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ICTE Journal Has a New Look

Dear readers,

A number of authors from all around the world have published their papers in the ICTE Journal over the last six years. This fact proves that our journal is becoming well-known among foreign researchers specializing in the use of information and communication technology in education. We realize that the growing interest of authors in publishing their papers in our journal is mainly caused by the number of databases in which the journal is included, as a result of which the papers are accessible to more readers. We hope that in the near future, our journal will also be included in the SCOPUS and Thomson Scientific (Web of Science) databases.

The following map shows the countries from which the authors who have published their papers in our journal come.

We hope that the yellow-colored portion will continue to grow, enabling us to provide our readers with balanced scientific information from all around the world. Now let's take a closer look at the current issue.

The first paper describes practical aspects of pedagogical cybernetics in mathematics instruction. The main aim of this paper is to discuss the possibilities for the application of the principles of technical cybernetics and its advanced strategies in the pedagogical practice.

Video and audio recordings of lectures are becoming the standard in a number of schools. The paper *Enterprise Lecture Capture Technologies and Value to Student Learning* presents the opinion of students on the value and contribution of those recordings to learning. The research is aimed not only at determining the value of those recordings, but also at their impact on student attendance at lectures.

The next paper is aimed at the use of eLearning in work safety education. The author is comparing and contrasting traditional and eLearning-based instruction. This research may be beneficial in a number of

ways, i.e. it may help reduce the number of work-related injuries, reduce training costs and save the state money spent on sickness insurance.

The last paper in this issue focuses on the implementation of blended learning in the university environment. In order to identify the critical factors of the implementation of blended learning at universities, the authors analyzed 15 publications on this subject.

Finally, let me thank all the authors for their papers and for helping to further develop this dynamically evolving field. Dear authors, have a wonderful summer. We hope that when the summer is over, you will once again want to share your research with us.

Tomas Javorcik

Executive editor

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ADAPTIVE CONTROL STRATEGY IN CONTEXT WITH PEDAGOGICAL CYBERNETICS

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ABSTRACT

In this paper, the practical aspects of the pedagogical cybernetics are described. A generally known feedback model of an educational process is modified for the purposes of a student knowledge support in the mathematical education. This modification is connected with the corresponding area of the technical cybernetics. These principles can be situated in the pedagogical area with the similar aims as in a processes control. A proposed model of an adaptive control is recommended as a suitable form of an interaction between a student and a teacher. Although this approach can be time-demanding, its appropriate advantages can be utilized in favor of practice in an individual consultation. In this paper, the described proposal of the advanced control model is supported by a free-available software. The application of this proposed strategy was practically realized in the author's consultations at the Maths Support Centre at the Faculty of Applied Informatics at the Tomas Bata University in Zlin.

KEYWORDS

Adaptive control strategy, cybernetics, feedback model of education, consultations, mathematics, free-available mathematical software.

1 INTRODUCTION

In the pedagogical cybernetics (Granic et al., 2009; Gushchin & Divakova, 2015), a generally known model of an educational process has a feedback form, as can be seen in (Cevik et al., 2015). A teacher and a particular student can be situated in this process by the abstract models. In a modular view on the modelled educational process (Granic et al., 2009), the connection between a student and a teacher has the specific feedback form. In a plenary lecture, a feedback connectivity it is not always applicable. In a seminary, this feedback functionality can suitable achieve the aim of this educational strategy.

In the field of simulation (Corriou, 2004), a model should be characterized by the important parameters. This declared model can substitute a real object (e.g. a student in the pedagogical cybernetics) with respect to its significant attributes (e.g. a knowledge level of a student in the pedagogical cybernetics). A method for a determination of these parameters is identification (Nelles, 2001). The identification should be performed in an initial part of a feedback process. Then an interaction between considered objects can be suitable stated in the feedback approach to education.

The pedagogical cybernetics fulfills similar aims as the technical cybernetics (Kučera, 1991) in which the models are described by a mathematical background in a form of a differential equation (Balátě, 2004). The identification process may be realized online (Corriou, 2004) or offline (Ingole et al., 2015). In each time

of a technical feedback control of a process, a controlled object can be repeatedly identified. This specific type of a process control is denoted as an adaptive control strategy (Bobál et al., 2013). This method is very important in case of the time-variant parameters of a controlled model. This problem can be described by a differential equation with the time-variant parameters (Balátě, 2004) in the mathematics.

In the pedagogical cybernetics, a principle of the adaptive control can be applied in an analogical form. However, this principle is not strictly based on the mathematical background. In this paper, the strategy of the adaptive control is presented in the context of an educational practice. This proposed repeating form of an identification process in the feedback model of a learning strategy may be applied in an educational process. However, this concept brings a disadvantages based on a recurrent time-demanding interaction between a student and a teacher. For this reason, the recommended application may be having a form of the individual consultation of student. In this paper, the practical application of the proposal is demonstrated in the author's consultations at the Maths Support Centre at the Faculty of Applied Informatics at the Tomas Bata University in Zlin presented in (Pátíková, 2016). In this type of an education centre, a greater count of students may come visit the tutor. Therefore, a second advantage of the proposed approach is a decreasing of time of a problem-explanation with the required quality.

2 METHODS AND PROPOSED MODIFIED STRATEGY

Generally Used Method of Feedback Model in Pedagogical Cybernetics

A feedback model of an educational process is widely described in (Cevik et al., 2015) and can be seen e.g. in Fig. 1 in a form of a mathematical education. This control strategy is based on the same principles as in case of the technical cybernetics (Kučera, 1991).

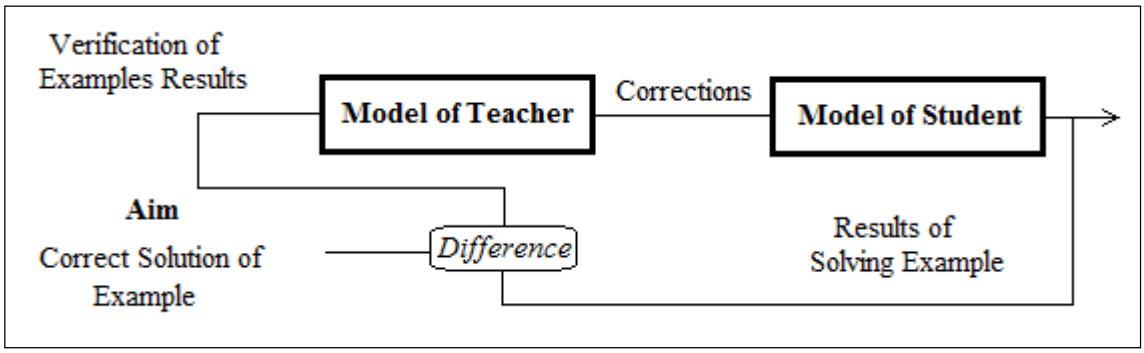

Figure 1 Feedback Model of Educational Process with Example in Mathematics

A student or a teacher is in this context substituted by an abstract model in the pedagogical cybernetics. In comparison to the technical cybernetics, the models are only moreover described by a mathematical background e.g. by a differential equation in (1). Variable t represents time, where $t>0$ for purposes of consideration of physical causality ($m < n$). Variable y expresses output information from the control model (e.g. student). An interaction between the considered models is performed by variable u in the equation (1). The feedback model (Fig.1) is characterized by the constant time-invariant parameters $a_i, b_j, i \in \langle 0,..,n \rangle, j \in \langle 0,..,m \rangle$. An order n of a differential equation is usually equal to 2 in the most of practical applications.

$$a_n y^{(n)}(t) + ... + a_1 y'(t) + a_0 y(t) = b_m u^{(m)}(t) + ... + b_1 u'(t) + b_0 u(t) \quad (1)$$

Variable y can represent information which is presented by the student. The corrections u for the students are expressed by the teacher. Variable u is then determined by the teacher.

These signal variables are not in a humanistic area further used; however, the connectivity between the two areas of cybernetic is demonstrated.

The model of student is very simple identified in this type of an educational process. Therefore, an adaptive control strategy may be suitable used for these purposes.

Proposal of Utilization of Adaptive Control Strategy in Context with Pedagogical Cybernetics

In the pedagogical cybernetics (Granic et al., 2009; Gushchin & Divakova, 2015), the adaptive control principle (Bobál et al., 2013) based on feedback strategy may be considered; however, this proposal is not widely described in the literature.

In the adaptive approach, a controlled model (e.g. a student in the pedagogical cybernetics) can be generally described as an abstract object with a time-variant structure. This change of a model behavior is defined by the non-constant parameters of the model in the technical cybernetics, as can be seen in equation (2). Because a dynamics of the model is changing, a structure defined by parameters should be repeatedly identified (re-identified). Differences of equations (1) and (2) are based on the time-variant parameters a_i and b_j.

$$a_n(t)y^{(n)}(t)+\ldots+a_1(t)y'(t)+a_0(t)y(t)=b_m(t)u^{(m)}(t)+\ldots+b_1(t)u'(t)+b_0(t)u(t) \tag{2}$$

In the pedagogical cybernetics, a repeatedly identification (Corriou, 2004) may be an analogical process as in the technical cybernetics. The possibilities of a model re-identification may be consisted of a testing of a student on its knowledge. In the environment of a high school, this method can be time-demanding with consideration of a higher number of the students in a lesson. An appropriate environment for an application of the adaptive control strategy can be an individual consultation of a student, as is further discussed in this paper.

Proposal of Adaptive Control Strategy in Favor of Education of Mathematics

A disadvantage of a repeatedly identification is a time-demanding property in the adaptive control strategy in the feedback cybernetics model. This problem can be eliminated e.g. using information technologies. The particular solution can be an application of free-available mathematical software. The implementation of the proposal of the adaptive control strategy in a mathematical educational process in sense of the feedback control can be seen in Fig. 2.

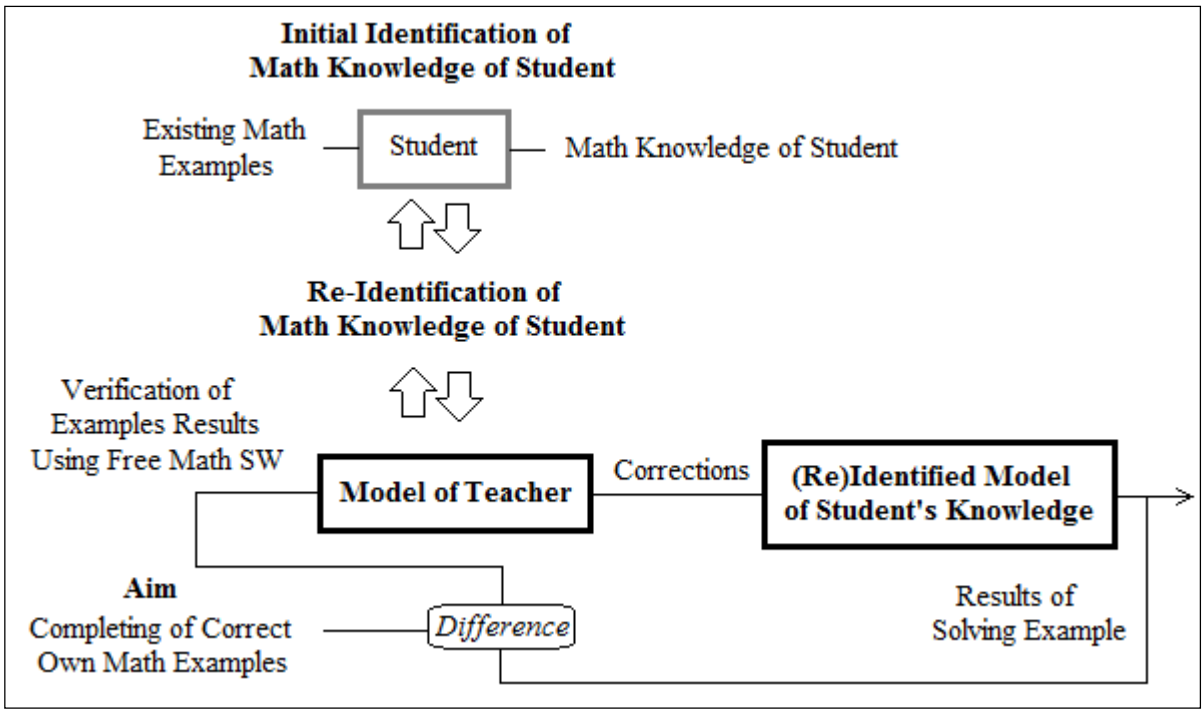

Figure 2 Proposed Model Focused on Example of Mathematical Practice

The re-identification of the particular student knowledge can be supported by these practical software possibilities. The aim of the acceleration of the time-demanding re-identification may be fulfilled. Further, a free based software (e.g. Octave, wxMaxima, SciLab, etc.) can be used at home by the students and can suitable improve their skills.

Free-Available Mathematical Software Tools as Support of Proposed Approach

In case of a linear algebra or a mathematical analysis, the MS Excel may not be a full-complete solution for learning. However, the most used functions for matrices processing are available. The main difference of using of these functions is an evaluating by a key-shortcut *Ctrl+Shift+Enter* instead of *Enter*. In this computational environment, the symbolical and numerical calculations are not implicitly aggregated. This type of calculations may be suitable solved in the further free-available softwares.

The free-available programs Octave and wxMaxima fulfill a purpose of symbolical calculations. Octave can be used as a support for the control-system theory as well. In this application, the symbolical toolboxes (e.g. for operations with polynomials) are included. For the symbolical computations in mathematics is appropriate the software wxMaxima too. In both programs, all operation for matrices are supported. Example of the elementary operations with matrices can be following commands: *inv*, *det* or *roots* for a determination of the polynomials roots.

In the free-available software PAST (Hammer et al., 2001), the essential statistical computations are provided. The elementary statistic characteristics (e.g. a sample mean value μ, a standard deviation σ^2) and hypothesis testing (Cortes, 2016; Kitchenham, 2016) for *n* data variables $X_i; i = \{1,...,n\}$ (in form of equations (3) or (4)) can be recommended to the students of statistics. The conclusions of normality and a hypothesis testing are based on interpretation of a significance value *p* calculable in this software. The null hypothesis H_0 is rejected in favor of the alternative hypothesis in case when the found significance value *p*

is greater than a pre-defined significance level α. The rule for the significance level is that α is usually equal to 0.05 in the pedagogical research.

$$H_0 : \mu_1 = ... = \mu_n;\ H_1 : \mu_1 \neq ... \neq \mu_n \tag{3}$$

$$H_0 : \sigma_1^2 = ... = \sigma_n^2;\ H_1 : \sigma_1^2 \neq ... \neq \sigma_n^2 \tag{4}$$

The important problem before an application of a statistical method for a purpose of the hypothesis testing is a determination of a probability distribution of the research *n* data variables X_i. On the normal distributed data ($X_i \sim N;\ i = \{1; n\}$) could be applied the parametric methods (Cortes, 2016; Kitchenham, 2016), in the opposite case ($X_i \not\sim N;\ i = \{1; n\}$) may be used the non-parametric tests (Cortes, 2016; Kitchenham, 2016). The normal probability distribution of data can be tested by Shapiro-Wilk test (Alizadeh Noughabi, 2016).

The advantage of the PAST is a complex software solution based on a table-cells layout. The office programs include the additional tools for hypothesis testing. The principles are based on the same principle of the calculation of significance value *p*. Software PAST is free-available and suitable for students. The advanced functionality of this program can be utilized by researchers as well.

3 RESULTS AND DISCUSSION

The proposed strategy was practically realized at the Maths Support Centre at the Faculty of Applied Informatics at the Tomas Bata University in Zlin. The author of this paper is a member of a team of the voluntary tutors under the leadership of Mgr. Zuzana Pátíková, Ph.D. (Pátíková, 2016).

In the author's consultations of students in the mathematical preparation, the proposed adaptive control strategy of teaching was applied. The identification of the student knowledge was performed in the initial parts of the learning sessions. Explained mathematical problems were linear algebra, mathematical analysis, linear differential equations and advanced statistical methods.

The identification was realized using the examples of several elementary problems in the particular area. The notices of students were controlled. Using free-available mathematical programs, the adaptive educational process with the re-identification achieved the aims of the individual consultations.

In the terms of the cybernetics, a model of a student was analyzed and its knowledge level was then repeatedly identified. The time-demanding identification may be possible in this individual form of an education. The free-available software for purposes of math learning can save this useful time. The most used software applications were: for statistics - PAST, for linear algebra - Octave and for the symbolic computations - wxMaxima. Using the student-knowledge identification, the consultations can be specific and the problems can be suitable solved.

The particular number of students in the consultations was approximately 15 with some repeated visits. Students had mostly a distance form of study. Lessons were provided on Saturdays. The field of a study of these students had a different spectrum; however, the study contained the mathematical focused background.

Each student of the consultations denoted that the possibilities of using of the free-available mathematical software are foreign to them. After the short tutorial, they denoted an advantage of a free-availability of the software. The matrix functions in MS Excel were unknown to them. On the repeated visits, the students appreciate these software products. In save time, number of the mathematical examples was computed by

students. With the most positive evaluation, the free software PAST was denoted for its comfortable functions for the statistics.

One student regularly repeated the learning sessions in the complex preparation on the thesis focused on a statistics research in a health care. The main software support was PAST. The solved problems were a normality testing and a testing of the hypotheses. The normality of data was determined by the Shapiro-Wilk test in PAST. For the hypotheses testing based on a comparison of the mean values, the Mann-Whitney and Kruskal-Wallis test were provided, because data had not a normal probability distribution.

Ten students wanted to explain the linear algebra problems. In the consultations, the own examples were constructed by the students with a verification in the denoted free-available softwares. Matrices were discussed and an inverse matrix or determinants were manually expressed. Determinants of a higher order were solved using the Laplace theorem. The control mechanism for these purposes was an algebra program Octave.

Four students wanted to prepare to the differential and integral calculus. The further exercised problem was the particular type of the linear differential equations solved in the written form and on the board. Many examples were realized on the symbolic principle in the wxMaxima in favor to the adaptive control strategy of learning in the mathematical consultations.

In these cases, the proposed strategy (Fig.2) with the described software support was realized on the principle based on the adaptive control. Utilization of this method was very usefull and achived a dynamical educational process of the individual consultations at the Maths Support Centre.

CONCLUSION

The adaptive control strategy of an educational process was described and utilized in the author's consultations at the Maths Support Centre at the Tomas Bata University in Zlin, where the author of this paper is a voluntary tutor. In the practice, the students were repeatedly identified by a teacher in favor of an improving of its knowledge using the adaptive control strategy. The support of the realized teaching strategy is in a form of a free-available mathematical software, which can spend time in the consultations. In case of a greater number of students with different topics in the consultations, the proposed strategy has an accelerating aspects. The main aim was to point out the possibilities of a wide application of the cybernetics principles of the technical cybernetics and its advanced strategies. The pedagogical practice can be based on these principles which can be applied in the area of the pedagogical cybernetics. Further strategies can be inspired by the technical cybernetics in the proposals in the future research. This paper can be considered as an initial qualitative research of the utilization of the practical aspects of the cybernetics principles. In the further research, the quantitative research may be realized.

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TRAINING SYSTEM FOR OCCUPATIONAL HEALTH AND SAFETY WITH USING ELEARNING

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ABSTRACT

Recently there has been a noticeable trend of rising awareness among the employers in Poland of the fact that training on occupational health and safety may to the quality and effectiveness of their business. Providing safe employment is beneficial to both the employer and the employee. Work safety has an influence among others on efficiency, which is in turn one of the fundamental factors affecting the profitability of business activity, especially at the time of crisis.
Work safety is important not only at micro but also macroeconomic level as lack of accidents affects the reduction of job costs, the state spends less on accident allowances or rehabilitation benefits. In the traditional approach to training focus was placed only on the training content regardless of the assessment of its effectiveness, and particularly the quality of training measured as the assessment given by the trainee.
This study presents a proposition of a new approach consisting in reviewing traditional training on occupational health and safety. This approach aims at improving the quality of training through an appropriately developed training system with the use of e-learning.

KEYWORDS

e-learning, ICT, occupational health and safety, traditional training

1 INTRODUCTION

To this end the following research problem must be formulated:

Is it possible to develop a training system with the use of ICT and e-learning owing to which the state of occupational health and safety could be improved by raising the level of selected occupational health and safety competences among employees, in particular the least developed competences?

2 THEORETICAL BASE

Developing the system, we base on:

a) Legal acts on the subject matter of the training on occupational health and safety:

   Regulation of the Minister of Economy of 18 July 2001 on the manner of checking the qualifications required for the operation and maintenance of technical machinery (Official Journal no. 79, item 849 as amended) ,

b) Definitions related to training on occupational health and safety in accordance with Regulation of the minister of Labour and Social Policy of 9 October 2007 amending the regulation on training in the scope of occupational health and safety (Official Journal no. 196, item 1420):

- training;
- course;
- seminary;
- directed self-study;
- teaching training.

c) organisational unit providing educational activity in the area of occupational health and safety, which may be:

- lifelong learning centre;
- practical training centre;
- vocational training institution;
- upper secondary school;
- research and development unit, higher education institution or any other scientific unit.
- association with its statutory aim to conduct activity connected with occupational health and safety,
- legal or natural persons conducting educational activity on the basis determined in the regulations on freedom to conduct business activity if they conduct educational activity in the area of occupational health and safety.

d) employee's scope of occupational health and safety competences for a given job position,

e) published his first article on programmed teaching in 1954. Before Skinner, as early as 1920, programmed instruction was first attempted in Poland by S. Trębicki and in 1926 in the USA – by S.A. Pressey. Programmed instruction is based on an appropriately arranged programme containing interrelated logical doses of information on a given topic.

Programmed instruction distinguishes the following types:

- linear programming (B.F. Skinner) which consists in dividing the instructional material into merit-related and logically interrelated portions of information (steps) where filling the gap with the correct answer the student moves on to another portion at which point he compares (checks) the answer he has given with the programmed answer,
- branched programming (created by N.A. Crowder), consisting in applying doses of information, selecting one of the several answers in the programme and checking it where apart from the correct answer the student finds out about why that particular answer was true,
- mixed programming, which has different variants, e.g. the block method which was developed in Poland by Cz. Kupisiewicz. It boils down to the subsequent exposure of blocks of content, interwoven with blocks aimed at revising, systemising, extending and testing.

e) Bloom taxonomy of educational objectives.

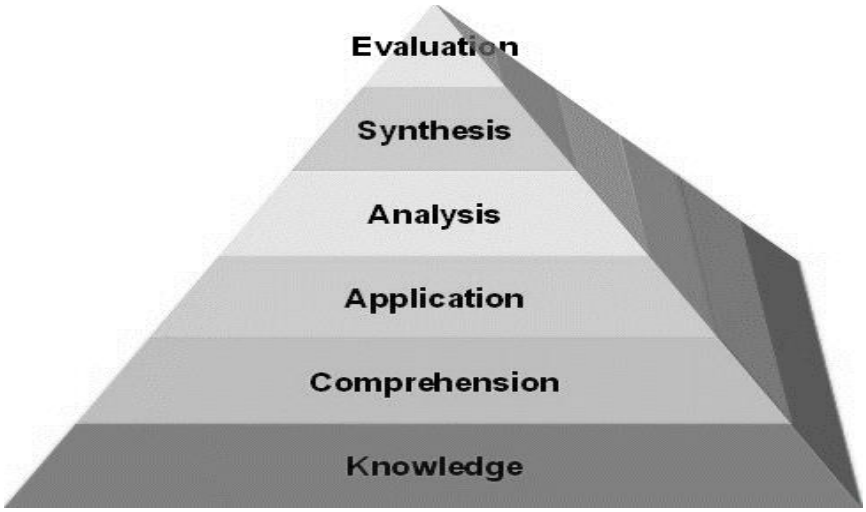


Figure 1 Bloom taxonomy of educational objectives

The proposed occupational health and safety training system is designed according to the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation). The main assumption of the model is the iteration of the process of constructing a course.

The ADDIE model consists of the analysis phase, the assumptions and conditions, course design, course development component, implementation and evaluation. Construction of a good e-course, which runs under the ADDIE model, is an ongoing process. After the evaluation stage, there is the next stage of analysis, which starts the next phase of work on the course and which is aimed at creation of a bug free, efficient and user friendly product.

Table 1 Phase of Instructional System Design (ISD)

Phase	Name	Operation
1	**Analysis**	On this stage, the conditions, in which the created training will be functioning, should be determined. The analysis includes: • determination of the scope of the project; • selection of the technology, in which the training will be made; • characteristics of the target group - who the recipient of the content is, what the current knowledge and training needs are; • determination of the objectives of the training - what messages, competences or skills are to be acquired by the course participants as well as determination of the signs of achievement of these objectives; • determination of limitations and obstacles in distribution of materials, e.g. bandwidth of Internet connections, possibility to attach soundtrack; • planning of the frameworks of the project. Collection of the data needed for the analysis may be performed through surveys, questionnaires or interviews with the final recipients or with persons responsible for the training (lecturers, coaches, employers). Analysis is one of the most important stages in the entire **project** cycle since all decisions made in further phases depend on the findings made during Analysis.

2	**Design**	In this phase, proper measures are selected for the objectives and conditions of the training determined during Analysis. On the basis of the materials from the substantial expert, contents, interactions and multimedia are selected. Preparation of the basic objects is the starting point for planning of the division into lessons, modules and topics. The result of this stage may be development of documentation putting together the technical strategy and the visual concept of the design. This specification may also acquire the form of a scenario or prototype, i.e. simplified outlines (paper or electronic) of the interface, outlay of the content on the screen, manners of navigation and the schemes of the course of the training.
3	**Develop**	It is the most technical stage since it includes preparation or acquisition of the necessary training elements - texts, films, animations, interactions, games, simulations. The scope and the content of these materials is determined in Design phase. During Development, they are developed and integrated. At the end of this steps, the tests of conformity with the specifications and standards are performed.
4	**Implement**	In this phase, the course is installed in the environment that will be used by training participant. Final start-up may be preceded with functionality tests. As of the moment of distribution of the prepared materials, the teaching and learning process commences. The training participants obtain access thereto and their actions may be supported by mentors as well as substantial and technical experts.
5	**Evaluate**	Functioning, form and content of the prepared training is assessed. All preceding stages of course creation may be subject to evaluation. The conclusions and observations are used for improvement of both the methodological & technical side of the product and the process of its creation.

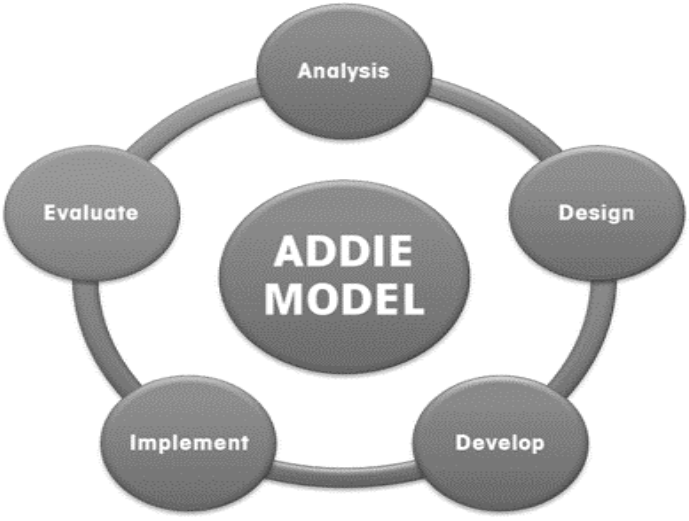


Figure 2 ADDIE model

This results in designing training content being an ongoing process. This model organises the work of a project team which must be composed of team members playing the role of a project manager, substantive expert, methodologist, IT specialist and multimedia art specialist.

Depending on the type of instruction, organisation and aims of evaluation there may be conducted analysis of teaching effectiveness by means of various models, e.g. the models developed by Kirkpatrick, Phillips, Brinkerhoff, Bushnell and others. During the process of evaluation of teaching data of various kind will be collected and next divided into groups according to categories and levels.

In our e-learning environment the following test will be used:

- preliminary didactic tests (pretests),
- didactic tests taken during the learning process,
- final didactic tests (posttests),
- retention tests taken three months after the course completion (retests).
    - possibility of using ICT and e-learning in the scope of occupational health and safety training.

3 MAIN AIM OF RESEARCH

The aim of proposed research is developing and evaluating a training system in the scope of occupational health and safety with the use of ICT and e-learning. It is based on an e-learning course containing a didactic module aiming at developing the employee's competences in the scope of occupational health and safety. It is enhanced by elements of programmed instruction which involves the principle of gradual increase of difficulty level.

The developed training system with the e-learning component would manage the employee's training by means of an LMS (Learning Management System) based on the principles of programmed instruction according to an algorithm proposed by the present authors.

The training system would comply with Polish legal acts in terms of the subject matter of the training related to occupational health and safety.

The expected result would be the improved state of occupational health and safety through an appropriately developed training system. The authors assume the level of occupational health and safety will rise in firms and institutions where the system will have been used.

4 TRAINING SYSTEM DESIGN

Analyse – analysis of the current state of the studied area of problems

At this level the constructed system's teaching aims as well as expected results will be developed. Survey research will be conducted in relations to the knowledge and use of ICT tools and e-learning in Silesian Province in selected work places/institutions/firms among employees in various positions, also representing training sections. A decision will be made on what mechanism will be selected for presenting new content in the scope of training (e-learning platform, if so what platform? Or another multimedia tool). Also conducted among the employees in selected work places/institutions/firms will be analysis of the level of competence in the scope of occupational health and safety and the state of health and safety at work.

Design – designing a training system

At this stage the teaching aims of the created system, its schedule, duration and pace will be developed. Charts and diagrams showing the manner of presentation and scope of study will be created. Methods and conditions of participants' assessment will be determined. The method of system evaluation as well as the methodology of data collection for analysis and the way of presenting final reports will be specified.

Develop – developing a training system

At the stage of development, a course will be created, and its particular modules and lessons will be filled with study materials: texts, instructional films on occupational health and safety, tests, etc. For the purpose of constructing the course the charts and diagrams created during the design stage will be used.

5 STRUCTURE OF THE PROPOSED E-LEARNING COURSE

The e-learning course in the scope of occupational health and safety will be placed on the e-learning platform of the University of Occupational Safety Management in Katowice, Poland or an institution where research will be conducted (provided it owns one). The course will have a hierarchical and modular structure and consist of several standard blocks:

- introduction to a distance course;
- thematic module;
- summarising module.

The proposed structure of the thematic e-learning course will be as follows:

- Introduction to the distance course: Course description, Literature, Glossary of Terms, Forum, Registration Questionnaire, Legal acts on Occupational health and safety.
- Thematic module: Pre-test (a diagnostic test); Information material on the studied area; Thematic lessons containing a didactic module, Block of Tasks; Testing and checking knowledge; Block of interactive communication between the tutor and the students and between the students themselves; Additional information materials on the studied area; Checking knowledge.
- Summarising module: Examination test; Final questionnaire, Reflexive (evaluation) survey.
  The platform will consist of 3 most important parts:
- Administrator's panel,
- Tutor's panel,
- User's panel.

The course features the following components/modules of the platform: Questionnaire, Lesson, Quiz, Assignment, URL, Forum, Chat, Glossary.

Each lesson will be a multimedia programme. All items of information, advice and instruction will be transmitted in the written form. The employe will navigate throughout the course by means of hypertext. During the period of the course the employee's work will be assessed. Through automatically generated reports the tutor will have access to information on how well the employees have developed particular competences.

6 IMPLEMENTATION OF THE E-LEARNING COURSE

The stages of design and development will be followed by the system implementation. After the course preparation and before the system evaluation begins a pilot experiment is planned which including consultations with methodologists, health and safety trainers in order to find out about their remarks and comments. The aim of this stage will be:

- to search for imprecise statements in training materials placed in the course and included in the tests,
- to examine the functioning of the didactic module which develops the employees' health and safety competences,
- to find out the level of comprehension of test tasks and verify their content,
- to verify the appropriate order of questions in a test,
- to verify the duration of the course and the tests.

Evaluation of the training system

What follows next is the main research within the framework of which will be selected:

- the experimental group (EG) – to be working with the use of the e-learning course,
- the control group (CG) – to be working without access to the e-course.

The development of the employees' competences will be measured three times:

- by means of the pretest prior to the training commencement,
- by means of the posttest at the end of the training,
- by means of the retest three months after the training completion.

For analysis of the results of the main experiment the following methods will be applied:

- t-Student test for uncorrelated groups,
- t-Student test for correlated groups,
- Pearson coefficient of correlation.

Towards the end of the experiment survey studies will be conducted among the employees (participants of the experimental group EG) as well as the trainers, methodologists evaluating the course and prepared methodological materials for trainers and course users.

7 EXAMPLES OF CURRENT TRAINING ON OCCUPATIONAL HEALTH AND SAFETY IN POLAND

- **HTTPS://WWW.SEKA.PL/DEMO-BHP/**

Seka is the leader in organisation of occupational health & safety courses in poland. since the beginning of its activity, it has trained over 1,000,000 persons. Its offer includes e-learning occupational health & safety courses in polish and english versions for three groups of positions:

- periodic training for administration & office employees,
- periodic training for employers and other persons managing employees,
- periodic training for engineering & technical employees.

These training are developed in articulate software. they contain:

a) screens with active infographics;

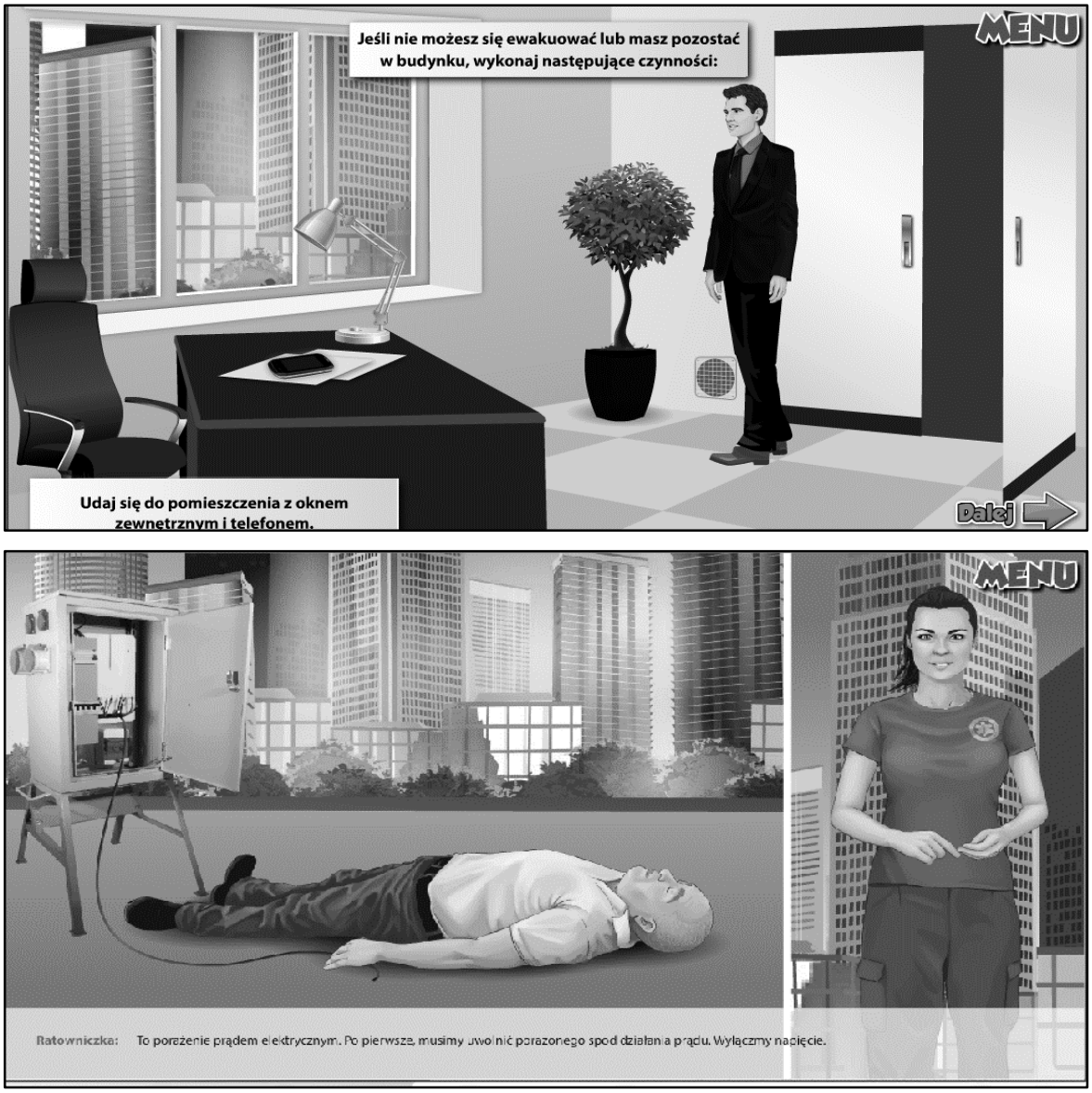
b) screens with a tutor and animation presenting the training contents;

c) screens with exercises;

d) screens with interactive photos;

e) animated screens with interactive fire protection manual;

f) screens with first aid provision manual.



- **HTTP://WWW.KNO.KOWEZIU.EDU.PL/REPOZYTORIUM-KURSOW.HTML**

Online vocational education course repository

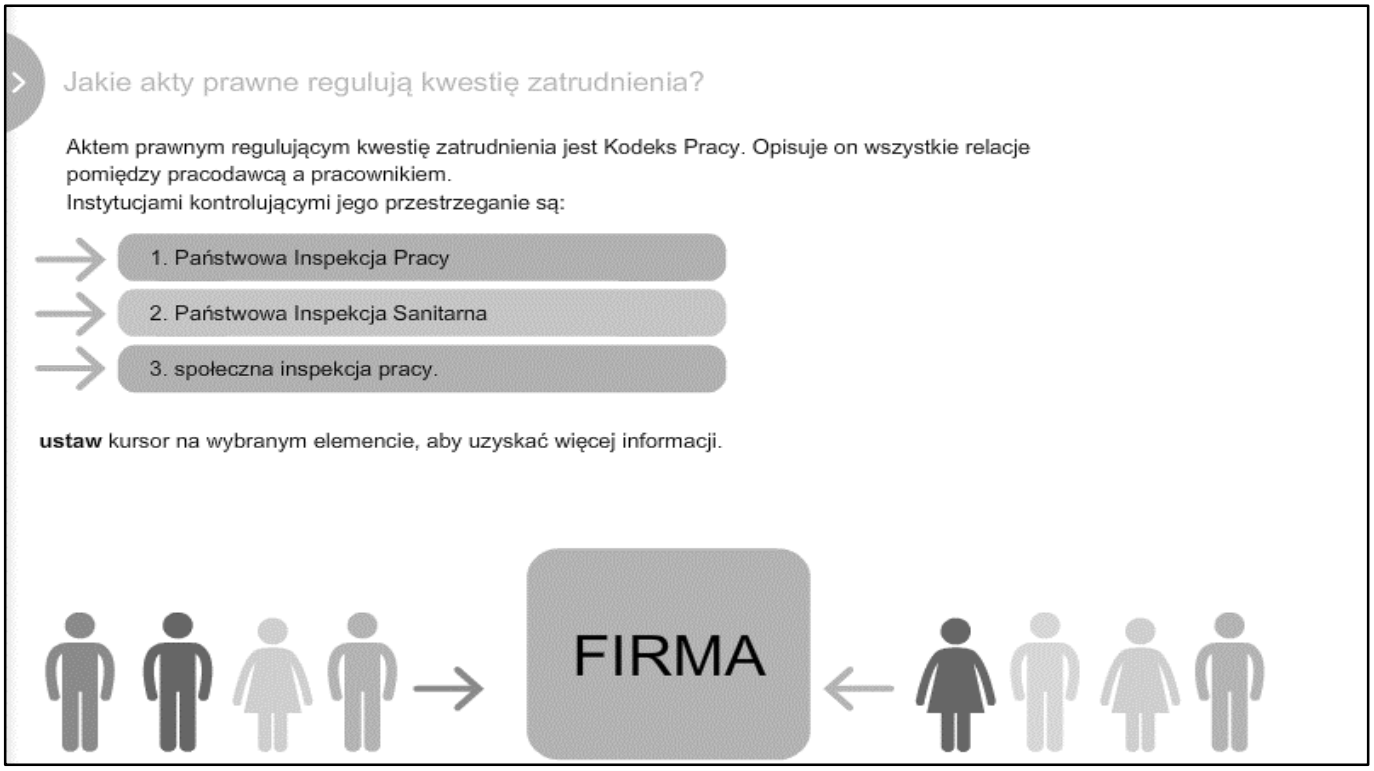
The repository consists of 169 online courses on Moodle platform for vocational education developed within the system project of the National Centre for Supporting Vocational and Continuing Education **'Model of the system of implementation and popularisation of distance education in lifelong learning'.**

The objectives of the project were as follows:

- popularisation and promotion of distance education in vocational education and continuing education,
- ensuring of high quality of distance education services through development of the standards for designing and conducting of e-learning courses,
- activation of institutions for implementation of distance education,

- improvement of the competences of the personnel of the educational institutions in the field of implementation and use of distance education.

The courses are dedicated mainly to the participants of qualification vocational courses but the individual course modules (presentations, films, podcasts, tests) may be also used successfully during school classes.



CONCLUSION

The authors have presented the proposition of research consisting in the design and evaluation of a training system in the scope of occupational health and safety with the use of ICT and e-learning at the heart of which i san e-learning course which contains a didactic module developing the employees' health and safety competences. It is enhanced by elements of programmed instruction which involves the principle of gradual increase in difficulty level. The presented proposition was developed on the basis of the experience gained during the research conducted as part of the PhD dissertation on the use of e-learning in mathematics teaching. It is also extension of one of the dissertation's final conclusions which postulate adaptation of the designed system of education not only at school or academic level but also in the scope of training on a variety of subjects in various business sectors, enterprises or in our case in the area of occupational health and safety. Working on an outline of the prepared project the following barriers have been identified in reference to the realisation of the project:

- lack of awareness among the managers and employees of enterprises of the need to educate and be taught how to learn,
- lack of awareness of the fact that e-learning constitutes an important element of raising competitiveness of the enterprise, management of knowledge and information,
- lack of ability and rules of e-learning based education with Focus on self-study, self-directed learning in particular,
- to the authors' knowledge there have not been developed any methodology of evaluation of the effectiveness of e-learning in the scope of occupation health and safety training, which would allow to collect and systemise appropriate data and evaluate the e-learning process.

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ENTERPRISE LECTURE CAPTURE TECHNOLOGIES AND VALUE TO STUDENT LEARNING

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ABSTRACT

Enterprise Lecture Capture technologies have increasingly become pervasive in higher education. This article presents student views on the value of recorded lectures and their contribution to learning. The research examines how students engage with recorded lecture materials and the likely of this engaging impacting on lecture attendance. The results suggest that students found access to recorded lectures valuable to learning. They reported that recorded lectures offer alternative learning opportunities for missed lectures and are useful in revising for exams. Analysis of the data further revealed that provision of recorded lectures to students does not directly contribute to class absenteeism. The present study adds to growing research evidence in support of the value of recorded lectures in enhancing student engagement with learning materials.

KEYWORDS

Enterprise Lecture Capture, Recorded lectures, flexible learning, engagement, learning.

1 INTRODUCTION

Enterprise Lecture Capture technology describes a group of emerging learning technologies (e.g. Echo 360, Podcast, recollect, e-presence or Camtasia). These technologies are used for recording audio, video, PowerPoint and events associated with learning. Further, educators use these technologies to produce learning materials to enrich face-to-face, online or blended learning environments (ELI, 2008; Larkin, 2010; Rui, Gupta, Grudin & He, 2004; Toppin, 2011; Zhang, Rui, Crawford, & He, 2008; Wald & Li, 2012). The rapid deployment of these technologies is attributed to students preference to courses that are accompanied by online recordings because it helps them effectively review missed classes (Daniel & Bird, 2016; Gorissen, Van Bruggen, & Jochems, 2012; Owston, Lupshenyuk & Wideman, 2011).

There is a large body of studies that suggests that students' engagement with recorded lecture materials improve learning. For example, O'Callaghan et al. (2015) conducted a systematic review of several research studies looking at the deployment of recorded lectures in higher education and benefits to student learning and concluded found that students find the availability of recorded lecture materials valuable to learning. Similarly, Yeung, et.al. (2016) recently reported that first-year students find the use of recorded lectures in blended learning context useful to learning. Research has also revealed that recorded lectures provide students with flexible learning opportunities because many students can conveniently access these resources through their mobile and ubiquitous devices (Manca, Caviglione, & Raffaghelli, 2016). Additionally, a recent review suggests that lecturers recognize the benefits of lecture recordings for students learning and

teaching opportunities afforded by these technologies (O'Callaghan, et. al., 2015). Despite the positive learning experience associated with engagement with recorded learning materials, there is a growing literature contesting access to recorded lecture materials and students engagement in learning. It has been argued that making recorded lectures available, disrupt lecture attendance (Chang, 2007; Stroup, Pickard & Kahler, 2012).

The article adds to the growing body of research on student engagement with recorded lecture materials. The goal of the study reported in this paper is to explore how students engage with recorded lecture materials and whether or not this engagement is likely to influence lecture attendance. The research aims to open dialogue on students' expectations of the digital learning environment and identify professional development opportunities for university teachers to engage with digital technologies in teaching effectively.

2 RELATED LITERATURE

Educational researchers have been questioning teacher-centric approaches to learning that focus on information transmissions, rather than active learning (Safari & Rashida, 2015). Due to the increasing diversity of students entering into higher education institutions, researchers have suggested the utilization of student-centred approaches, which involve active engagement in the classroom, encouraging students to be in control of their learning (Michael, 2006; Freeman et al., 2007; Chaplin, 2009). Subsequently, several institutions are actively exploring these approaches, together with strategies to transform learning environments through the use of digital tools (Walvoord & Johnson, 1998; Baker, 2000; Billings-Gagliardi & Mazor, 2007). Active learning approaches are student-centered, technology-rich learning environments. They involve the provision of blended and online learning environments (Green, 2015), supported by various forms of enterprise learning technologies (e.g. learning management systems, recorded lectures, class response systems). Blended learning environments provide students with flexible learning opportunities including access to various learning resources (McGarr, 2009).

Many institutions use Enterprise Lecture Recording technologies to support the pre-production of learning resources for blended learning environments. Institutions of higher education deploy lecture capture technologies in the classroom for the following reasons:

- to enhance student engagement with course materials and promote flexible access to learning (Al Nashash & Gunn, 2013; EDUCAUSE, 2008),
- enable students effectively revise for lectures and exams (Brooks, al et 2011),
- to allow students catch up on particular parts of lectures they might have missed during live lectures (Karnad, 2013; Marchand et al. 2014; Song, et.al, 2006),
- moreover, as a substitute for missing face-to-face lectures (Craig, et, al, 2009; Willing & Hofman, 2010).

Students access to recorded lecture materials show consistent patterns, with the highest peak normally seen at the beginning of the semester, dropping sharply in the middle of the semester, and rising at the end of the semester, nearing exams (Kinnari-Korpela, & Korpela, 2014; Phillips et al. 2011). However, there are exceptions in some domains (e.g. Medicine), when students are more likely to access recorded lectures even for a class they have completed (Perumal & Daniel, 2015). A substantial number of studies have revealed that students positively value the availability of recorded lecture materials (Dey, Burn, & Gerdes, 2009; Gosper et al. 2007; Green, Pinder-Grover & Millunchick 2012; Pale, Petrović, & Jeren, 2014; von Konsky, Ivins, & Gribble, 2009).

Absenteeism has been a significant problem in many institutions of higher learning (Chang, 2007; Devadoss & Foltz 1996; Romer, 1993). Researchers have linked absenteeism to poor learning outcomes (Devadoss & Foltz, 1996; Romer, 1993; St Clair, 1999; Thatcher, Fridjhon, & Cockcroft, 2007). A main outstanding debate in the literature related to the deployment of recorded lecture materials is that it is more likely to disrupt lecture attendance and exacerbate the issue of absenteeism. It has been argued that if recorded lecture materials are made available, then some students would treat them as a replacement for live lectures (e.g. Davis et al. 2009). Yet, some researchers found a weak correlation between student access to lecture materials online ahead of scheduled lectures and drop in lecture attendance (Traphagan et al. 2009; Walls et al. 2010). Others showed no significant effect on students access to recorded lectures and absenteeism (Holbrook & Dupont, 2009; O'Callaghan, et. al., 2015; Philips, et, al., 2011; Pursel & Fang, 2012; Traphagan, et, al, 2009; Yeung, 2016).

The issue of class absenteeism is significantly complex; students make deliberate decisions to attend or not to attend particular lectures, irrespective of whether or not they have access to recorded lecture materials in advance (Mattick, et al. 2007; Billings-Gagliardi, & Mazor, 2007). Many factors influence lecture attendance, including the quality of a particular lecture, conflicting deadlines on assignments in other classes, the lecturer's ability to engage, sustain and entertain students in class, and illness or bereavement (Van Blerkom, 1992; Clay & Breslow, 2006; Lovell & Plantegenest, 2009). This research is motivated by students' changing expectation of the digitalization of learning in higher education. It focuses on student experience with the provision of recorded lecture materials and the extent to which this disrupt regular attendance.

3 BACKGROUND TO THE STUDY

Students remain the main advocates in support of the use of recorded lecture materials. Enterprise Lecture Capture technologies provide educators with flexible ways to capture teaching and learning interactions. The research reported in the article is part of an ongoing research project in a teaching and research intensive public university in New Zealand, where teaching staff were provided with the opportunity to record lectures and make them available to students. This initiative is part of a wider institution redesign of the learning environment with aim supporting the digital learning environment.

3.1 Research Questions

The research project reported in this article sought answers to the following issues:

1. What are students' perceptions of the value of recorded lectures to learning?
2. How are students engaging with recorded lectures?
3. Will provision of recorded lectures contribute to lecture attendance?

4 METHODS AND PROCEDURES

This study is guided by a survey research design, utilizing an online questionnaire with closed and open-ended questions. By employing a multi-model approach to data collection, qualitative responses were used to explain the quantitative measures and to provide context for interpretation of the results. The development of the questionnaire involved reviewing current research studies on the utilization of recorded lectures and challenges associated with these learning resources. The questionnaire was designed to collect demographic data and students perceptions of the value of recorded lectures to learning. The recruitment procedure involved profiling all University courses (n=132) that were providing recorded lecture materials

to students. Academic staff responsible for each course was requested to send an email inviting students to participate in the survey online. A total of 228 students voluntarily participated in the survey.

5 DATA ANALYSIS

The questionnaire generated quantitative and qualitative data analyzed concurrently. Specifically, the responses to closed-ended questions were analyzed using IBM SPSS 22, with descriptive statistics used to summarize the results. Moreover, responses to open-ended questions were compiled and thematically analyzed using NVivo software. The process involved reading and re-reading the open-ended responses (Brauan & Clarke, 2006), themes were identified within segments of texts associated with the closed-ended questions and coded for prevalence as well as the frequency of occurrences. Table 1 presents respondents' demographic information.

Table 1. Respondent demographics

Category	Respondents (n, %)
Division	
Health Sciences	(120, 58.8)
Sciences	(48, 21.5)
Commerce	(26, 11.7)
Humanities	(16, 7.2)
I don't know	(12, 5.4)
Year	
First year	(66, 30)
Second year	(60, 27)
Third year	(64, 28)
Fourth year	(17, 8)
Other	(15, 7)
Technology usage	
Laptop	(211, 93)
Desktop computer	(46, 20.2)
Tablet	(35, 15)
Smartphone	(31, 14)
Other smart device	(4, 1.8)
Other	(3, 1.3)
Age range	
17-24	(202, 89.8)
25-34	(14, 6.2)
35-44	(6, 2.7)
45-54	(2, 0.9)
55+	(1, 0.4)

6 RESULTS

Overall results indicated that the availability of recorded lecture materials significantly contributes to student learning. They serve as revision tools and help students to engage with the content of the subject deeply. Recorded lecture materials also set the stage for improved engagement between students and lecturers. Further, the provision of recorded lectures to students ahead of scheduled lectures does not necessarily result in absenteeism. The proceeding sections present detailed results along the three research questions.

6.1 What are students' perceptions of the value of recorded lectures to learning?

Recorded lecture materials offer students numerous opportunities to access and review learning materials. Respondents stated that they strategically use recorded lectures to foster deep learning. As a tool, these materials help them in revisiting complex concepts they might have missed during lectures. Furthermore, respondents said the availability of recorded lectures after scheduled lectures offer an opportunity to concentrate on listening to the lecture instead of taking notes during lectures. Access to recorded lectures helps students to plan their schedule and efficiently manage time.

> *"Allows me to search and review when having difficulty understanding. It is less stress to write things down during the lecture so that you can listen! When I can progress through course material at my pace, I feel like I am making good use of my time, which is very rewarding and makes me more excited to engage with the material because it is at a suitably challenging level."*

> *"In one of my subjects, I struggle with the material, so it makes a huge difference being able to hear it again before a tutorial. It leads to better grades in my tutorial. I can go back and answer questions and come up with better, more informed questions for a lecturer."*

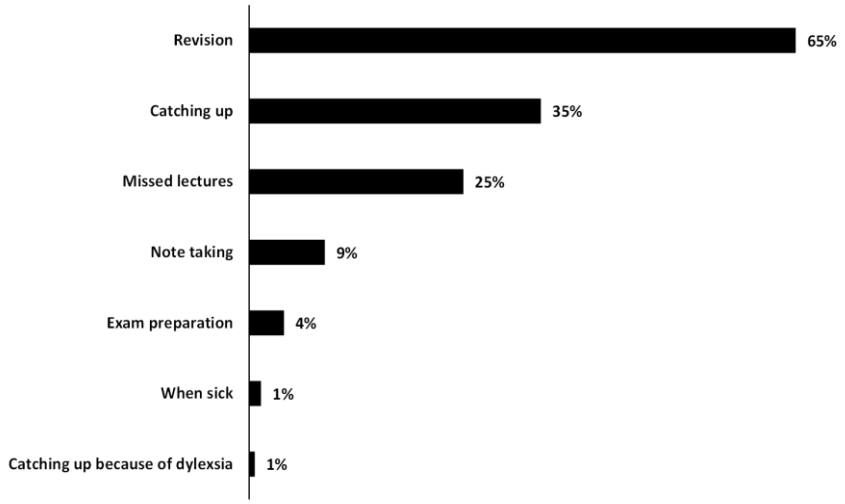
Results of the survey (see Table 2) are consistent with the observations that recorded lectures augment live lectures. A significant number of respondents reported that recorded lectures helped them to effectively review lecture content (194, 85%), and to be able to get back with highly complex issues they might have grappled with during lectures (173, 76%).

Table 2. The most useful aspects of recorded lecture materials to learning

Why I use recorded lectures	Total respondents (n, %)
Being able to review the lecture again	(194, 85)
Being able to review the clarification of issues or questions	(173, 75.9)
Flexibility of where I can listen to the lecture anywhere anytime	(150, 65.8)
Revision for exams	(105, 46.1)
Being able to listen instead of also taking notes in lectures	(78, 34.2)
So that I do not have to go to lectures	(24, 10.5)
Other	(14, 6.1)

Further, the availability of recorded lectures online provided students with the flexibility to access learning materials across time and space (anytime and anywhere) (150, 66%). Over half of the students mentioned that they use recorded lecture materials when studying for exams (105, 46%). Several Themes describing various purposes for using recorded lectures were identified in the data (see figure 1). Among them, the revision was the most predominant use of recorded lecture materials.

Figure 1. Major themes: I use recorded lectures for:



Recorded lectures help students with learning disability (e.g. listening, language or motor skills) to tackle the challenges of taking notes and listening to the lecturer.

> *"I am dyslexic, and for some lectures, it is tough to take notes because of the pace of speech or the complexity of the words I am trying to write down or a combination of both. This was the case when I took a law class, and I believe I would have failed the second semester if lectures were not recorded."*

> *"It is helpful to listen to recorded lectures because of my dyslexia I cannot take down all the notes from the actual lecture, so I need to review the lecture on the stuff I missed out on to supplement to notes."*

The analysis examined whether the year of study differs with perceived value of recorded lectures, a Chi Square test was conducted. Results showed that first year students(66), second year students (60) and third year students (64) were more likely to value recorded lectures, compared to students in the final year (fourth year) of their programme (33); ($x2 = 100$, $df=25$, $N=227$, $p\leq0.05=0.001$). Further, the Phi value seems to suggest a strong (0.67) and significant ($p\leq0.05=0.001$) relationship between students perception of the value of recorded lectures and the year of study.

6.2 How students engage with recorded lectures?

Respondents held a consistent view on the value of recorded lectures to learning across divisions (see figure 2). Four levels of engagement with recorded lectures were identified: engagement with content, engagement with the lecturer, and engagement with peers (see Table 3).

Figure 2. Student engagement with recorded lecture and improved learning

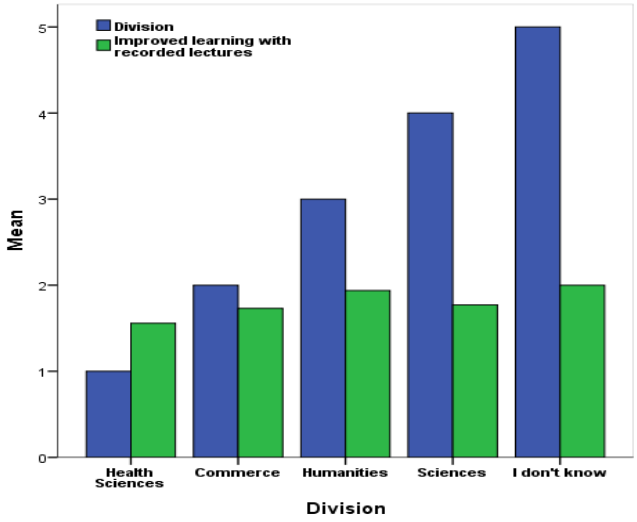


Table 3. Contribution of recorded lectures to learning by year of study

Current year of study	Respondent (n, %)	Median	Std. Deviation
First year	(66, 29.5)	1	0.84
Second year	(60, 26.8)	2	0.92
Third year	(64, 28.6)	1	0.69
Fourth year	(17, 7.6)	2	0.64 1.25

Time of access to recorded lecture materials was also identified as a crucial element in the extent to which these resources can have on student learning. Respondents' different time preferences to access recorded lectures, with the majority in favoring access after scheduled lectures (152, 67%). Others said they prefer access to these materials anytime during the semester (53, 23.3%). Respondents also stated that they better engage with the content of a lecture when they were able to view the recorded materials in conjunction with other learning materials (see Table 4).

Table 4. Use of recorded lecture materials

How I use recorded lectures	Respondents (n, %)
In conjunction with other study related materials (e.g. notes, textbook)	(194, 85.1
During my study time at the University	(165, 72.4)
In my leisure time at home	(127, 55.7)
In conjunction with other social media	(36, 15.8)
While I am doing other things	(26, 11.4)
During lectures	(19, 8.3)
Other	(7, 3.1)

6.2.1 Engagement with the subject

A large number of those who filled in the survey reported that the use of recorded lectures improved engagement with the subject (181, 80.4%). They were able to review and listen to recorded lectures to be better understand what the lecturer said in class.

> *"Sometimes lecturers talk quite fast and move on before you have time to write everything down. Having the lectures available makes it easier to catch key information because you can pause the recording and write it down with your notes before hitting play again. You are allowed to digest the material at your speed, so you understand it more thoroughly."*

> *"For lectures where much material is covered, or that where I am finding it a bit harder to understand, recorded lecture materials are great to use after going to the lecture. Also, a couple of times I have decided not to go to class and use the time to work on an assignment due that day, because I know I can have access to materials later and get good notes. That way I was able to manage my time effectively."*

6.2.3 Facilitating engagement with Lecturer

Respondents did not have a shared view on whether or not recorded lectures helped them engage with the lecturer. Over a third (78, 35%) reported access to recorded lectures helped them connect with the lecturer and ask specific questions on concepts they did not fall under in lectures. Others mentioned that access to recorded lectures did not contribute to better engagement with the lecturer of the course.

> *"As I can listen more attentively to the lecture, I can pick out the parts that I find the most difficult more easily and then I can ask the lecturer more precise questions after, rather than general issues that may have arisen due to focusing on writing notes and missing key information…."*

> *"When I review the lecturers material I get more familiar with how the lecturer presents information in the lecture theater, and ultimately facilitating my learning."*

> *"Recorded lectures are far more helpful when the audio is accompanied by the visual of the lecture slides; it makes it easier to use the recording because you are not distracted by trying to keep up with what slide the lecturer is on."*

6.2.4 Facilitating engagement with peers in and outside of class

The survey asked students whether the use of recorded lectures improved their engagement with peers. A large number (114, 50.7%) stated it did not. However, a small number (30, 13.3%) said access to recorded lecture materials helped them to engage effectively in discussions with peers. Others were indifferent to this question.

> *"If I am listening to the recording because I am sick and not attending, then I am not engaging with my peers. However, as the recording helps me understand the material more thoroughly, I engage more with my peers because I am more confident in the material and ask more questions. I also think that the ability to review information and better understand it leads to a better discussion with peers*

> *"When studying in groups...I can pause the lectures and discuss questions with classmates, which I am unable to do during the lecture. I do now write down questions I think of during the lecture to ask later on."*

6.3 3. Will provision of recorded lectures ahead of scheduled lectures affect lecture attendance?

Significantly a larger majority (204, 90%) of respondents stated that attending lectures is crucial to their learning. They mentioned that they view the availability of recorded lectures as supplementary to live lectures rather than a replacement. They also said they felt obligated to attend lectures because they pay fees to learn from lecturers in class rather than listening to audio or video transcripts on their own.

> *"I think skipping lectures is a waste of time; it is easier to learn it from the lecturer rather than have to do it in your own time. Recording help with being able to listen again and pick up things you may have missed while you were writing notes in the lecture."*

> *"I pay for a lecturer to teach me, why not show up prefer lectures, doesn't matter and I do not like being "behind" whatever how hard we study, and the school does not want us to pass at all.*

> *"I pay for the lectures, the immersion and experience and knowledge from the lecturers and university environment, not for the equivalent of a long YouTube video. Furthermore, readings are provided for each lecture that is for preparation before the lecture, making both available before the lecture would make one of them.*

Some respondents mentioned that the availability of recorded lectures online did not stop them from attending lectures, because they believe they learn better during lectures as more information is often presented during lectures.

> *"Having the lectures available online is no replacement whatsoever to physically being at the lecture. A lot more details are processed and understood in the actual lecture theater itself. The physical act of going also reinforces to the brain that the lecture theater is a place of learning and hence will absorb more information."*

Respondents also mentioned that attending live lectures offers them an opportunity to socialize with other students, facilitating the collaborative learning experience. They also mentioned that going to the lectures provide them numerous opportunities to engage with peers, share knowledge and ask the lecturer questions during lectures.

> *"Going to lectures gives you the opportunity to ask questions and draw any diagrams from the overhead projector that are not on the recording. Going to the lecture also ensures that at least you have learned something instead of putting it off until later. Recordings are an aid, nothing else."*

> *"In my experience so far, I have found the recorded lectures very useful if used as a resource to support and further enhance learning. It has most definitely helped me numerous times and solved the problems I was having regarding not understanding/having questions."*

Although a significant number of respondents indicated that recorded lecture materials are supplementary to live class, there was a small number (22, 11%) who in contrast saw these materials as a replacement for live lectures.

> *"If recorded lectures are made available, I will feel as though probably wouldn't attend the lectures because I would have all the content online. Then again, I would still think of attending the lectures as I would be able to ask the lecturer questions about the material I have not understood and sometimes the lecturer may vary their lecture."*

> *"Access to recorded lectures gives an excuse not to go if I am running late or have something else on. But if recorded lectures are not made available, I feel that going to the lecture is my number 1 priority, but if they are provided, then my priorities might change."*

6 DISCUSSION

Lecture Capture technologies such as videographers, Echo360 can record a vast amount of information for a variety of purposes. Research suggests that these technologies provide educators, administrators, and students with a set of powerful tool for enhancing the educational experience (DeSantis, et al. 2011). For this reason, the number of teaching and research intensive institutions are increasing utilizing these technologies to record their teaching activities and making them available to students. Observational studies on student engagement with recorded lectures consistently report positive learning outcomes (Grabe, & Christopherson, 2008; Traphagan et al. 2009; Walls, et al. 2010).

Consistent with the evidence available in the literature, a significant number of respondents in the research reported in this article viewed recorded lectures positively. They said that the availability of recorded lectures afforded them with most needed flexible access to learning anywhere and at any time. Results of the analysis also showed that students use recorded lectures primarily for revisions, especially when preparing for exams, with a small number of students who reported using recorded lectures as supplementary for missed lectures, or aid for clarifying issues missed during lectures. Though the majority of respondents viewed the availability of recorded lectures as complimentary to attending live lectures, some view recorded lectures as a substitute for scheduled lectures.

Further, contrary to previous studies suggesting that low achieving students are more likely to benefit from lecture recording (Kinnari-Korpela & Korpela, 2014; Owston, et al. 2011), results of this study revealed that all respondents highly value the contribution of recorded lectures to their learning. Availability of recorded lectures can foster effective student engagement with learning. The majority of those surveyed in the study reported that the ability to access, especially after lectures improved their engagement with the content of learning materials, and improved their interaction with the lecturer. Further, respondents stated that the availability of recorded lectures provided them with an opportunity to attentively listen to the lecturer during lectures, instead of listening and taking notes at the same time. Also, students found recorded lecture materials useful in facilitating active learning in collaborative spaces, and vibrant discussion on difficult topics.

Lecture attendance and absenteeism (see, for example, Moore, et. al., 2008) though linked, they individually complex phenomena are bound to happen in any educational system, irrespective of the implementation of any particular learning technology. In this research, a significant number of students indicated that access to recorded lectures is unlikely to diminish their lecture attendance. Instead, these resources enable them to effectively manage their learning environment and actively negotiate their individualized learning pathways.

7 LIMITATIONS AND CONCLUSION

In the last decade, Enterprise Lecture Capture technologies have increasingly become pervasive in higher education, because of their maturity and ability to capture and generate high-value content of teaching and learning activities. These technologies provide educators with flexible and innovative approaches to recording live classrooms and distributed them to students through many channels (e.g. Learning Management System).

This research broadly explored how students view the value of recorded lecture materials toward their learning. The research examined how students engage with these materials, and whether or not providing them with these materials can influence their lecture attendance. This research contributes to the growing evidence of the value of recorded lectures to student learning. However, results presented in this study should be generalized with caution, as positive perceptions of the value of recorded lectures may not necessarily contribute to improvement in learning outcomes. More research is needed to examine access analytics on recorded lectures and their correlations with student grades. In the future, it is also important to observe how students engage with recorded lectures in various forms of learning environments (formal, informal, and non-formal and online blended). Furthermore, future studies will explore how lecturers engage with recorded lectures in their teaching.

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CRITICAL FACTORS FOR IMPLEMENTING BLENDED LEARNING IN HIGHER EDUCATION

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ABSTRACT

The use of blended learning environments in higher education has rapidly increased in the 21st century. Tools and techniques that initially were used in experimental distance education courses are today part of mainstream education with blended learning as a continuum between traditional face-to-face teaching and pure online courses. In this wide variety of course design there are success stories, but at the same time examples with low pass rates and poor learning outcomes.

The research question for the study is: Which aspects have to be considered in the design and implementation of blended learning in higher education? To answer this question, 15 selected publications were analysed in a literature review with the aim to identify important and critical factors when implementing blended learning in higher education.

As a result of the inductive analysis around 50 found factors have been grouped into 10 Categories of critical factors and 4 Blended learning perspectives in a strive to identify critical aspects of contemporary blended learning in a comprehensive structure. One conclusion is that blended learning today can be seen as a mature educational concept still in need of redesign. Problems that were reported two decades ago are now combined with other more recently identified critical factors. The presented categories and perspectives might be valuable as a checklist for implementations of blended learning and hopefully a useful base for further research in the field of blended learning.

KEYWORDS

Blended learning, Technology enhanced learning, E-learning, Higher education

1 INTRODUCTION

Blended learning in higher education has rapidly increased in the 21st century and as pointed out by Garrison & Kanuka (2004) the adoption of blended learning approaches in higher education is inevitable. From being an experimental concept in distance education courses, blended learning are today part of mainstream education. In a broad definition blended learning could be seen as the continuum between traditional face-to-face teaching and pure online distance courses (Watson, 2008) but the more complex definition must also include the concept of integrating the strengths of synchronous and asynchronous learning activities in a thoughtful design (Garrison & Kanuka , 2004).

The synchronous and asynchronous teaching and learning design could be seen as part of the technological and multimodal dimension in Picciano's (2009) conceptual blended learning model. There is no single type of blended education, and along the continuum from fully online to fully face-to-face extremes there will probably be a growing number of variations. Online curricula will evolve as a natural component of

instruction design at the same time as an increasing number of primarily distance-based programs can include face-to-face teaching components (Watson, 2008).

In this wide variety of instructional design several success stories have been identified, but at the same time there are many reports on failures in design as well as in the implementation of blended learning. There is an obvious economical aspect of the shift to blended learning, but in this study the focus is on the factors that are important for improving the teaching and learning quality, with decent pass rates as well as teacher and student satisfaction.

1.1 Research question

Which factors are critical and have to be considered in the design and implementation of blended learning in higher education?

In the 21st century there has been a rich plethora of blended learning setups tested in various parts of the world. This literature study has strived to identify the lessons learnt and best practices for the identified critical factors.

2 METHOD

This study was carried out as a literature review with a design inspired by the methods that earlier has been used by Wu, Chiou, Kao, Hu, and Huang (2012) and by Schweighofer and Ebner (2015). In this study the adapted method consists of the following four main steps:

1. Definition of Blended Learning
2. Definition of search strategy
3. Definition of selection criteria
4. An inductive data analysis

2.1 Definition of Blended learning

Blended learning has been a constant hype in the 21st century and sometimes so widely defined that it makes it hard to find any learning system not included (Graham, 2006). To meet the aim of the study and try to identify as many aspects as possible, the term Blended learning is in one dimension broadly defined as "The convergence of online and face-to-face Education" as in the study by Watson (2008). At the same time it is important to also include the dimension of technology and media use as it has been depicted in the multimodal conceptual model in Figure 1 below. This conceptual model was proposed and presented in an article published by Picciano (2009).

In this study Picciano's conceptual model has been used in the analysis of findings and discussions in the selected articles. One of several interesting aspect of Picciano's conceptual model is the distinction in the lower right corner between asynchronous and synchronous teaching and learning technology. Another Picciano concept is whether the use of a high degree of media infusion can meet the different needs and different learning styles in today's heterogeneous student groups.

Even if the concept of different learning styles has been questioned in later research it makes sense to care about student variations in study techniques and their various choices of paths through a given course content. It is also important to involve the third quadrant in the model with media infused teaching and learning activities in face-to-face sessions.

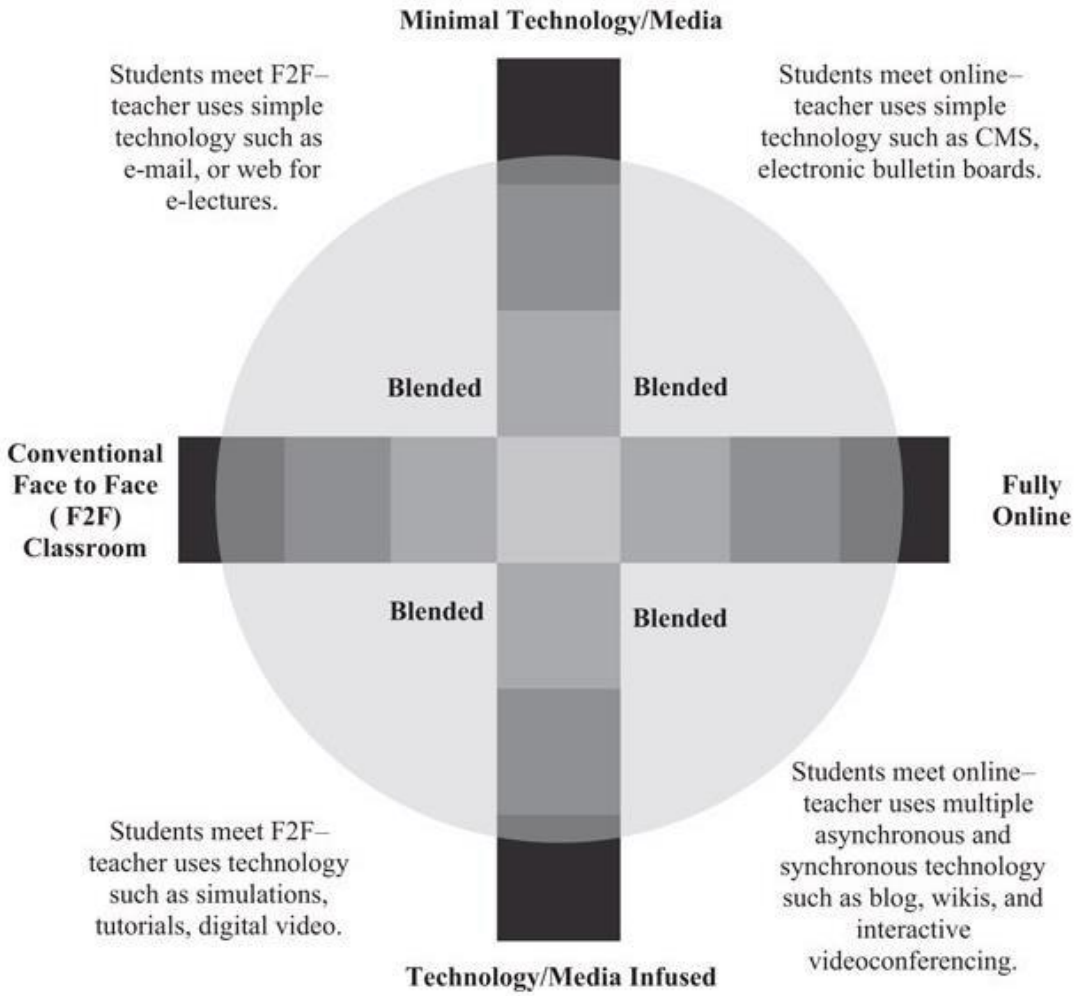

Figure 2 Picciano's conceptual multimodal model

2.2 Definition of the search strategy

To answer the research question and to construct an appropriate definition of blended learning, publications have been found with the following search strings:

1) "Defining Blended Learning"

2) "Defining Blended Learning" and "Higher Education"

3) "Blended Learning" and "Critical Factors" and "Higher Education"

2.3 Definition of selection criteria

Inclusion and exclusion criteria for publications to be part of this study are as below:

- Publications have to be in English
- Publication have to have a relation to the field of blended learning as it is defined for the purpose of this study
- Publications have to address one or more factors that could possibly be considered when implementing blended learning approaches **or** add to the discussion on the definition of blended learning

- To assure a relevant analysis of the current state of blended learning at least one third of the articles should be published in 2016-2017

In a strive of holism, publications should preferably have a methodological and geographical spread. The number of citations and articles ranked in the Norwegian list have also been considered, but it has always been how the publications have analysed and discussed factors or approaches in the field of blended learning that has mattered the most.

2.4 Data analysis

Selected papers have been analysed inductively without any pre-definition of main variables. The overall strategy of a qualitative and inductive analysis is to allow important analysis dimensions to emerge from found patterns, without presupposing what the most important dimensions should be (Quinn, 2002). During the analysis these patterns and their synonyms, hyponyms and hypernyms were collected, compared and clustered to form categories or analysis dimensions. Furthermore, the qualitative analyst has tried to seek and find inter-relationships between the emerging dimensions, as it is recommended without any pre-constructed assumptions (Quinn, 2002).

3 SELECTED PUBLICATIONS

In Table 1 below selected publications are listed in chronological order with number of citations, rank in the Norwegian list of publications, locale of study, methodology and contributions. The aim is to provide an updated analysis of the current state of blended learning but some older seminal papers are included for background and definition of terms. In the Norwegian list of accredited scientific journals, series and publishers, publication channels can be ranked as Level 2 (highest), Level 1 or Level 0 (unranked).

Based on the search strings and selection criteria described under 2.2 and 2.3 and a removal of irrelevant publications the following 15 articles were selected, but the analysis is also based on articles that are referred to in the selection presented below. This has been carried out as a 'backward reference search', a technique that involves identification and examination of references or works that are cited in an article. This is a way to learn more about the development of knowledge on a topic and to identify to identify experts in the studied domain (Webster & Watson, 2002; Steiger, Albuquerque, & Zipf, 2015; Machi & McEvoy, 2016).

Table 1 Sample of Publications on Blended Learning

Author(s)	**Year**	**Citations**	**Rank N L**	**Locale of study**	**Methodology / Data collection**	**Main findings / Contributions / Critical factors**
Garrison & Kanuka	2004	2197	L 1	Canada	Literature study / Position paper	Early definitions. Learning outcomes, and student satisfaction
Graham	2006	1575	L 0	US	Literature study / Position paper	Reasons for Blended learning, Definitions & visions

Watson	2008	201	L 0	US	Position paper	Definitions & visions, Teacher role Classroom design
So & Brush	2008	644	L 2	Singapore	Mixed Methods, Survey, Interviews	Course structure, Emotional support, Communication and Social presence
Picciano	2009	165	L 1	US	Literature study / Position paper	Definition, Conceptual model Learning styles, Multimodality
Kim, Kwon & Cho	2011	168	L 2	South Korea	Survey / Question-naires	Media integration & instructor's quality teaching - related to social presence and learning satisfaction
Al-Busaidi	2012	33	L 1	Oman	Survey / Question-naires	Critical factors in VLE learner perspective
Al-Busaidi & Al-Shihi	2012	43	L 1	Oman	Survey / Question-naires	Critical factors - instructioner / teacher perspective
Lin & Wang	2012	104	L 2	Taiwan	Mixed Methods	A blended learning framework
Garner & Rouser	2016	1	L 0	Australia	Qualitative case study-Qualitative survey	The balance between F2F on campus contact and asynchronous learning
Chen & Yao	2016	3	L 1	Malaysia	Survey-questionnaires	Design for the younger generation
Shand, Glassett-Farrelly & Costa	2016	1	L 1	US	Small sample Survey	Principles for redesign of Blended learning

Raphael & Mtebe	2016	0	L 1	Tanzania	Mixed methods	Instructors' support services
Thai, De Wever, & Valcke	2017	0	L 2	Vietnam	Quasi experiment	Flipped classroom concept
Fleming, Becker & Newton	2017	0	L 2	Australia	Online survey	Low complexity, authenticity and technical support are more important factors than age

The idea with a methodological spread is that the different research approaches together should reveal more critical factors than a study with less approaches would do. Several quantitative and several qualitative studies have investigated the same themes but with different methods for data collection. Not all studies show an excellent research design but all of them have contributed with critical factors worth considering in the implementation of blended learning.

The idea with a geographical spread is that studies from different regions with cultural and infrastructural variations would reveal more critical factors than a selection with less diversity. However, studies from different areas of the world often tend to focus on the same factors, but that the same factors sometimes are more relevant or important in specific contexts. As intended and later confirmed there are definitely lessons to learn from studies in other parts of the world.

4 FINDINGS AND DISCUSSIONS

As pointed out in the article by Chen and Yao (2016) a tendency in past studies on blended learning has been to identify and discuss factors that focus primarily on technology. On the other hand, one finding is that there are several studies that argue for the need to focus on pedagogy and learning objectives and not solely on technology (Hoffman, 2006; Garrison & Vaughan, 2008; Alammary et al., 2014; McGee & Reis, 2012; Shand, Glassett Farrelly & Costa, 2016). Other findings in this study are that technology still is a critical issue (So & Brush, 2008; Fleming, Becker & Newton, 2017), not least in developing regions (Al Busaidi & Al-Shihi, 2012; Raphael & Mtebe, 2016), and also the more positive idea of technology as a supporting factor for innovative didactics and instructional design to satisfy the needs in heterogeneous student groups (Picciano, 2009).

Methodology used in the analysed publications show large quality variations both when it comes to design and descriptions. In the Level 2 publications the research design is well described and thoroughly carried out, but these well-designed studies have not always contributed with the most interesting or surprising findings. The most obvious finding is the unexpected complexity of blending learning and the amount of found critical factors and themes. In an endeavour for a holistic multi-stakeholder presentation, found factors and themes have been grouped into 10 Categories of critical factors and 4 Blended learning perspectives.

4.1 Categories of critical factors

1. Technology - virtual learning environments and media integration

There exist, as mentioned above, a large number of studies that focus on the technological aspects of blended learning. As mentioned by Chen and Yao (2016), it is important to look at other aspects as well,

but since technology is the basic ingredient that is blended with traditional learning it will be a critical factor in all implementations and cannot be neglected. In the history of blended learning, a wide variety of technologies such as television, computers, presentation software, and simulation programs have been tested during the years with a varying degrees of success (Picciano, 2009).

Since blended learning is based on web-based learning content and communication, it relies on a learning management system (LMS) or a virtual learning environment (VLE) to structure content and to facilitate interaction (Watson 2008; Garner & Rouse, 2016). The success of a LMS or a VLE in academic institutions may initially be based on teachers' and instructors' acceptance, but in the long run it is the learners' continuous acceptance and use that matters (Al-Busaidi, 2012). Teachers and learners always have different perspectives on the usefulness of involved technology, but what they have in common is that their computer anxiety, technical pre-knowledge and personal innovativeness are critical factors in their attitudes (Al-Busaidi, 2012; Al-Busaidi & Al-Shihi).

A study by So & Brush (2008) found that the participants with the lowest expectations on the investigated course where the ones that had encountered technical problems in previous blended learning experiences. What seems like a wise principle is to start blended courses with an orientation that informs students on how to use non-trivial online components, or to include digital tutorials in the online environment (Hoffman, 2006; Garrison & Vaughan, 2008; Shand, Glassett-Farrelly & Costa, 2016). There is also an identified need for technical support for teachers and instructors (Raphael & Mtebe, 2016).

2. Didactics - pedagogy, instructional design and the teacher role

One of the most frequently cited reasons for implementing blended learning is the possibility for more effective pedagogical practices, but online learning often suffers from cognitive overload by making large amounts of information available (Graham, 2008). There are many research articles advocating various pedagogical models such as constructivism, constructionism, connectivism or problem based learning, but the online part of blended learning should rather focus on didactics in a mix of ideas from various pedagogical models like it has been suggested by Terry Anderson (2008).

Instead of selecting a pedagogical model that could fit all blended learning implementations the choice of critical factors should rather be a selection of instructional design and teacher activity. Studies indicate that instructors' characteristics such as attitude, teaching style, control and responsiveness are important (Al-Busaidi, 2012) and that instructor's teaching quality are affecting students social presence as well as learning satisfaction (Kim, Kwon & Cho, 2011). Furthermore, students have a need to feel confident that teachers' feedback to concerns, assessment outcomes and guidance should be timely and responsive. (Garner & Rouse, 2016)

A condensed and useful guideline for instructional design might be Shand, Glassett-Farrelly & Costa's (2016) second principle of blended learning redesign:

"Content delivery mechanisms, student engagement activities and assessments should be based on course content, learning needs of students, and pedagogical affordances of the designated technology tools" (Garrison & Vaughan, 2008; Massie, 2006; McGee & Reis, 2012; Means et al., 2013)

3. Course outcomes - learning outcomes and learner satisfaction

To achieve maximum outcomes of blended learning the approach should be to primarily focus on learning outcomes (Alammary, Sheard, & Carbone, 2014; Shand, Glassett-Farrelly & Costa, 2016) and that blended

learning design/redesign should start by identifying key learning outcomes (Garrison & Vaughan, 2008; Shand, Glassett-Farrelly & Costa, 2016). Active engagement, collaboration and social presence have been identified as a contributors to successful learning outcomes (Parker, Maor & Herrington 2013; Garner & Rouse, 2016). Collaboration and social presence will be elaborated in the fourth category.

Beside the importance of concrete learning outcomes, a critical factor is to consider learner satisfaction. According to the study by Diep et al. (2016) instructor expertise, students' perceived task value and achievement goals are the most important factors to achieve learner satisfaction. Furthermore, there are findings indicating that student perceptions of collaborative learning in blended environments have positive relationships with perceptions of social presence and student satisfaction (So & Brush, 2008). A way to stimulate social presence and learner satisfaction could be to increase the use of media technology (Kim, Kwon & Cho, 2011), another is to care about feedback to students' concerns and queries, (Garner & Rouse, 2016).

4. Collaboration and social presence

The described importance of teacher-student and student-student interactions in learning processes indicates that e-learning alone is unlikely to be the most effective teaching and learning strategy (Rhem, 2012; Chen & Yao, 2016). A study by So and Brush (2008) found that students with high perceptions of collaboration in the learning process also perceived high social presence. Sometimes neglected emotional support is an important factor to reduce students' sense of distance in online learning environments. Their recommendation is a course design that provides such socio-affective interaction (So & Brush, 2008).

This article can only partially answer the important questions posed by Graham (2008):

- "When and why should we be considering human interaction such as collaboration and learning communities?"
- "How does live interaction versus low fidelity, asynchronous interaction affect the learning experience?"

Collaboration and interactivity among course participants could be seen as a catalyst for social presence but not necessarily leading to learner satisfaction (Kim, Kwon & Cho, 2011). To enable interaction and social presence are important factors in blended learning environments (Garner & Rouser, 2016), but not every course outline needs to require students to do group work or rely entirely on reflective activities (Picciano, 2009).

5. Course design

This is the central category that has to consider and combine all critical factors from all other categories. Appropriate course design has to include relevant multimodal technology didactics that support collaboration and active learning for successful course outcomes. The recommendation is to use a combination of synchronous and asynchronous activities, in a stepwise implementation that avoids trends and hypes to assure learning quality within the existing economic constraints in higher education.

The course structure is a critical factor related to students' perceptions of collaborative learning, social presence, and satisfaction (So & Brush, 2008). Blended course design must connect the face-to-face and online components with a meaningful flow from one medium to the next providing the students different paths through the course content (Shand, Glassett- Farrelly & Costa, 2016). One of the analysed articles claims that the younger generation demands a new redesign (Chen & Yao, 2016), another claims that age is not the critical factor and that main issues to consider are low complexity, authenticity and technical

support (Fleming, Becker & Newton, 2017). Finally, in analogy with recommendations for all types of educational contexts quality learning content is essential (Lin & Wang, 2012).

6. Synchronicity vs. asynchronicity

An effective blending of synchronous and asynchronous features can create confidence and support students' peer interaction (Hrastinski, 2010). A study by Garner and Rouser (2016) recommends a balance between traditional face-to-face activities that offers a richness of human interaction and technology enhanced asynchronous online activities. Relationships between students, teachers and peers created by the traditional synchronous interaction will later be carried over into the asynchronous online instruction making students feel more confident in their online engagement (Garner & Rouser, 2016).

The question that remains is whether the synchronous interaction should be created online like it is depicted in Picciano conceptual model or if asynchronous online activities might be combined with synchronous offline activities as suggested by Garner & Rouser (2016). Maybe answer can be Picciano's idea that the course design and the teaching tools should support the learning outcomes and not necessarily be the same in all courses (Picciano, 2009).

7. The heritage from technology enhanced distance courses

Even if blended learning can be seen as a concept that complements and cures some main issues in technology enhanced distance courses several critical factors are inherited from pure online distance education. Low complexity, authenticity and technical support seem to matter in all forms of technology enhanced learning (Fleming, Becker & Newton, 2017). To avoid earlier detected problems such as learners getting stuck in a state of confusion (Hara & Kling, 2000) or with a feeling of loneliness and boredom (Brown, 1996) blended learning must, like distance education, be designed with a human touch, otherwise there is a risk for low motivation (Keller & Suzuki, 2004).

Whether the course mode is face-to-face or online, three critical aspects are: the cognitive aspect, the social aspect, and the teaching presence and if neglected this will affect learning outcomes, student satisfaction and completion rates (Garrison & Kanuka, 2004). Studies report that technology enhanced courses in general (Chen & Yao, 2016) and MOOCs in particular still have a lower completion rate than traditional face-to-face courses with 5% seen as a high completion rate for MOOCs (Holland, 2016). A percentage impossible to accept in any form of traditional higher education.

8. Multimodal overloading

Studies indicate that students tend to be more socially engaged and satisfied with their learning with dynamic and interactive media formats. This may include asynchronous discussions, facilitating interaction, and involving useful resources in forms of graphics and audio or video files. (Kim, Kwon & Cho, 2011) Another promising multimodal blend is to involve game-based learning which also can be designed as collaborative learning and student interaction (Babu et al., 2016). It seems strategically wise for institutions to emphasise on multimodal dimensions in the redesign of blended learning environment especially if the course content should attract the younger generation as well (Shand, Glassett-Farrelly & Costa, 2016; Chen and Yao, 2016).

Picciano (2009) claims that in today's heterogeneous student groups, learners are representing various generations, different personality types and different learning styles, teachers and instructional designers ought to use multiple approaches and multiple modalities. Even if several later studies denies the idea of learning styles, students with different background have different needs and study techniques. A

recommendation for redesign is that learners should be provided with multiple paths through the course content, and preferably through different media, to better construct their knowledge (Shand, Glassett-Farrelly & Costa, 2016). To overload multiple approaches and modalities is often costly and time consuming, but also a best practice for instructional design.

9. Trends and hypes

Like other mature concepts blended learning has its trend and hypes. One trend seem to be that blended learning, that initially was a way to enhance traditional learning, now use the blend to balance online distance learning with face-to-face activities (Garner & Rouser, 2016). This seems like a sensible way to handle many of the issues that are discussed above under Category 7.

The strongest current hypes seem to be MOOCs (Massive open online courses) and the concept of 'The Flipped Classroom'. Author's opinion is that the positive reports on implementations of the flipped classroom concept (Herreid, & Schiller, 2013; Thai, De Wever, & Valcke, 2017) are worth further attention, if the concept involves more than just adding pre-recorded videos. Despite the fact that the concept shares the problems with other methods that depend on students preparing outside of class (Herreid, & Schiller, 2013), most blended learning researchers seem to view the flipped classroom as *"a strategy that nearly everyone agrees on"* (Slomanson, 2014).

MOOCs do not have the same consensus and after the initial celebrations when the concept was launched in 2011, there are now more critical opinions as well. The MOOC concept has been criticised for doing things more cheaply (Waldrop, 2014), but also for the low pass rates and poor quality (Holland, 2016).

10. Economy

There are several reasons for implementing blended learning and cost effectiveness has always been a major goal in higher education as well as in companies (Graham, 2006). The early view of technology enhanced learning as a simple way of making money has later been contradicted by low completion rates, high initial costs for preparing learning content and substantial costs for system maintenance (Rhem, 2012; Chen & Yao, 2016). Still there are many examples of low-budget implementations but the lesson learnt is that initial investment and careful time consuming course design pays off in the long run.

4.2 Blended learning perspectives

In blended learning as in many other areas there are multiple stakeholders and that successful outcomes often can be achieved with a multi-stakeholder approach. Author's suggestion is to consider the following four perspectives.

1. The University perspective

Maybe that the most obvious perceived advantage of e-learning is that factors such as enrolment, administration, delivery and assessment can all be automated and placed online. A fact which theoretically removes the upper limits on student enrolment (Holland, 2016). While the university perspective often is to increasingly look for innovative ways to make courses more accessible for students, the Teacher and the Learner perspectives must include to increase social presence and learner satisfaction (Garner & Rouser, 2016).

There are several reasons for universities to get involved in blended learning, two of them are the potential for pedagogical richness and the access to knowledge. At the same time two other reasons are cost

effectiveness, and the ease of revision (Graham, 2006). Another reason is to open up for lifelong learning and that older students tend to enjoy the flexibility of asynchronous online activities (So & Brush, 2008).

2. The Learner perspective

If the quality of blended learning environments do not live up to the same standards as traditional educational settings, blended learning is not an interesting alternative for most learners. Updated learning material of high quality is always a prime factor for the learning outcomes (Lin & Wang, 2012) and so is the quality of the virtual learning environment (Lin & Wang, 2012; Al-Busaidi, 2012). But blended learning must not only be about distributing learning content or activities (Graham, 2006) and should also include students' social and emotional needs (Picciano, 2009).

As blended learning evolves it should stay learner centred (Watson, 2008), but to achieve learner satisfaction there are also needs for discussions, collaboration and emotional support (So & Brush, 2008). To attract the younger generation is one reason for redesign of blended learning (Chen & Yao, 2016), but a better practice would be to look at the redesign issues that are common for all age groups (Shand, Glassett-Farrelly & Costa, 2016).

Two other promising ideas to make blended learning more attractive are to involve more relevant media technology (Kim, Kwon & Cho, 2011), and to care about students' need of feedback and guidance (Garner & Rouse, 2016). Teachers need to present a human face to students and share their personal experiences of the subject to create a reciprocal relationships that can inspire learner engagement with improved learning outcomes (Garner & Rouse, 2016).

3. The Teacher perspective

There are some obvious benefits from the university perspective and from the learner perspective but in a multi stakeholder approach there must be something for the teachers as well. The findings from a study by Al-Busaidi & Al-Shihi (2012) indicated that important factors to address from a teacher or instructor perspective are:

- Computer anxiety
- Learning environment quality
- Technical support
- Management support
- An incentives policy

There is also an identified need to provide professional development for online teaching (Graham, 2006) and to provide a model for teacher and instructor support (Raphael & Mtebe, 2016). Furthermore, teachers' satisfaction was found to be a significant factor for their motivation for further use of blended learning environments (Al-Busaidi & Al-Shihi, 2012). There are several obvious reasons for universities and learners to shift to blended learning but the incentives for teachers are not always that easy to find.

A Swedish longitudinal case study found that teachers choice of tools and technology in a virtual learning environment were dependent on the impact on their workload. Conclusions are that some kind of incentives for lecturers are needed if educational institutions should be able to offer students' a richer possibilities for collaboration and interaction. (Garrote Jurado, 2012) To motivate teachers to involve in blended learning by offering some incentives has also been suggested by Lin and Wang (2012).

4. The Global perspective

One strength of blended learning is the ability to find, reuse and rapidly distribute learning content. Yet, there is mostly a need to customise the content to the local cultural context (Graham, 2006). The same need for adaption to different regions and cultures can be identified for virtual learning environments and learning management systems as well (Al-Busaidi, 2012). For an emerging region with a teacher shortage it could be tempting to set up conveyor belt model of course content production, but without local adaptation the result can be stereotypical and decrease the learning potential (Mozelius & Hatakka, 2009).

In several developing regions with a shortage of teachers blended learning approaches adapted to the local conditions have opened up for a higher intake to tertiary education (Mozelius & Hatakka, 2009; Raphael & Mtebe, 2016). Learning management systems have a promising potential for developing countries, as it provides tools to build human resources (Al-Busaidi, 2012) and support the idea of education for all. On the other hand, rural regions with poor infrastructure often have the most urgent need for a support model (Mozelius, 2014; Raphael & Mtebe, 2016).

5 CONCLUSIONS AND FUTURE WORK

The chosen mix of quantitative and qualitative studies have been fruitful and also a way to strengthen the validity of findings. Early studies with a high number of citations are mostly conducted without detailed method descriptions but this kind of positional papers seem to get more readers and citations than the more thoroughly conducted studies. Publications that are ranked as Level 2 in the Norwegian list generally have a more rigorous research design and more detailed descriptions in the method chapters. However the first conclusion is that the mix of methods and also the geographical spread for the studies were a way to reveal more critical factors than what would have been the case with publications with less variety.

Blended learning is a complex field without any silver bullet that guarantees success, and factors that lead to success in one of the described perspectives might be problematic from another. The early view of blended learning as a concept where technology could replace teachers and save money has been replaced with a more mature view where the teacher / instructor role is as important online as in face-to-face activities (Lin & Wang, 2012; Garner & Rouse, 2016). Blended learning today is a mature concept, but still with a need for redesign (Shand, Glassett-Farrelly & Costa, 2016). With the advancement of technology and to build a bridge between face-to-face learning and fully online learning, blended learning was introduced which had a rapid increase of usage. In summary, blended learning could be seen as the continuum between traditional face-to-face teaching and pure online distance courses.

A found consensus is that all of the selected publications consider the blend of face-to-face sessions and online activities better than just one of them, if the implementation is carefully done. As with a fully online learning environment, even a blended learning environment face challenges. In this paper, based on the past research that has been carried-out, in order to address our research question, we have analysed the critical factors associated with designing and implementing blended learning in higher educational context. These critical factors can be grouped into 10 categories as technology, didactics, course outcomes, collaboration and social presence, course design, synchronicity vs. asynchronicity, the heritage from technology enhanced distance courses, multimodal overloading, trends and hypes, and economy.

Economy and cost efficiency is, as always, important to consider but the conclusion is that initial planning and investment is the recipe that pays off in the long run. Recommendations are to consider all found categories mentioned above and also the four various perspectives analysed such as the university

perspective, learner perspective, teacher perspective, and global perspective. All found categories have interdependency and the fifth category might be renamed from 'Course design' to 'Implementation' as an aggregation of all the other categories.

It can be argued that search criteria as well as the selection of publications could have been carried out differently. There are also reasons for extending the selection to be able to find more factors, categories and perspectives, but the choice was also based on time constraints. Hopefully, found categories and perspectives might be useful for future studies in the field of blended learning.

5.1 Future work

Nowadays, blended learning has become a worldwide trend and therefore, universities encourage their teaching staff to be more innovate by integrating ICT facilities through implementing blended learning solutions into their teaching practices. Also, teaching staff need to be the forefronts in implementing blended learning in their courses. Considering the above, based on the findings in this study, it would be interesting to further explore the teacher role and teachers' view on blended learning implementations in higher education. An idea could be to do use a mixed method approach with questionnaires followed up with interviews. The analysed publications are not without a teacher/instructional designer/subject matter expert perspective but it could be of value to investigate bottlenecks and if there exists a need for further training and support. Teachers and instructors trained for traditional face-to-face environments do probably not have the appropriate sets of skills and knowledge for blended environments.

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