list of facts and formulas relevant to the teacher's domain (Darling-Hammond et al. 2005). Instead, experts organize their knowledge around core concepts or ‘big ideas’ that guide their thinking about domains and acting in the classroom. Beginners rarely refer to major principles (Larkin et al. 1980). When watching a videotaped lesson, expert teachers’ perceptions differ from those of novice teachers (Sabers et al. 1991). Expert teachers interpret practices according to very different standards, using more sophisticated pattern recognition and segmentation.

Study 3 focuses on the essential for learning at vocational and professional higher education ie.g. the tight integration between practical, theoretical, and self-regulative knowledge (Tynjälä, 2008). One method to enhance this integration can be a systematic video-observation of one 's real work situations, where students can analyse and reflect the practice in the frame of theories. There are several studies published regarding the role and benefits of using videos and video-observations in education and in teacher education particularly (e.g., Hougham, 1992; Wang & Hartley, 2003; Powell 2005; Maclean & White, 2007; Rich & Hannafin, 2008; Calandra, et al. 2009; Kong et al. 2009; Tripp & Rich, 2012; Coffey, 2014; Goeze et al. 2014; Mercado & Baecher, 2014; Gaudin & Chaliès, 2015). We argued that teachers need their own experiences of video-observations to understand, justify and apply video-observation as a teaching method. Thereby, we designed and implemented pedagogical experimentations, which focused on enhancing video-supported collaborative learning (VSCL) for the professional teacher education (Burns & Laitinen-Väänänen, 2018). One aspect and assumption in developing the pedagogy was, based on the previous studies, that observing one’s own work, and particularly peer’s work (Wu & Kao, 2008), would empower and encourage to make the change and development into the working practices. This international research sheds light on that perspective.
The research question in study 3 was: What kinds of meanings do the students give based on their experiences to the video-supported collaborative learning?

METHODS AND RESULTS

Study 1: Acquiring Expert’s Vocabulary: Analysing Students Textual Feedback on Video Recordings.

Method

This study 1 reports an experiment in bachelor-level courses of a VET teacher education curriculum in the Netherlands. This experiment aimed to support student teachers’ development from 'novice' to 'starting expert’ by using teacher-students’ video recordings of their teaching practice and peer feedback. The study concerns a pre-experimental one-group case study design (Campbell and Stanley, 1966) with

repeated observations: x-O-x-O-x-O-x-O-O^{f} (N=15 students). Dependent variables to indicate the growth of expertise were lexical richness, semantic cohesion and betweenness centrality.
Lexical richness has been used as a linguistic variable to assess Alzheimer's disease progression (Hernández-Dominguez et al. 2018). In contrast to the loss of words and meaning, our hypothesis is that students will acquire more vocabulary, professional terms and that their lexical richness is increased at the end of the course.. We used the Type-Token Ratio (TTR) to measure the lexical richness of students' vocabulary each month to detect when it increased.

Lexical richness reflects the variety of the lexical items, it does not reflect the meaning that they create together. Therefore, we included the assessment of *semantic cohesion* of the students' comments. We used two metrics: 1) based on the semantic similarity between all words in a given text. 2) based on the centroid distance between all words given in a segment of text (Korenčić et al. 2018).

We used KBDeX to analyse the *betweenness centrality* (Matsuzawa et al. 2012; Oshima et al. 2013) to measure the extent to which an 'expert' word had a mediating function in the conceptual network of words. We identified topics by applying topic modeling methods, a probabilistic technique used in machine learning (ML) and Natural Language Processing (NLP) to explore documents. A topic represents a group of words with a high likelihood of occurring together in a document (Ignatow and Mihalcea, 2017). The resulting groups of words can be interpreted as lexical fields. The meaning of the words in a lexical field depends on each other; they form a conceptual structure that is part of a particular activity or field (school: teacher, book, notebook, pencil, student, etc.).
We used a well-known statistical language model, Latent Dirichlet Allocation (LDA), to generate the topics (Ignatow & Mihalcea, 2017). The data used for this analysis corresponded to the literature used by students during their course. For the topic modeling analysis, we did not consider the time as a variable to analyse the topics' evolution during the semester.

We pre-processed the data by conducting the usual tokenisation, lemmatisation, and part-of-speech (POS) tagging. The reason for filtering only using nouns and adjectives is that we wanted to analyse the attitude towards learning and teaching of the student teachers. According to Biber and Conrad (2019), academic prose has a higher frequency of nouns than conversations.

Results

Overall, our results show that the lexical richness (see fig. 1) and the semantic cohesion in the students' peer feedback and reflections increased, indicating that these students were developing from novices into experts (Radović et al. 2020).

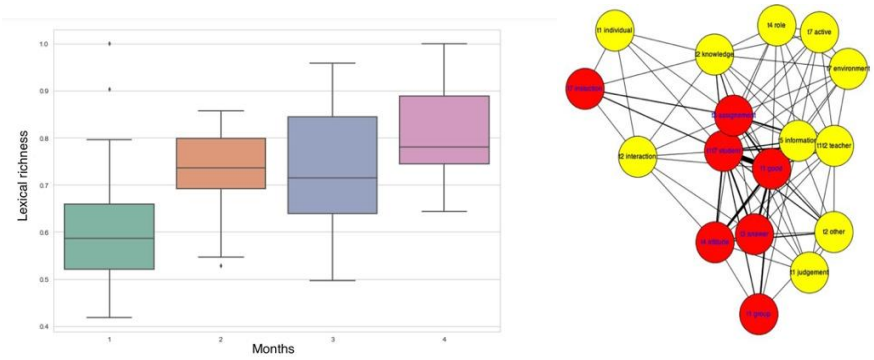

Figure 1: Students' feedback lexical richness increased during the course (left), Semantic network of one of the analysed student groups (right)

Results show that in the beginning of the course, students had little knowledge of the literature concerning interaction and teaching practice. Giving more useful, content-related peer feedback on peers' teaching practice requires more knowledge and understanding that leads to a cohesive teaching concept. This developed during the course, as could be seen by two factors. First, lexical richness increased steadily over time for all four subgroups. Second, KBDeX-analysis of the word networks show that at the end of the course the networks were stronger than in the word networks at the start. At the end of the course, stronger relations were established between a larger number of topic keywords (fig. 1). Thus, expanding students' activities with video recordings, feedback, interactions and reflections did not hinder their conceptual development and growth of expertise. Overall, our results lead to the conclusion that the lexical richness in the students' peer feedback and reflections increased, e.g. students' use of 'expert vocabulary' grew. This indicates that students were developing from novices into starting-experts. So, students incorporated new vocabulary and maintained semantic consistency (Schank et al. 1999).

Study 2: Video-Supported Collaborative Learning within the ViSuAL Project: a qualitative analysis using nVivo

Method

More specifically, the qualitative analysis carried out through the nVivo software allowed the researchers to collect the evidence necessary to answer the following research question:
To what extent did the VSCL approach prove efficient for the teachers and students involved in the ViSuAL project?

And the sub-questions: 1. What kind of objectives were used? 2.What kind of prerequisites are needed? 3. What kind of technology was used and how did it

support collaborative learning? 4. What is the role of the teacher? 5. What kind of VSCL learning activities are involved? 6. What were the learning outcomes? 7. What are the VSCL learning scenarios used?
Fifty-eight documents (12 experimentation plans, 11 video ethnographies, 12 video blogs, 11 appreciative interviews and 12 case reports) constituted the corpus of the data included in the analysis. Analysis was performed via content analysis by applying categories (Miles & Huberman, 1994). Researchers thematically aggregated the data into eight macro categories derived from the key words of the abovementioned sub-questions: 1) collaborative learning activities; 2) effects; 3) issues; 4) objectives; 5) prerequisites; 6) role of the teacher; 7) technology function; with the added technology (8) category. The coding scheme was tested on 20% of all the data sources by two researchers (Cronbach's α=.85) and then applied to the whole corpus using nVivo software.
This presentation focuses specifically on the references coded into categories 1 and 2 and will present the most significant results found with respect to the effects (330 references) and collaborative learning activities (174 references).

Results

Within the category "effects" we've found evidence to support the creation of four dimensions: 1) effects on teachers' pedagogical practices, such as changes in teaching practices (31 references), effective feedback (30 references), learning from viewing video recorded practices (30 references), personal and professional growth (13 references), improving opportunities for bridging theory and practice (10 references) and new pedagogical ideas and competences (9 references); 2) effects on students personal, social and attitudinal development, in which we've included positive attitudes towards VSCL (57 references), deeper reflections and learning (32 references), changes in behaviors and thinking (11 references) and students agency (3 references); 3) effects on the development of skills and abilities reported, consisting in changes in video competences (21 references), changes in collaboration competences (19 references) and changes in digital skills (15 references); and 4) effects on learning, based on what was stated by the experiments' participants regarding the learning process and the adoption of collaborative learning and knowledge building principles manifested in activities such as knowledge sharing (11 references), students engagement on learning (11 references), idea sharing (9 references), peer support (7 references), strengthen group ties (6 references) and improving problem-solving skills (5 references).

Regarding the collaborative learning activities, the analysis shows that the most referred activity was the reflective discussion (31 references), which features included the involvement of several people engaged on carrying out a collective discussion on a topic, "feedback giving", "reflecting on a practice from a video, with the final goal to reflect on their own practice", and other kind of discussions finalized "to see the change in [one's and others'] practices". Another interesting result shows

that collaborative video design, creation and editing (26 references) was the second most referred activity. This activity included a group of many others such as to design activities on videos performed collaboratively in groups, which could vary from “creating a storyboard for the sketch they wanted to film in order to help their colleagues learn” something or to “receiving a video made by their peers on that procedure and turning it into an interactive video”. Other less frequent quotations have appeared also within the data.

Study 3: Enhancing video-supported collaborative learning - learners’ perspective

Method

After participating in the experimentations, the higher education students’ (in BSc-degree programs for Facility Management and Music pedagogy, in pre- and in-service programs for Professional Teacher Education) and trainees (in in-service training for Management and Leadership) (N = 57) were asked for reflective feedback, by applying open-ended questions, as part of their final program assignments and in their course feedback.
The data were analysed by applying the content analysis (Miles & Huberman, 1994). This qualitative analysis revealed themes that students raised when reflecting on their VSCL experiences.

Results

Based on the analysis, five main themes emerged describing the meanings students gave to the VSCL: ‘positive experience’, ‘saves and requires time’, ‘difficult but instructive’, ‘peer’s essential role’ and ‘I learn a lot’. These themes were described more openly with extracts from the data in the presentation.

CONCLUSIONS

Conclusions for the studies presented in this symposium went as follows. Regarding the first study, it is possible to state that the influence of peer feedback using video recordings of authentic teaching situations stimulates creation of more advanced ‘personal’ concepts about teaching. This finding may encourage student-teachers to update their knowledge base by using pedagogical and methodological insights offered by the teacher trainer and the course literature. The findings can motivate teacher-educators and student-teachers to improve their teaching skills and practice and to recognize relevant patterns in their thinking about teaching reflecting on video practice recording helping to become more expert: true professionals.

From the second study, results coming from the analysis proved to be consistent and allowed us to understand in what way and to what extent did VSCL sustain learning and professional development. Moreover, among the cases studied it was possible to observe that there is a great variation in terms of collaborative learning activities but also that that wide specter of variation seemed to lead to very positive effects towards VSCL and to support the flowering of knowledge building.

In the third study, the i.e presented showed that video-observation is a powerful and practical tool to combine practical and theoretical knowledge in learning. In addition, that study indicated that student's own and peer's video analysis enhance reflective skills. From that perspective, the findings of the third study study complement those of earlier studies. Furthermore, that study indicated that seeing and analysing your own practice from videos can be difficult, even embarrassing for the student. However, that experience could be turned into a positive, empowering, and instructive experience over time. Despite these mixed feelings, or maybe because of that, video-observation and -analysis could be considered as a powerful learning tool. Another interesting observation was the question related to the nature of peer-student's role in supporting professional development and learning. This is an important finding, as in collaborative learning, the crucial element is the social interaction and its power in the learning process. Though, the main reason for designing and implementing VSCL experimentations was not financial, it was interesting that students mentioned video-observations to save time and money. A possible explanation for this might be that students did not need to travel to the university to discuss their teaching practice, as they had access to the uploaded video recordings online - and were able to review and comment on them at home. Based on the research related to the third study, we suggest expanding the research-based use of video-supported teaching and learning in vocational and higher education.
Especially now, when we all are more experienced in using digital tools in learning, and when collaborative learning is more difficult to implement than in face-to-face practice, and as teaching the practical skills online asks for innovative practices.
In another article, submitted to the European Journal of Teacher Education the pedagogical model that could be generated on the basis of these and other data-analysis is described (Cattaneo et. al. 2022, under review).

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