Measuring Business Value of Learning Technology Implementation in Higher Education Setting

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Abstract

This paper introduces the concept of Business Value of Learning Technology and presents an approach how to measure the Business Value of Learning Technology in Higher Education setting based on a case study in Computational Science and cognate areas. Computational Science subject area is used as a pilot for the studies described in this paper since it is a multidisciplinary area, attracting students from diverse backgrounds and Computational Science is both the natural environment to promote collaborative teaching methods and collaborative provision of courses and as such requires more streamlined management processes. The paper, based on the above case study, presents the motivators and hygiene factors for Learning Technology Implementation in Higher Education setting. Finally, the Intersecting Influences Model presents the influences of pedagogy, technology and management over the motivation and hygiene factors, together with the corresponding generalization for PG level HE setting.

Keywords: Business Value in HE setting, Motivation Factors in HE, Measuring Business Value in HE Setting, Computational Science.

1 Introduction

This paper introduces the concept of Business Value of Learning Technology in HE, discusses how to measure the Business Value of Learning Technology in Higher Education setting based on case study in Computational Science. The case study was built upon the ACET (Advanced Computing and Emerging Technologies center) managed postgraduate courses: the MSc in Network Centred Computing, the Erasmus Mundus MSc in Network and e-Business Centred Computing and the MSc in Computational Science by Research. The efforts were initially concentrated on the Computational

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Science subjects included in these MSc courses as these are core subject modules taught to all registered students before they choose a specialization.

The subject modules in question were Transferable Skills coupled with Network Computing (at the University of Reading (UoR), UK) in order to deliver a set of team based projects, where the results of the former were utilised by the later as well as both modules using the Collaborative Creative Cross-Pollination (CCCP) learning activities [1]; Algorithms for Databases and Knowledge Mining (as part of Erasmus Mundus MSc in NeBCC, Aristotle University of Thessaloniki (AUTh), Greece), where development team project was based on the individual research projects that the team members did, Computational Intelligence and e-business (also as part of EM MSc in NeBCC at AUTh) also applying team assessment; Postgraduate Research Skills (UoR, UK) assessed by team report proposing algorithmic solution to given mathematical problem, and the Mathematical Modelling (UoR, UK) module requiring the students to take set of industry related seminars from the Mathematics department and work with their peers from the Mathematics MSc. More detailed presentation of the implementation of the CCCP activities and other team exercises was given in the ICCS'12, Sixth Workshop on Teaching Computational Science (WTCS 2012) [2] and also in [1].

The reasoning behind using Computational Science subject area as a pilot for the described in this paper approach was that as multidisciplinary area, attracting students from diverse backgrounds, Computational Science is both the natural environment to promote collaborative teaching methods and collaborative provision of courses and as such requires more streamlined management processes.

Business Value for IT is an emerging area driven mainly by industry. Resent books on the subject are written by M. Curley [3] and D. Sward [4], Intel Corporation. There is also an Innovation Value Institute (IVI) [5] located in the National University of Ireland, Maynooth, on the subject matter. The proposed approach advocates to introduce certain metrics for estimating the Business Value of IT. The metrics is linked with defining the baseline, defining the IT innovations to be introduced, defining the expected productivity gain and measuring ROI (Return On Investment) within the given timeline [4]. David Sward, for example, gives the following definition of the business value, accepted in Intel Corporation [4]:

"Business Value is the benefit for business groups, represented in dollar terms, that is a result of Information Technology (IT) solutions or services, as evidenced by one or more of the following:

- Direct contribution to the corporation's market position or revenue

- Deliverables and results that support solving customer business needs and challenges

- Financial improvements derived from customer cost savings or benefits

- Examples of technology investment that advance the industry."

The author collaborated with the IVI in the area of applying the Business Value for IT approach and ideas to the public sector, e.g. in a university environment. So the approach is from the point of view of defining the Business Value and the metrics for a university environment.

Herzberg in his studies (Herzberg 2003) has investigated the major factors to motivation to work (or "job attitude factors"). The author believes that comparable set of factors exists in an educational setting and they can be inferred using Herzberg's methodology. In his studies, Herzberg identified a triad of factors -"first-level factors, second level factors and effects" (Herzberg 2003).

According to Herzberg [6] the first-level factors appearing in "Long-Range and Short-Range high attitude sequences", ordered by percentage of appearance the highest first are [6]: 1.Achievement, 2.Recognition, 3.Work itself, 4.Responsibility, 5.Advancement, 6. Salary, 7.Possibility of Growth, 8.Interpersonal relations-subordinate, 9.Status, 10.Interpersonal relations-superior, 11.Interpersonal relations-peers, 12. Supervision-technical, 13. Company policy and administration, 14. Working Conditions, 15 Personal life, 16 Job security.

Herzberg also considered interlinked factors [6]: 1.Recognition and achievement being closely linked, 2.Achievement is linked with recognition, responsibility and the work itself, (and whichever is

considered as a primary factor of the previous four, the remaining three are secondary) 3.Advancement being linked with salary and work itself.

Herzberg also introduced the hygiene factors[6]: 1.Company policy and administration, 2.Supervision-technical, 3.Salary, 4.Interpersonal Relations, 5.Working Conditions.

The motivation in educational context is considered in Section 2, the motivation factors in HE context are presented in Section 3, an example of a possible approach how to assess the Business Value of LTI (Learning Technology Implementation) in HE context together with the ACET case study example is presented in Sections 4 and 5 respectively. The Analysis, generalization and conclusions are presented in Section 6.

2 Motivation in Educational Context

What motivates students to perform better and how to enhance this has been discussed time and time again. In their work Chickering and Gamson [7] deduced the seven principles for good practice in undergraduate education:

1. Student faculty interaction – affordance of contacts in and out of class
2. Student collaboration – collaborative learning activities
3. Encouragement of active learning – emphasis on all parts of the learning cycle: conceptualization, reflection, abstraction and practice
4. Prompt feedback – adaptation through dialogue with teacher and peers
5. Emphasize on time-on-task – sufficient time and it effective use
6. Communication of high expectations – expecting high results and supporting extra efforts
7. Respect of diverse learning styles – student centered model accounting for background knowledge and allowing individualization of the experience

The seven principles are grounded in pedagogical theory and lay out a blue print for managing the teaching process. There are obvious parallels between the Herzberg motivators and the seven principles (Table 1).

Principles of good practice in HE	Herzberg´s Motivators in work environment
Student faculty interaction	Recognition, Interpersonal relations - superior
Student collaboration	Recognition, Interpersonal relations - peers
Encouragement of active learning	Work itself
Prompt feedback	Recognition, Company policy and administration
Emphasize on time-on-task	Company policy and administration
Communication of high expectations	Achievement, Possibility of growth
Respect of diverse learning styles	Recognition, Work itself

Table 1: Relation between the principles of good practice in HE and Herzberg´s motivators

If we look at Higher Education and Learning Technologies Implementation (LTI), the question is to identify these hygiene factors and motivators in respect to learning and the learning process, e.g.:

- Which are the hygiene factors and motivators in respect to the learning and the learning process?

- How the appropriate technology can enhance the motivators and facilitate the hygiene factors?

3 Motivation Factors in Higher Education Context

3.1 Major Drivers and Rationale

The major drivers were research and teaching leadership, producing the right profile of graduates for the academia and industry, meeting the students expectations [8].

One of the triggers also is the constantly increasing demand on limited teaching staff combined with frozen budgets or budget reductions. This inevitably calls for higher efficiency.

One of the opportunities to achieve that is to implement efficient IT solutions in order to enhance first the Teaching and Learning process through implementing novel pedagogical approaches and second to reduce the administration and administrative costs through streamlining the administrative processes and de-centralizing the dissemination of teaching materials and assessment submissions through a Learning Management System (LMS) or Virtual Learning Environment (VLE). Both can lead to direct communication between lecturers and students and faster feedback to students.

In our case, at the Advanced Computing and Emergent Technologies Centre (ACET), at the University of Reading, UK, it was required to optimize the budget and from point of view of staffing it was decided to replace the two secretaries with several postgraduate (MSc/PhD) students who were doing the secretarial jobs part-time and in the same time introducing new IT solutions and optimizing the workflows in the office, and also introducing new electronic application systems for the MSc applications, thus optimizing and reducing the administration time and the time to deal with student applications. At the same time these PhD students were proceeding with their PhD part-time.

The next administrator employed at the successful end of the above changes was a single person on a higher grade dealing with overall administrative support of the Centre.

The study has been focused to the MSC degrees delivered by ACET Centre, among which there are two collaborative provision degrees: Erasmus Mundus Joint MSc in Network and e-Business Computing, MSc by research in Computational Science and the local MSC in Network Centred Computing. Various forums and groups were established in the integrated on-line course management system in order to catch the students at application phase before enrolling on the programme and continuing functioning after they actually enrolled on the programme throughout their studies. Based on new pedagogic approaches and the CCCP learning activities [1] new teaching methods were implemented on several subject modules in order to engage students in Collaborative Learning. This enabled us to increase the business value for ACET in line with the business plan in terms of higher student results, more interesting and in depth student projects, increased number of publications of the students with professors teaching on the programme.

The author believes that the approach helped to achieve the goal of LTI business value not only in financial terms of the implementation of an LTI solution by measuring the impact it had on selected parameters critical for the strategic goals of the ACET Centre but also in academic and research terms increasing the quality of the academic output as well as the international research collaboration.

Following Herzberg's approach the author has defined two sets of questionnaires, one focusing on the students and extended one for the professors and lecturers teaching on the courses. The questionnaire is divided in three parts: questions on identifying the satisfying factors using IT, questions on identifying dissatisfying factors using IT and questions on general technology use.

3.2 Identifying the major motivation factors in HE context

The satisfaction and motivation levels of students in two consecutive years on the intakes of three MSc programs: the MSc in Network Centred Computing, the Erasmus Mundus MSc in Network and e-Business Centred Computing and the MSc in Computational Science by Research have been studied. All the students taking modules on the above programs were asked to reply to the set of questionnaires mentioned above. Analyzing the replies in my opinion the following motivation and hygiene factors can be discovered in the case of HE setting, which correlate with Herzberg's theory.

Consider first the analysis of the student replies. The motivation factors which came out from the surveys are presented below:

- Achievements (these are mainly conditions to facilitate further achievements, for example participation in Alumni association, writing papers for Erasmus Mundus MScs Annual Conference etc.)

- Recognition in HE (Higher Education) setting is through assessed works, marks and final degree.

- Student Involvement and Participation (active student participation through Class Representative, Forums, Interviews and feedback on the course. etc.)

- Teaching Methods – "modules very well structured and balanced", "good", "good opportunity to stay in touch with lecturers", "block system lectures and labs very beneficial"

- Feedback – "good", "more feedback mechanisms at the end of each module needed", "feedback collected for the whole program regularly.", "more feedback is needed, some marks published too late"

- Technology Features Facilitating the learning. The students have outlined some key features such as: "24/7 availability", "remote access to data and content", "access to articles, forums, wikis", "ability to submit work electronically 24/7", "online collaboration tools to exchange info and collaborate on projects". All the students rated positively and non-negatively (5 only) that the technology used was satisfactory and that was easy to use the collaborative and communication tools.

- Interaction with Conveners and Professors, "good interaction student-teacher", "active participation in the learning process", "Professors open for help and discussion", "teachers and tutors always welcoming and ready to assist", "lecturers always available", "some external lecturers difficult to contact"

- Visibility (integration with the local student body, opportunities for socializing and networking, added value elements, international experience, good teamwork, integration with student organizations, strictly student forums, etc).

Consider now the hygiene factors identified:

- IT Support (features and reliability of the Technology used). Was rated positively and non-negatively outlining that "the training given was adequate", "navigation was intuitive", "interfaces were usually user friendly", "online help was easy assessable", "minimized downtime of the system". All the students interviewed rated positively the reliability of the environments used. All the students rated positively and non-negatively (three only) that the environments used were easy to navigate.

- Content and Assessment of the study program – "good lecture material, good quality", "multiple methods used", "lectures on-line, easy to access", "greater correspondence of module name to content sometimes needed", "objectives mostly clear", "amount of assessment somewhat high"

- Quality of Teaching , "the combination between the lectures and seminars is very good", "some lectures are too deep", "sometimes the pace of teaching is too fast", "modules were well structured", "lectures well complemented by seminars", "pushing students to the limit, properly understanding to reach goals through proper research"

- Teaching and Learning Resources , "handouts not always provided", "good, well balanced", "always enough materials", "some need clearer explanation"

- Administrative Support, all were positive or non-negative, with only 5 negative responses. The students knew who to contact in administration, learning support was available, information was given on time. Some student comments "good", "very good", "admin well organized", "admin very cooperative in resolving issues".

- Organization and Student Support, all students rated the available student support positively and non-negatively, with only one being negative. Some students' comment on "good support", "high collaboration lecturers-students".

The motivators and hygiene factors in HE setting can be summarized in the following table:

Motivators	Hygiene factors
Achievements	IT Support
Recognition	Content and Assessment
Student Involvement and Participation	Quality of Teaching
Teaching Methods	Teaching and Learning Resources
Feedback	Administrative Support
Technology Features Facilitating the learning	Organization and Student Support
Interaction with Convenors and Professors	
Visibility	

Table 2: Motivators and hygiene factors for students

Achievements and recognition were the two most important motivators for students, further student involvement and participation was also very important for them and their early involvement through online forums was very valued, interaction with professors during the studies was also strongly pointed out. Technology features facilitating learning were key motivator. The feedback and teaching methods were seen as very important for their advancement and higher achievements.

On the hygiene side, the IT support as enabler was clearly stated, students were not happy if the connection was slow, bad connectivity, software platform not delivering the functionality required etc.. Students outlined the importance of the quality of the teaching materials and the quality of teaching also as well as the importance of Teaching and Learning resources and their availability 24/7 are key enabler. The administrative support as well as organization and student support were important for students to enable them to do the admin efficiently and up to date.

Consider now how knowing the motivators and hygienes we can enhance the learning process and in turn facilitate hygienes and enhance the motivators. One possibility is to introduce novel pedagogical approach based on collaborative learning and coupled and supported by advanced

collaborative ICT. These are expected to impact if properly introduced on the teaching and learning as well as on the admin and overall on the business processes. We would expect to be able to increase the student throughput, student performance, allow further flexibility in the subject portfolio and be able to develop new areas and free some funding for PG grants, all these in turn will help enhance the International Recognition and Employability of the students.

4 Measuring Business Value in HE

ACET was a founder and an associated member of the IVI (Innovation Value Institute) until 2011. The author's involvement with the IVI was in the area of studying and development of the IT-CMF for the Public Sector.

The translation of these levels for Higher Educational setting as an example of non-for-profit organization and more specifically the investment in Virtual Learning Environments and other IT tools can be managed with respect to business value. This can be achieved by analyzing success or failure of investment in tools as well as staff training and student skills acquirement based on improved student results and increased satisfaction but not as direct cost benefit.(see Table 3).

IT-CMF Level	Description	IT-CMF in the Higher Education Context
1	No defined processes	Ad Hoc decision resolving particular current needs – isolated cases of use of VLE, conferencing or web tools by some courses or departments
2	Cost control and services focus	Cost effective investments in providing services – centrally supported VLE , conferencing tools, mail service for all students, central Database
3	Investment governance based on business cases	Management or educational reasons for investment – centralised administrative systems for submission and management of work and marks; availability of collaborative tools and digital learning materials; simulation and visualisation tools
4	Portfolio management	Sustained investment in advanced technologies and tools facilitating research and collaboration and staff training for implementing the technology in the teaching and learning process coupled with creation of cross disciplinary bodies for managing the developments
5	Alignment with organisational business objectives	Strategies accounting for the benefits with great revenue distance – students taught in technology rich environment with state-of-the-art tools gain advantage in terms of future proof skills and knowledge acquired, which in turn would reflect into better employability. Research publications increase based on achieving results impossible without IT investment and so on

Table 3: Defining IT-CMF in HE Context

5   Business Value Assessment at PG Level

In the case of ACET the analysis of level of capability maturity of IT management for business value was conducted through evaluation of course administration and identification of management processes.

Time consuming processes:
- Processing coursework
- Collecting marks
- Processing Student Applications
- Preparing paper handouts for students

Repetitive processes:
- Information to teaching staff
- Preliminary information about student performance.

Expenses incurred due to specific way of work:
- Dissemination of paper handouts
- Storing of paper copies of coursework, etc.

The decision was taken to integrate LMS and make 100% use of various University systems into the course management and administration as well as implement our own electronic application system.

So, on first instance an MSc/PhD student was employed instead of a secretary in order to transfer the admin to a paperless one using the Blackboard VLE, secondly two MScs have developed, under our supervision with the support of one PhD student, our own electronic application system producing applications in a format required by the Faculty of Science at Reading. Additionally a PhD student has developed student forums, chat room and other tools enabling incoming students to communicate with current ones before they enrol on the program. Therefore we can summarize the Course Management & Learning Technology Implementation as follows:

Stage 1: Cost effective investments in providing services (CMF level 2)
- Enforced use of a VLE (Virtual Learning Environment) in our case Blackboard. This was also the VLE used by the three degree awarding institutions in the Erasmus Mundus MSc. All the lecturers from the three universities as well as visiting ones used the same VLE.
- Paperless courses, store all the lectures, assignments etc. using the VLE, the students are given CD, have access to the VLE and are able to download the lecture notes, assignments, communicate with lecturers and view their marks.
- One IT account across all institutions involved in collaborative provision, All the lecturers from the three universities as well as visiting ones used the same VLE and e-mail accounts.

Stage 2: Management or Educational reasons for IT investment (CMF level 3)
- On-line Forums, chat rooms, enabling incoming students to communicate with the current students on the program. This enables exchange of views on routine information about accommodation, student societies etc.
- Visibility Events, such as the welcome week, and the Annual Workshop with the lecturers from all the institutions involved via teleconferencing or in person.
- "Document bank" of all course documents including the case of collaborative provision.

- Shared Content System across all institutions, enabling to keep lecture materials, marks etc. in one place.
- On-line application system, introducing online application system, one for all MSc programs in the Centre, this minimized the time spent dealing with applications.

Stage 3: Investment in advanced technology and tools facilitating collaboration and research (CMF levels 3 and 4)

- Measuring Business Value of LT Implementation, after implementing the above we have reduced the time spent on routine jobs, have minimized the use of paper and have automated the operations we could using IT. We have been able to reduce the permanent staffing being without need of higher number lower grade secretaries and instead having one office manager mainly supporting the research work of the Centre and reducing also the cost for paper thus releasing funds for PG grants.
- Managing LT Implementation for Business Value, here we are looking into managing IT in terms of increasing the outlined above parameters and enhancing the motivators and facilitating hygienes for students and staff.

The Business Value for the Centre and the University can be evaluated as follows:

- Clear alignment with the business objectives of the University such as Research and Teaching strategies and the University of Reading Corporate plan at the time of conducting the study. Aligning and advancing Postgraduate Education through portfolio management of LT to the strategic objectives of the Centre and the University of Reading.
- To attract increased number of high quality postgraduate research students and provide them with a stimulating and supportive research environment and training.
- Increased number of offered courses and a flexible postgraduate courses portfolio. The change of the course structure, of the curricula and possibility to offer more flexible program, enabling the students to choose their own program increased the attractiveness of the courses offered.
- This was a LTI investment that advances the use of novel technology and pedagogy for Teaching and Learning. Our Collaborative Learning approach based on Collaborative Creative Cross-Pollination (CCCP) activity model implemented on the MSc programs increased the achievements and marks of the students in comparison with the previous intakes. One student statement summarizes it all: The program "is pushing students to the limit properly understanding how to reach goals through proper research"
- Putting all the lecture notes, assignments, marks etc on VLE as well as introducing the software system for online application process, optimized the routine and time consuming tasks. The investment here was one MSc and one PhD student part-time with Computer Science background to digitize and set up the systems as well as one off investment in a sponsored MSc project to create the online student application system. In a long run saved all secretarial salaries and one part time PhD student is needed to maintain and reset the systems. Plus all the lectures and Teaching Assistants were now able in a distributed fashion to update their lectures, and assignments on the system. In addition, one system, handles the internal as well as the International Joint Degree Programs. The result is increased throughput and reduced costs.

The gains of this IT facilitated implementation are summarised in the table below:

	Teaching Methods and Curricula Design	Management Processes	Subject Specific
Use of IT	Support of team work and individual accountability	Common timetable and progression path Access to teaching and administrative resources irrespective of location	Remote access to relevant teaching resources including HPC resources
Gain	Development of problem solving, research and collaboration skills through implementation of CCCP activities	Streamlined administration Decentralised control over material update and student feedback	HPC and domain specific applications; Visualisation and simulation environments; Mathematical Modelling capabilities Over multidisciplinary subject area

Table 4: IT Impact

6 Analysis, Generalization and Conclusions

As previously stated, the author supposed that a set of necessary elements need to exist in the education context in order to prevent disappointment or failure (hygiene factors). However their presence is not sufficient to motivate students to learn or be satisfied with the experience, for which another set of factors is necessary to be present (motivators). Also these factors can indicate the existence, or lack of, synergies between technological facilitators, collaborative learning pedagogy and management processes in the educational context. In such a complex system as HE, these are key for creating successful programs. The eight motivators and six hygiene factors in HE context were identified and presented in Section 3 above. Although there is a context specific differentiation between the meaning of these factors in education and in work environment (Herzberg), there are obvious parallels between them.

According to Herzberg [6] the first-level motivating factors appearing in Long-Range and Short-Range high attitude sequences, ordered by percentage of appearance the highest first are: Achievement understood to be successful completion of a job, finding a solution to a problem, seeing the results of one's work etc.; and Recognition- the act of recognition from a peer, supervisor, colleague, professional colleague, general public, professional body, etc. He also considered interlinked factors, e.g. a frequency in which factors appear together in the sequences and Achievement is linked with recognition, responsibility and the work itself, (and whichever is considered as a primary factor of the previous four, the remaining three are secondary)

According to the study conducted by the author, Achievement is seen by the students as conditions to facilitate further achievements, for example participation in Alumni association, writing papers for Erasmus Mundus MScs Annual Conference etc. and Recognition is through assessed works, marks and final degree. In conclusion, in HE context Achievement and Recognition are interlinked factors too.

Herzberg´s highest frequency hygiene factors are Company policy and administration (adequacy or inadequacy of company organization and management) and Supervision-technical (relationship in which the competence or incompetence, fairness or unfairness of the supervisor, supervisors

willingness or unwillingness to teach, willingness or unwillingness to delegate are critical characteristics).

In the context of technology enhanced learning, they are comparable to the students´ understanding of IT support (features and reliability of the technology affording instant and constant access to supervisors, materials and peers); Administrative Support (clarity who to contact in administration, admin cooperation in resolving issues, information availability on time. learning support availability); Organization support (linked by students to visibility, affordance of student involvement and lecturer-student collaboration)

Reviewing the motivator and hygiene factors derived from the study it is possible to organize them into sets with predominant influence of one or several of the above mentioned areas – pedagogy, technology and management (see Figure 1).

Analyzing the influences of the three areas and their intersections, the following conclusions can be deduced:

1. The ways in which the areas influence the factors are:

- As facilitator, **the technology** is in the position to resolve or aggravate the issues with **means** to do, achieve, or communicate something
- **Pedagogy** sets the **principles** on which the teaching is based (course, activities, and materials design; level and type of communication between peers and with lecturers, and type of student´s feedback)
- The **management** creates organizational framework defining the **capacity** of this complex system to resolve potential problems expeditiously and create visibility and involvement for the students through rules, regulations and institutional bodies.

2. While some of the factors have clear affiliation to one of the areas, the majority of the factors need complex solutions involving more than one type of intervention.

- **Single area of influence**:
  IT support (HF) and *Technological features supporting learning* (M) success or failure can be resolved/ facilitated with purely technological means.
  Quality of Teaching (HF), *Content and Assessment* (HF), *Interaction with Convenors and Professors* (M), and *Teaching Methods* (M) are factors resulting from the specific way of teaching (pedagogy) and its quality.

- **Dual areas of influences**
  The dissatisfaction with administrative support may result from the existing administrative regulations, the staff competence or the poor level of technological support preventing students to interact with administration. Thus it falls under the influences of both management and technology areas.
  Teaching and learning resources can be poorly designed and in this case there is a pedagogical issue or the tools used do not allow adequate access or collaborative work which makes the problem on of technological type.

- **Triple (complex) areas of influences**
  Inevitably *Achievements* (M) and *Recognition* (M) as interlinked factors in Long-Range sequences are in the triple intersection and to be successfully facilitated require adequately functioning technology, appropriate pedagogical environment and supportive management processes.
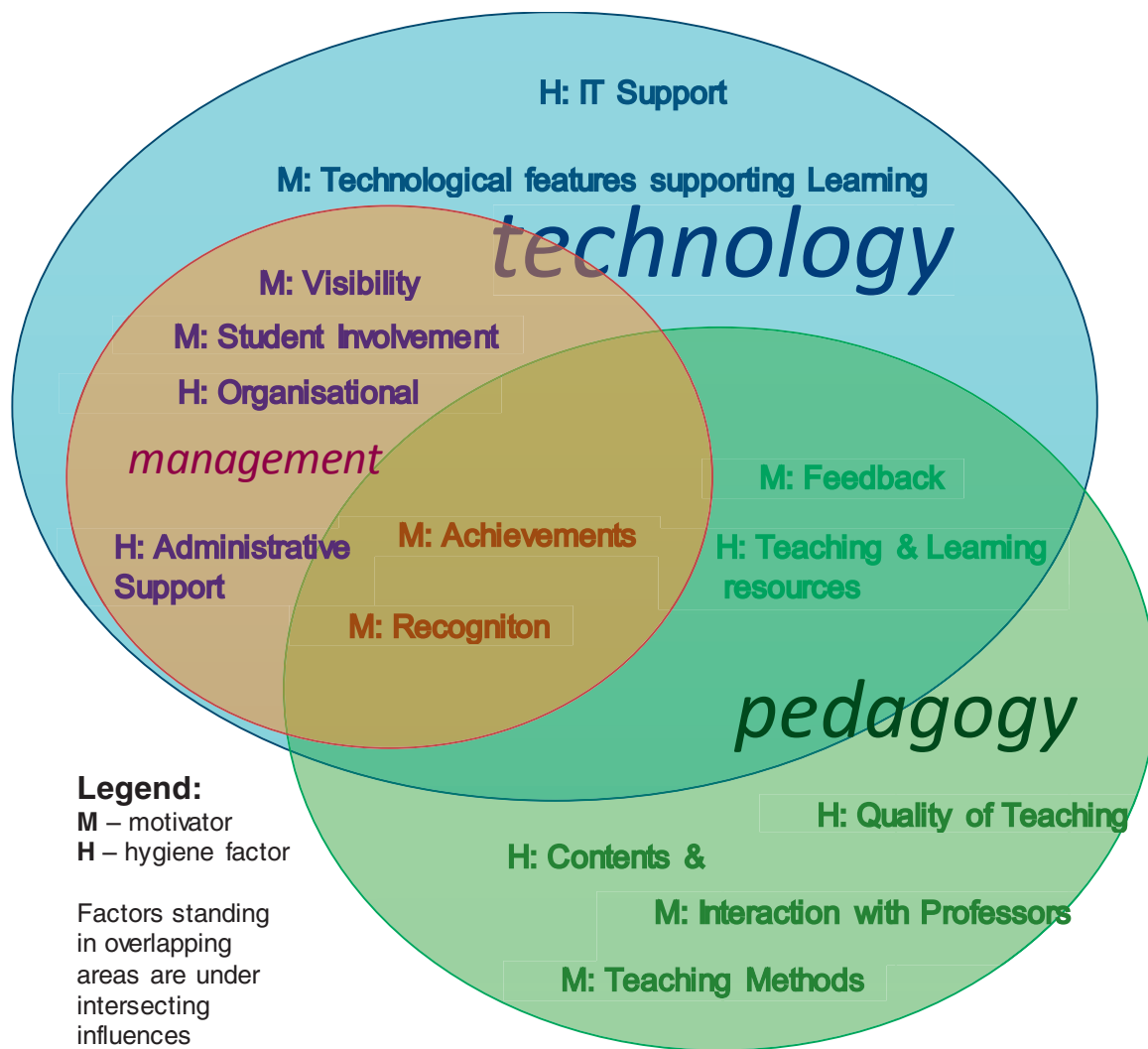
Figure 1: Intersecting Influences Model

In this paper the concept of Business Value of Learning Technology in presented, together with an example how to measure it in HE setting at PG level based on a case study in Computational Science. Computational Science subject area is used as a pilot for the studies described in this paper since it is a multidisciplinary area, attracting students from diverse backgrounds and Computational Science is both the natural environment to promote collaborative teaching methods and collaborative provision of courses and as such requires more streamlined management processes. Based on this study the motivators and hygiene factors for Learning Technology Implementation in Higher Education setting have been presented. Finally based on the study results it was possible to link together the intersecting influences of the pedagogy, technology and management through the Intersecting Influences Model which is one of the key findings of this paper.

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