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E- ASSESSMENT WITH MULTIPLE-CHOICE QUESTIONS: A 5 YEAR STUDY OF STUDENTS' OPINIONS AND EXPERIENCE

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ABSTRACT

Aim/Purpose	The aim of this study is to understand student's opinions and perceptions about e-assessment when the assessment process was changed from the traditional computer assisted method to a multiple-choice Moodle based method.
Background	In order to implement continuous assessment to a large number of students, several shifts are necessary, which implies as many different tests as the number of shifts required. Consequently, it is difficult to ensure homogeneity through the different tests and a huge amount of grading time is needed. These problems related to the traditional assessment based on computer assisted tests, lead to a redesign of the assessment resulting in the use of multiple-choice Moodle tests.
Methodology	A longitudinal, concurrent, mixed method study was implemented over a five-year period. A survey was developed and carried out by 815 undergraduate students who experienced the electronic multiple-choice questions (eMCQ) assessment in the courses of the IS department. Qualitative analyses included open-ended survey responses and interviews with repeating students in the first year.

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Contribution	This study provides a reflection tool on how to incorporate frequent moments of assessment in courses with a high number of students without overloading teachers with a huge workload. The research analysed the efficiency of assessing non-theoretical topics using eMCQ, while ensuring the homogeneity of assessment tests, which needs to be complemented with other assessment methods in order to assure that students develop and acquire the expected skills and competencies.
Findings	The students involved in the study appreciate the online multiple-choice quiz assessment method and perceive it as fair but have a contradictory opinion regarding the preference of the assessment method, throughout the years. These changes in perception may be related to the improvement of the question bank and categorisation of questions according to difficulty level, which lead to the nullification of the 'luck factor'. Other major findings are that although the online multiple-choice quizzes are used with success in the assessment of theoretical topics, the same is not in evidence regarding practical topics. Therefore, this assessment needs to be complemented with other methods in order to achieve the expected learning outcomes.
Recommendations for Practitioners	In order to be able to evaluate the same expected learning outcomes in practical topics, particularly in technology and information systems subjects, the evaluator should complement the online multiple-choice quiz assessment with other approaches, such as a PBL method, homework assignments, and/or other tasks performed during the semester.
Recommendations for Researchers	This study explores e-assessment with online multiple-choice quizzes in higher education. It provides a survey that can be applied in other institutions that are also using online multiple-choice quizzes to assess non-theorical topics. In order to better understand the students' opinions on the development of skills and competencies with online multiple-choice quizzes and on the other hand with classical computer assisted assessment, it would be necessary to add questions concerning these aspects. It would then be interesting to compare the findings of this study with the results from other institutions.
Impact on Society	The increasing number of students in higher education has led to a raised use of e-assessment activities, since it can provide a fast and efficient manner to assess a high number of students. Therefore, this research provides meaningful insight of the stakeholders' perceptions of online multiple-choice quizzes about practical topics.
Future Research	An interesting study, in the future, would be to obtain the opinions of a particular set of students on two tests, one of the tests using online multiple-choice quizzes and the other through a classical computer assisted assessment method. A natural extension of the present study is a comparative analysis regarding the grades obtained by students who performed one or another type of assessment (online multiple-choice quizzes vs. classical computer assisted assessment).
Keywords	multiple-choice question, learning management system, Moodle quiz, e-assessment, summative assessment

INTRODUCTION

The present paper's research was developed at the Porto Accounting and Business School (ISCAP) of the Polytechnic of Porto. ISCAP gathers around 270 teachers and 4,300 students who attend a variety of undergraduate and graduate programs, namely, Accounting and Administration (AA), International Commerce (IC), Administrative Assistance and Translation (AAT), Business Communication (BC), Management of Tourism Activities (MTA), Human Resources (HR), Library and

Information Sciences and Technologies (LIST), Creativity and Business Innovations (CBI), and Marketing (MK). ISCAP also offers Master Programs in Accounting and Finance (AF), Auditing (AD), Organizational Management (OM), Digital Marketing (DMK), Logistics (LG), Entrepreneurship and Internationalization (EI), Organizational Management (OM), Administrative Assistance (ADA), Business Information (BI), Finance (FI) and Intercultural Studies for Business (ISB).

The Information Systems (IS) department was responsible for this research and is composed of more than twenty lecturers teaching Information and Communication Technologies (ICT) to all degree programs at ISCAP. Some courses explore spreadsheets tools and other courses use Database Management Systems (DBMS) to solve management problems. These subject areas are taught to more than 1,000 students by 18 teachers and around 500 students by 10 teachers, respectively. Usually the lecturer teaching both subjects is the same.

The traditional method that had been used since 2000 in the IS department at ISCAP was the "Classical Computer Assisted Assessment" (CCAA), which was done by requesting the students to perform tasks directly in a DBMS or a spreadsheet. This assessment is held two or three times during the semester, depending on the course. Since the CCAA tests are performed mostly during lecture time and several times during the semester, this brings some issues that have to be solved. Namely, the difficulty to afford a computer per student; the great number of students in class which increases the possibility of fraud, such as cheating; the need of several exam shifts and consequently the need to construct as many different exams as the number of shifts may present difficulties concerning tests' homogeneity. Furthermore, the considerable amount of time spent by lecturers in the grading process cannot be overlooked, as at each assessment moment each student generates at least one file that needs to be opened and marked for each task. Aware of this reality, the department teachers felt the need to implement a new assessment method and realised that e-assessment would be the appropriate option.

In order to perform e-assessment, a group of teachers of the IS department decided to use the Learning Management System (LMS) Moodle to run mini-tests. Since 2006, this approach was being used, but to assess theoretical topics. These tests were composed of multiple-choice questions (eMCQ). However, to apply this approach to assess practical topics, a new assessment method had to be implemented. In Babo and Azevedo (2013), there is the description of the method implementation, as well as the challenges and concerns derived from it.

Assessment is an important feature of education with deep implications for teaching and learning (Pereira, Flores, & Niklasson, 2016). The students' perceptions about the assessment affects their learning (Lynam & Cachia, 2018), therefore there was a need to understand the opinions of the people involved. This was the reason why Babo, Azevedo, and Suhonen (2015) and Babo and Suhonen (2018) have researched the opinions and perceptions of students and teachers, respectively, about e-assessment with MCQ. However, the study from 2015 was limited to a group of 84 students of the school year 2012/2013.

In this paper, we extend those studies to a larger number of students, from diverse courses and program degrees, along 5 school years, from 2012/2013 to 2016/2017. In addition, we crossed this information with that obtained from the teachers. The aim of this study is to understand the students' opinions and perceptions on the new assessment method. This method was implemented in an effort to improve the assessment procedures, by shifting it from the traditional assessment to e-assessment.

LITERATURE REVIEW

Since the focus of this paper is to gauge the opinions of students and teachers about the eMCQ assessment, there is a need to explain some concepts of the assessment sphere, such as the types of assessment: continuous assessment and e-assessment. Also, Learning Management Systems (LMS), Moodle, multiple-choice questions (MCQ), and Problem-Based Learning (PBL) need to be clarified.

Assessment and E-assessment

The awareness that assessment can improve education and help determine the learning outcomes of the individuals has been around for a long time. According to Pereira, Flores, and Niklasson (2015), the learning quality can be influenced by the assessment practices. It is an important instrument to assure that students attain the learning goals effectively. The assessment can also be considered as an essential part of the teaching and learning processes (Buzzetto-More & Alade, 2006; Kanwar, 2012; Wiliam, 2018).

Assessment models guide how the evaluators do or should do their evaluation practices. These models establish the "evaluation purposes", strategies, activities, and the people that participate in the assessment process, as well as "method choices, and roles and responsibilities of the evaluator" (Coryn, Noakes, Westine, & Schröter, 2011). According to Anh (2018), in the 40s, 50s, and 60s, there was the creation of several evaluation models. For educational and educational program evaluation purposes, the following models were developed: "Tyler's objective model, Stake's responsive model, Scriven's Goal Free model and Stufflebeam's CIPP model" (Anh, 2018, p. 140). Tyler's objective model conceptualised the evaluation as a comparison between the intended and the actual outcomes. This model considers "curriculum as a means of aiming toward an educational object." Tyler's model is best used when the evaluator needs to identify if the learning outcomes of the programs were met (Anh, 2018, p. 142; Tyler, 1949).

Stake's responsive model "sacrifices some precision in measurement, hopefully to increase the usefulness of findings to persons in and around the program" (Stake, 2011, p. 184). This model is based on "what people do naturally to evaluate things" (Stake, 2011, p. 185) and assumes that "there may be many valid interpretations of the same events, based on a person's point of view, interest, and beliefs" (Anh, 2018, p. 143). Therefore, the evaluator has to consider all these interpretations (Anh, 2018; Stake, 2011). The goal free model was developed by Scriven in 1972. This model focuses the evaluation on the educational outcomes (Anh, 2018). It is an evaluation where the "evaluator conducts the evaluation without particular knowledge of or reference to stated or predetermined goals and objectives" (Youker & Ingraham, 2014, p. 51).

The CIPP (Context, Input, Process, and Product) model is defined as a "comprehensive framework for guiding formative and summative evaluations" (Stufflebeam, 2003, p. 2). This model is based on "learning by doing" (Anh, 2018), since it emphasises "the evaluation of teaching learning and development process" (Aziz, Mahmood, & Rehman, 2018, p. 192) and provides a "view of every element by evaluating (…) from each and every angle" (Aziz, Mahmood, & Rehman, 2018, p. 192). The CIPP model also intends to make an effort to "identify and correct mistakes made in evaluation practice" (Anh, 2018, p .146) and, therefore, implement new and innovative practices.

Regarding the CIPP model, the assessment can either be formative or summative. According to López-Pastor and Sicilia-Camacho (2017), formative assessment is the method where, during the learning process, the teachers provide information to students in order to modify their understanding. It can also assist the teacher to adjust their teaching approach (Ferrão, 2010; Myers, 2013; Torres, Lopes, Babo, & Azevedo, 2011). Summative assessments "intend to capture what a student has learned, or the quality of the learning, and judge performance against some standards" (National Research Council, p. 25, as cited in Dixson & Worrell, 2016, p.156). In brief, formative assessment's purpose is the improving of teaching and learning, as well as the identification of students' difficulties, while the purpose of a summative assessment is to evaluate the learning outcomes and knowledge of students (Dixson & Worrell, 2016).

Both assessments can be used in a continuous assessment approach. It means that throughout the semester, as an alternative for a single final exam, there are several assessments (Day, van Blankenstein, Westenberg, & Admiraal, 2018). According to Tuunilaa and Pulkkinen (2015), continuous assessment can motivate students, because when teachers provide them with feedback, they are able to evaluate their learning and thus work harder. This type of assessment can also improve student

engagement, as well as help teachers to understand "what and how to teach" so that the learning development of students can improve (Day et al., 2018; Tuunila & Pulkkinen, 2015, p. 672). Therefore, continuous assessment can encourage more effective study behaviour and result in higher student academic achievement (Day et al., 2018).

With the development of technology, the urge to innovate assessment in education is essential. So, e-assessment has been replacing the traditional assessment. It can be described as an assessment that uses Information and Communication Technologies (ICT), which comprises the entire assessment process, since it is used for the presentation of assessment activity, designing assignments, recording of responses, and storing results. E-assessment can increase the efficiency and reduce the costs of assessment. The systems used for e-assessment are recognized as safe and suitable to the individuals' needs (Bahar & Asil, 2018; Joint Information Systems Committee, 2007; Okada et al., 2019; Ripley, 2017).

Past research has shown that students preferred e-assessment through MCQs and perceived it as adequate to test their knowledge (Ranganath, Rajalaksmi, & Simon, 2017). E-assessment was also found to improve students' engagement and learning (Holmes, 2015). Some reasons why students prefer this type of assessment over the traditional one is because of its fast feedback and learning benefits (Alsadoon 2017).

Learning Management Systems (LMS) And Multiple-Choice Questions (MCQ)

Learning Management Systems (LMS) are platforms that support e-assessment. LMS provide tools and functions to support teaching and learning. LMS can be defined as a "webpage with embedded instructional tools that permit faculty to organize academic content and engage students in their learning" (Gautreau, 2011, p. 2, as cited in Fathema, Shannon, & Ross, 2015, p. 210). According to Koneru (2017), Moodle (Modular Object-Oriented Dynamic Learning Environment) is an open source LMS that supports "self-assessment, peer assessment, formative, summative and competency-based assessment" (p. 129). It allows easy submissions of students' works and their management, as well as assessment and fast marking.

To perform e-assessments through the Moodle platform, there is the use of multiple-choice questions (MCQ) quizzes. These quizzes consist of several questions that have a set of possible answers. According to Holmes (2015), the students are more focused on understanding when learning for a MCQ assessment than when studying for a long answer assessment where they focus on remembering facts so they can reproduce it in their answers. This type of evaluation can be preferable because it can be less stressful and more convenient, the feedback can be given in a faster manner, and there is an easiness to access and submit. The evaluated can organise their own time to complete it, so it can be a more relaxed assessment, as well as be easier to focus (Holmes, 2015). In fact, answering a multiple-choice task is always more attractive and direct for students than when they are required to write (Smith & Karpicke, 2014). Those authors (Holmes, 2015; Smith & Karpicke, 2014) know that if the communication between students and teachers was performed by answering multiple-choice questions, they will have better results.

The e-assessment through MCQ quizzes has several advantages, such as the following:

> (a) its conditioning for automatic correction, which has contributed to the widespread use of this kind of assessment (Babo & Suhonen, 2018; Llamas-Nistal, Fernández-Iglesias, González-Tato, & Mikic-Fonte, 2013; Sorensen, 2013). "From the lecturers' point of view, this tool facilitates the classification and management of errors, guaranteeing the coherence of the grading and revision processes" (Llamas-Nistal et al., 2013, p. 86), and significantly reduces the burden associated with testing large student cohorts (Babo & Azevedo, 2013; Bull & McKenna, 2004, as cited in Nicol, 2007, p. 53);

(b) the reduction of the grading time (Babo & Azevedo, 2013; Babo et al., 2015; Douglas, Wilson, & Ennis, 2012; Maier, Wolf, & Randler, 2016, p. 86) and marking of exams with a greater accuracy than human markers (Douglas et al., 2012; Jordan & Mitchell, 2009, p. 371);

(c) the possibility of homogeneity through different tests, which provides the students with the same difficulty testing in the different assessment shifts, as well as enable fairness in the use of random questions (Babo & Azevedo, 2013; Sorensen, 2013);

(d) the enabling of a quick coverage of curricula, removal of the error of marking, and allowing the banking of items for future use (Ferrão, 2010).

However, there are some concerns about MCQ, such as:

(a) the 'luck factor', making it possible for a failing student to pass due to randomly selected questions, allowing better marks without the corresponding knowledge (Babo & Suhonen, 2018; Llamas-Nistal et al., 2013; Maier et al., 2016; Sorensen, 2013);

(b) the matter of using question banks, which are accompanied by a set of problems, such as being time consuming, problems associated with the difficulty of developing good MCQs, the likelihood of security issues, and consequences associated with system instability (Babo & Suhonen, 2018; Ellaway & Masters, 2008; Ferrão, 2010; Miguel, Caballé, Xhafa, & Prieto, 2015; Sorensen, 2013);

(c) the shortcomings of MCQs, such as "multiple-choice items trigger rote memorization instead of deep learning processes" (Douglas et al., 2012; Zlatovic et al., 2015, as cited in Maier et al., 2016, p. 86; Sorensen, 2013; Ventouras, Triantis, Tsiakas, & Stergiopoulos, 2010);

(d) the absence of the ability to evaluate other types of skills/competencies (the so-called 'soft skills') in comparison to other modalities of assessment, like open-response, traditional on paper tests, or even directly on applications (such as Database Management systems (DBSM) or spreadsheets) (Babo & Suhonen, 2018; Llamas-Nistal et al., 2013).

Some of these concerns can be solved, namely the 'luck factor', by using a "combination of bonus and penalty in the pairs of MCQs" also allowing several positive marked answers "without the need of negative markings for each wrongly answered question" (Ventouras et al., 2010, pp. 460-461). This penalty system can be a method to avoid these concerns (Babo & Azevedo, 2013; Triantis & Ventouras, 2012).

Babo and Azevedo (2013) address the problem of the question banks and the shifting of the assessment strategy from CCAA to the e-assessment by the application of the Action Research Methodology, in order to not only create and improve a questions database, but also to try to solve some of the problems associated with it to achieve a sustainable way of using Moodle Quizzes to assess students aptitudes.

To overcome security issues, Ellaway and Masters (2008) have proposed solutions, such as requiring student ID, turning off mobile phones and, in addition, using strong personal passwords and IP restrictions to reinforce security (Babo & Suhonen, 2018).

During the learning process, a student can acquire problem-solving skills, personal, social, and/or technological competences, and the "learning achievements", which are the "theoretical and methodical knowledge" (Paechter, Maier, & Macher, 2010, p. 223). The students can also attain planning skills, "experimental learning", "analytical techniques", "managing information", and "self-monitoring one's learning behaviors" (Fitó-Bertran et al., 2015, p. 911; Zheng, Ward, & Stanulis, 2019, p. 2).

Regarding the capability to gain skills and competencies through MCQs testing, it is possible to acquire learning achievements, managing information, and learning self-monitoring (Fitó-Bertran et al., 2015; Paechter et al., 2010; Zheng et al., 2020). Scouller (1998) affirms that these quizzes are only capable of assessing "knowledge-based or lower levels of cognitive processing" skills (p. 456).

According to Elmas, Bodner, Aydogdu, and Saban (2018), MCQ format testing is "incompatible in some contexts" (p. 20), since this format is "more likely to focus on primarily one skill" (p. 21), instead of several skills. Also, these types of tests encourage the memorization of information instead of factual recognition (Johnstone & Ambusaidi, 2000; Nicol, 2007).

Nonetheless it can be "the most convenient, fair, and inexpensive way to judge an individual's level of performance or readiness" (Elmas et al., 2018, p. 20) when the questions are well-constructed. It is crucial to have questions of high-quality to be capable of testing comprehension and application concepts, as well as assess higher cognitive levels of learning and "proficiency in applying knowledge" (Cerutti et al., 2019, p. 2). It should develop the skills necessary for students to "self-regulate their own learning" (Nicol, 2007, p. 54) and promote their "self-evaluation" (Kangasniemi, 2016, p. 1). It is also important to provide feedback on the answers in order to assist students in learning how to search (Kangasniemi, 2016).

In order to solve the lack of ability to evaluate other skills and competencies, as well as assess the learning outcomes, the teacher can implement other assessment tasks besides the tests, namely, systematic homework, where the student has several tasks to accomplish during the semester, or the development and presentation of a project. One example of a learning method to assist with the acquisition of skills and competencies is the Problem-Based Learning (PBL) approach (Babo & Suhonen, 2018). Several studies point out the benefits of PBL in the development of content knowledge, problem solving competencies (Alias, Masek, & Salleh, 2015) and soft skills (Tiwari, Arya, & Bansal, 2017).

Problem-based Learning (PBL)

Problem-based learning (PBL) is an instruction approach that is centred in the learner. It can be implemented in a wide variety of subjects and has been implemented in educational environments. With this approach, students are presented a problem or a question where they have to collaborate, generate work, and show results. By striving to solve the problem, the learners are also engaging in active learning, since it facilitates the activation of previous knowledge, and are applying it to solve the assigned problems. They are encouraged to conduct research, where theory and practical knowledge has to be integrated, and at the same time they are able to develop skills to reach a solution to said problem (Khoiriyah & Husamah, 2018; Loyens, Jones, Mikkers, & van Gog, 2015; Savery, 2015).

In PBL, students are asked to work in small groups, in which they have to participate in discussions and arguments to find the best solution to the problem (Loyens et al., 2015). This collaborative work can assist the students in gaining content knowledge and problem-solving competencies (Alias et al., 2015); as well as, communication skills, data collection, analytical, and presentation skills (Tiwari et al., 2017).

Moreover, the PBL method can contribute to the development of learning skills, namely, critical analysis of arguments, deeper understanding of the scientific perspective, cognitive engagement, process, and content skills. All these skills and competencies can be important in the professional future of the students, since it will assist them to overcome challenges (Frank & Barzilai, 2004; Khoiriyah & Husamah, 2018; Loyens et al., 2015).

Methodology

Context of the Study and Participants

The research presented in this paper was developed at the Information Systems Department of IS-CAP. The assessment method performed in the IS Department was redesigned. The use of MCQ as summative e-assessment quizzes were delivered at three different moments, throughout the semester. They were implemented with the Moodle quizzes tool to assess the pre-defined learning outcomes.

During the test, the students could use DBMS or spreadsheet tools, which enabled them to perform similar tasks on a quiz. Also, a PBL project was used to provide the students with the opportunity to solve a practical management problem with spreadsheets or DBMS tools.

The final grade in the continuous assessment approach is achieved by the summative assessment and a PBL project. The summative assessment performed through "individual MCQ e-assessment quizzes" has a weight of "about 60% to 70%" (Babo & Suhonen, 2018, p. 10). The remaining 40% to 30% are obtained in a PBL project. A detailed explanation concerning the CCAA and e-assessment with MCQ is provided in Babo and Suhonen (2018).

Having begun a broader process of shifting the assessment procedures from the traditional assessment (CCAA) to e-assessment with eMCQ based on Moodle quizzes, it is crucial to recognise the views of the people involved (Babo & Azevedo, 2013; Babo et al., 2015; Maier et al., 2016; Sorensen, 2013; Stödberg, 2012).

The main goal of the current study is to gain awareness around stakeholders' opinions about the e-assessment procedures in an integrated way. To achieve this purpose, the main core of this research – to present a quantitative study on students' opinion about the new assessment with eMCQ across five academic years - is intersected with the insights obtained from teachers and students' interviews. Thus, this study is part of a broader investigation that was carried out in several steps over the years. To better understand the development of the research, a timeline with the various phases of the study is presented in Figure 1.

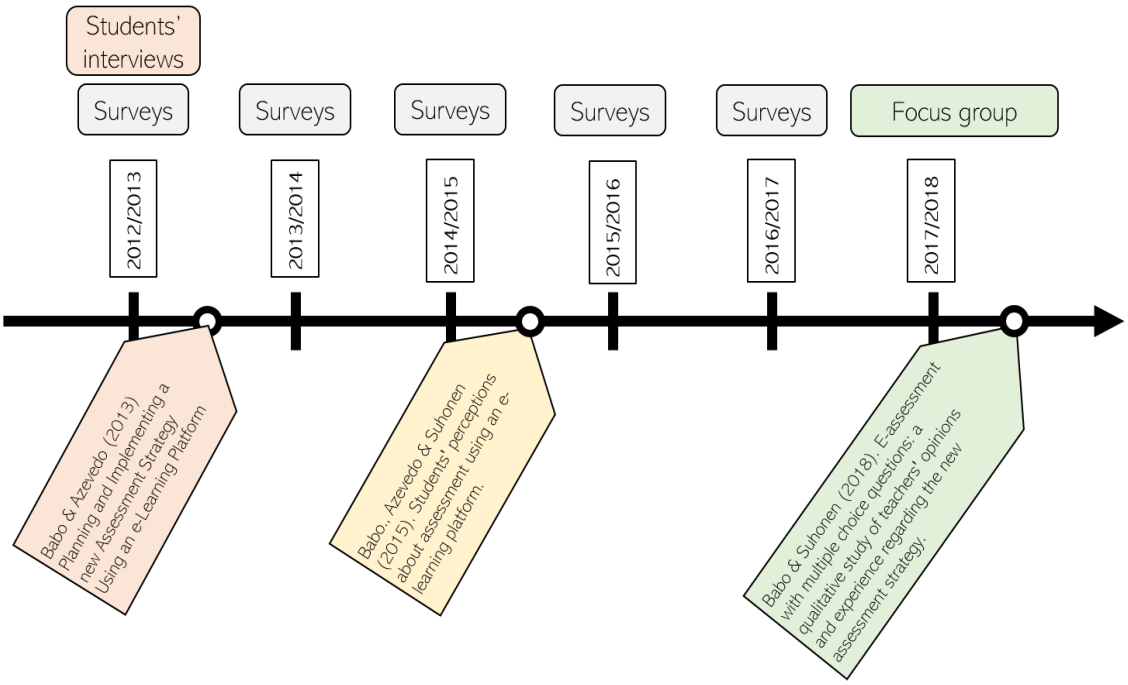


Figure 1. eMCQ design, implementation and analysis research timeline

The population involved in the quantitative study falls within the universe of students enrolled in the courses of the IS department from the programs Accounting and Administration, International Commerce, Administrative Assistance and Translation, Business Communication, and Marketing at ISCAP. The subjects covered in the e-assessment are spreadsheet and DBMS applied to solve practical management problems. At the end of each semester all the students who experienced the eMCQ assessment were invited to complete a survey to express their views on the new assessment method. Only fully completed questionnaires were considered valid for the study, a total of 815 in the five-year period.

As the sample taking part in the study varied depending on the year, the characterisation of each sample is presented in Table 1 for a better visualisation. We can observe that in the first year the study sample consists of N = 52 individuals (53.8% female and 46.2% male) enrolled in the Information Technologies (IT) course of the Marketing (MK) degree and is the object of a former study in Babo et al. (2015). In the following years, the number of students involved increased.

Table 1. Respondents Students' Samples to Satisfaction Survey over years

	N	Female (%)	Male (%)	Assessment Subject	Program Degree
2012/2013	52	53.8	46.2	Excel	MK
2013/2014	205	54.8	45.2	Excel	MK
2014/2015	312	61.5	38.5	Excel, Access	MK, AA, IC
2015/2016	95	57.8	42.2	Excel, Access	MK, AA, IC, BC, EI, ADA
2016/2017	151	65.4	34.6	Excel, Access	MK, AA, IC, BC, EI, ADA

In the years of 2012/2013 and 2013/2014, only the degree of Marketing (MK) used eMCQ tests. Throughout the years, this assessment was applied to other program degrees. In 2014/2015, Accounting and Administration (AA) and International Commerce (IC) degrees were added. And in the following two years, Business Communication (BC), Entrepreneurship and Internationalization (EI), and Administrative Assistance (ADA), were also added.

Instruments and Procedure

As mentioned earlier, the aim of this research is to understand the students' opinions and perceptions about the new assessment method based on eMCQ.

To study the subject, we combine a qualitative approach with a quantitative approach, making use of mixed methods. We adopted this methodology because mixed methods allow a more complete and comprehensive view of the problem under study (Creswell & Plano Clark, 2011), and several authors highlight the value and advantages of using these methods in various areas such as social and behavioural sciences (Tashakkori & Teddlie, 2003) and education (Ahn, Cox, London, Cekic, & Zhu, 2014). Thus, a longitudinal, concurrent, mixed method study was implemented over a five-year period, from 2012/2013 to 2016/2017. A survey was developed and carried out by 815 undergraduate students. Qualitative analyses included open-ended survey responses and interviews with repeating students in the first year.

The largest body of this research consists of the quantitative analysis of the data collected through surveys carried out by the students. In order to ascertain how students felt about the e-assessment (eMCQ), a survey was conducted at the end of each semester over five academic years. An online survey performed in the LimeSurvey application was used to discover the students' opinion about the new assessment procedure. Online surveys present numerous benefits in terms of cost, time, ease of administration, data organisation, and analysis (Dermo, 2009; Gill, Leslie, Grech, & Latour, 2013).

Furthermore, in order to gain insight into the theme under discussion in the present paper, interviews were also conducted with a group of students who had experienced both assessment methods in the year 2012/2013.

Interviews are a practical and efficient process for gathering data in qualitative research. The main goal was to collect data about human experiences such as "emotions, beliefs and behaviours" and to reduced bias (Castro, Kellison, Boyd, & Kopak, 2010, p. 2). Semi-structured interviews are valuable and flexible instruments that allow the researcher to explore the issues under investigation in more detail and to clarify some misunderstandings.

DATA ANALYSIS AND RESULTS

As mentioned previously, this study is part of a larger process of shifting the assessment procedures from the CCAA to e-assessment and intends to analyse students' opinions about e-assessment.

The present research took shape with a previous study focused on teachers' opinions on the same matter (Babo & Suhonen, 2018), in which a focus group methodology was used to gather valuable information. The focus group methodology allowed the researcher to analyse, select, and organise data into four main variables representing the participants' opinions about the new e-assessment procedure, namely Students' Attitudes (V1), Assessment Process and Skills (V2), Grading Process (V3), and Work Load/Question Bank (V4). Each of the categories includes specific topics, presented in Table 2, intended to develop a better understanding of the main study's considerations.

Table 2. Summary of the concepts resulting from the teachers' focus group analysis grouped in categories and topics
(Source: Babo & Suhonen, 2018).

Variable/ Category	Topic	Explanation
V1: Students' Attitudes	Random students complain about the new type of assessment.	Students are the main receivers of eMCQ assessment through Moodle quizzes. Therefore, their opinion about this new evaluation method should be measured and studied, regarding future improvements.
V2: Assessment Process and Skills	Students' random answers matching the correct answer. Better marks than the correspondent knowledge. Assessment skills are the same as the traditional assessment.	It is important to analyse which skills are developed and required by a type of assessment based on eMCQ through Moodle Quizzes. Subsequently, there is also a need to balance the new type of evaluation with the traditional one (CCAA).
V3: Grading Process	Less effort in the grading process. Higher objectivity in the grading process. Test homogeneity.	Grading is an essential stage of the assessment process. Hence it is relevant to consider the effort devoted to the grading process, as well as its objectivity and test homogeneity.
V4: Work Load/ Question Bank	Designing a question bank involves a lot of effort.	eMCQs in Moodle need an accurate, complete and well-designed question bank, which involves many working hours to categorise and design the questions.

SURVEYS

The data collected from the surveys across the five years are presented and analysed in this section.

The process of collecting quantitative data began in 2012/2013 and was developed along subsequent years until 2016/2017. In the first year, a pilot study was performed with 84 students in the Marketing degree at ISCAP.

From the pilot study it was concluded that students had positive perceptions regarding the issue eMCQ summative assessment performed within Moodle platform (Babo et al., 2015). Some negative perspectives of the students about this kind of assessment that were also identified are related to the short time to perform the test and with the servers' instability.

The results from the pilot study in the first year were encouraging, therefore the research proceeded and was extended. In the following years, it was targeted towards a larger number of students enrolled in diverse courses and program degrees involving a total of more than 800 students.

The online survey consisted of several questions (closed and open-ended) separated into three sections: students' characterisation, students' opinion about the new assessment strategy with eMCQ, and an open-ended question which allowed personal comments. Some problems identified in the pilot study, namely, about the servers' instability, were solved and questions regarding this were deleted in subsequent editions of the questionnaire.

The eight questions regarding students' opinion about e-assessment supported by eMCQ formed the main part of the research data. These items were measured on a five-point Likert scale (with 1 = strongly disagree and 5 = strongly agree) and the reliability of this scale was calculated using Cronbach's alpha. The values found for this measure are acceptable (Cortina, 1993).

The questions were made considering the Stufflebeam's CIPP Model. According to this model, the evaluation has to take into account "each and every angle" (Aziz, Mahmood, & Rehman, 2018, p.192). Therefore, students' opinions on whether they enjoy these tests are important, and the perception on easiness or difficulty of the tests have to be measured. When the students "like" this type of tests, it shows that the evaluation process is enjoyable, and when they enjoy the tests, they are happy with the process and/or results (Aziz, Mahmood, & Rehman, 2018). When students affirm that the tests are very easy or very difficult, it is possible to "identify … mistakes … in evaluation practice" (Anh, 2018, p.146), and thus the teacher may understand where there is the need for correction.

Starting with a descriptive statistical analysis, Table 3 provides information on means, standard deviations (between parentheses) and Cronbach's alpha of the different items in the survey over the five years.

Table 3. Students' opinion about eMCQ e-assessment

	2012/2013 N = 52 α= 0.74	**2013/2014 N = 205 α= 0.80**	**2014/2015 N = 312 α= 0.76**	**2015/2016 N = 95 α= 0.70**	**2016/2017 N = 151 α= 0.74**
I like this type of test (Q1)	3.83 (1.05)	3.38 (1.26)	3.34 (1.18)	3.63 (1.15)	3.62 (1.16)
This type of test is fair (Q2)	3.77 (0.97)	3.11 (1.28)	3.09 (1.20)	3.34 (1.25)	3.37 (1.23)
This type of test is easy (Q3)	2.87 (0.83)	3.04 (1.19)	2.98 (1.07)	3.24 (1.15)	3.39 (1.07)
I would prefer the traditional kind of test, similar to the practice in the classroom (Q4)	2.23 (1.15)	3.14 (1.38)	3.21 (1.37)	3.27 (1.18)	3.25 (1.35)

	2012/2013 N = 52 α= 0.74	2013/2014 N = 205 α= 0.80	2014/2015 N = 312 α= 0.76	2015/2016 N = 95 α= 0.70	2016/2017 N = 151 α= 0.74
With traditional test my final grade would be lower than with this type of test (Q5)	3.19 (1.27)	2.68 (1.39)	2.56 (1.21)	2.51 (1.16)	2.41 (1.27)
The time to answer the test is insufficient even for someone very well prepared (Q6)	3.42 (1.08)	2.85 (1.34)	2.97 (1.36)	2.85 (1.26)	2.96 (1.37)
I would like to have more time to answer the test, thus I would obtain better results (Q7)	3.78 (1.14)	3.20 (1.41)	3.41 (1.37)	3.27 (1.25)	3.47 (1.30)
If it were possible to choose, I'd like the next test to be evaluated directly with exercises in software, such as those in class (Q8)	2.08 (1.22)	3.02 (1.43)	2.94 (1.41)	3.05 (1.25)	3.11 (1.35)

For a better understanding, data is summarised in Figures 2 and 3 displaying the mean scores. Items considering students' perceptions about eMCQ are displayed in Figure 2, and items related with the time to answer the summative test in Moodle are shown in Figure 3. Thus, when the students agree with the statement of an item, a high value for the mean is expected. In contrast, a lower mean is expected when students disagree with the statement in the item.

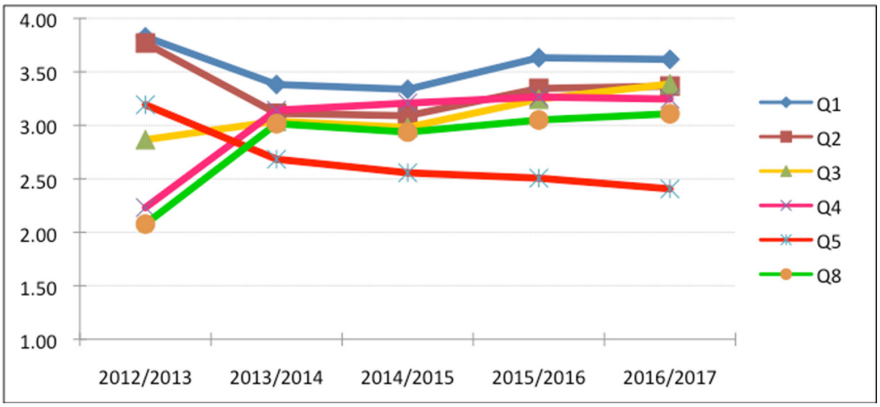


Figure 2. Students' perceptions about the eMCQ (mean scores)

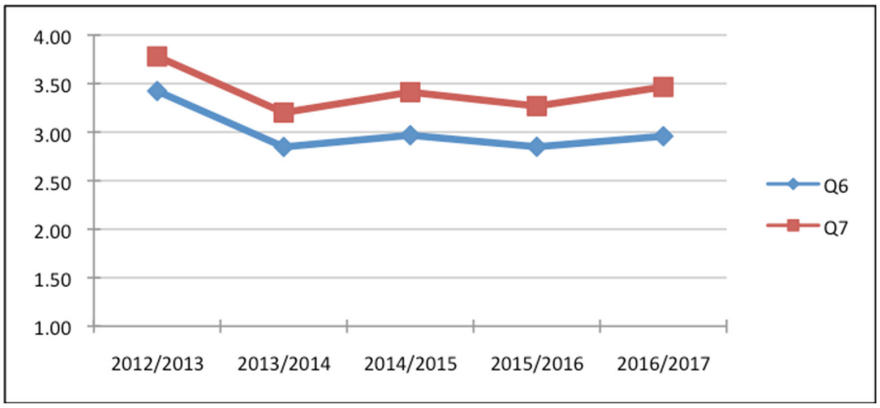


Figure 3. Students' opinion about the time to answer the test (mean scores)

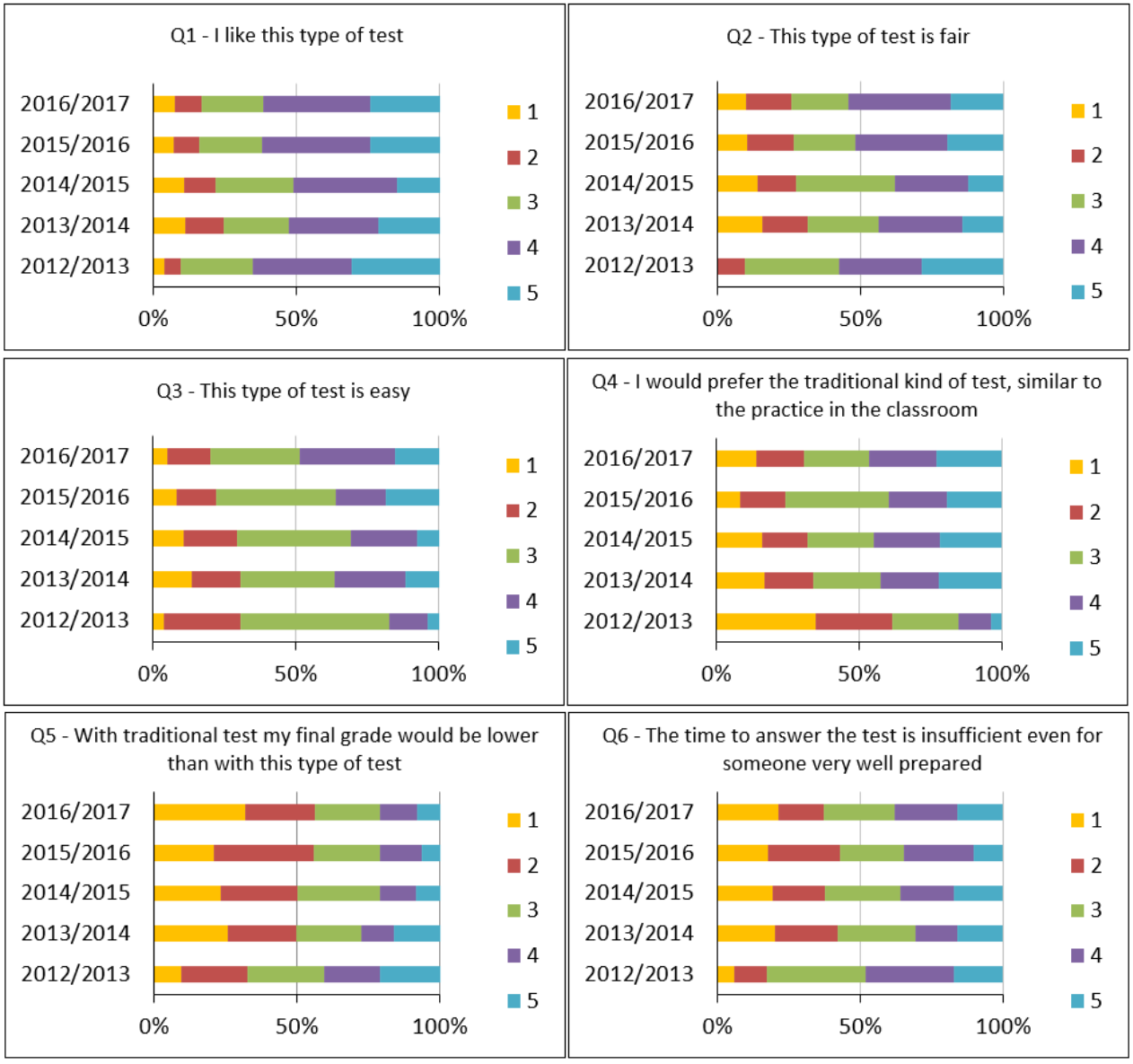
More positive attitudes about the assessment with eMCQ are translated by higher means in items Q1, Q2, Q3, and Q5 and by lower means in items Q4 and Q8 in Figure 2.

It is possible to observe the evolution of opinions over the years. Except in question Q5 – "With traditional test my final grade would be lower than with this type of test" – where it seems that opinions tend to stabilise over the time.

Questions Q1, Q2, and Q3 show high means emphasising students' positive attitudes about eMCQ. Although in Q5 the mean shows a downward trend. Also, Q4 and Q8 present values for the means slightly superior to 3 (except in the first year) which points to a negative opinion about eMCQ.

Figure 3 shows that students would like to have more time to answer the test although they do not consider the duration insufficient (mean inferior to 3). From the students' opinion about the "time to answer the test" collected in the first-year survey, the teachers decided to provide more time for the test, which was reflected in the following years. However, it seems that the students continue to ask for more time.

Figure 4 shows scores' distribution (from 1 = strongly disagree to 5 = strongly agree) for each question over the five years and add valuable information to Figure 2 and Figure 3.



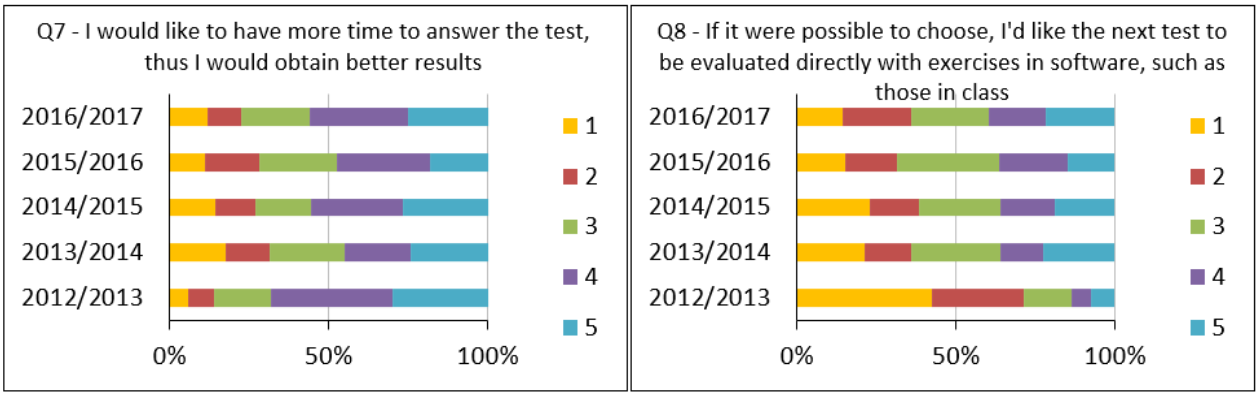


Figure 4. Points' distribution by question (%)

To verify the existence of significant differences through the five academic years, the Kruskal-Wallis test was applied on ordinal variables (questions in survey). This test found significant differences for all questions. Then we applied the Mann-Whitney U test between pairs of academic years to identify those differences. Some significant differences ($p < 0.05$) were observed and the results are summarised in the Table 4 showing the questions where this happened.

Table 4. Significant differences among the 5 years' survey

	2013/2014	2014/2015	2015/2016	2016/2017
2012/2013	Q1, Q2, Q4, Q5, Q6, Q7, Q8	Q1, Q2, Q4, Q5, Q6, Q8	Q3, Q4, Q5, Q6, Q7, Q8	Q3, Q4, Q5, Q6, Q8
2013/2014		---	---	Q3
2014/2015			Q1	Q1, Q2, Q3
2015/2016				---

We observe that the majority of the differences occur when we compare the first academic year with the others. This is expected since it was the beginning of the new e-assessment strategy implementation. Along the remaining consecutive academic years, there were not observed significant differences in general, except for Q1 (comparing 2014/2015 with 2015/2016 and 2016/2017), Q2 (comparing 2014/2015 with 2016/2017), and Q3 (comparing 2014/2015 with 2016/2017). In the two last years no difference was found.

Summarising, high means in Table 3 and the high percentage of agreement in Figure 4 show that students appreciate the eMCQ assessment (Q1) and they also view this type of assessment as fair (Q2). Concerning the difficulty of the eMCQ tests, the means over the last two years were increasing and the percentage of responses agreeing with the statement Q3 – "This type of test is easy" is superior to 36%. High means in Q4 and Q8, and low means in Q5 demonstrate that students prefer the CCAA to eMCQ. Students' opinion in the first year is very divergent from subsequent years. As pointed out in Table 4, significant differences were found comparing the year 2012/2013 with the following years. In the first year of the study the students seem to prefer eMCQ to CCAA, but this opinion was changed as time went on. It looks contradictory to the responses obtained in Q1, Q2, and Q3 where opinions are revealed favourable to eMCQ. Why do students like eMCQ assessment but prefer CCAA?

Open-ended questions

In order to clarify the previous questions and complement the quantitative analysis performed on the measured items, we also scrutinised comments from students in open-ended questions in the surveys. Therefore, as a follow-up to the variables/topics presented in Table 2, these comments provide important statements about eMCQ. The questions were the following: "Provide some advantages of the eMCQ assessment in relation with the traditional assessment"; "Provide some disadvantages of the eMCQ assessment in relation with the traditional assessment"; and "Provide some comments/suggestions regarding the eMCQ". The surveys' respondents, which were 815 students are identified by a 'R', were free to answer the open-ended questions, as a result, most of the students did not choose to answer as it involved an extra effort. The discussion below includes some of the respondents' answers to the surveys' open-ended questions.

Related to the variable **V1 - Students Attitudes (Random students complain about the new type of assessment)**, some students stated that they *"think it would be better to do the evaluation as the exercises done in the class*" (R1) and that they "*find it difficult to know if it is better to do the course with this type of evaluation or to do the exercises directly in Access*" (R21). As the students in the interviews raised issues about the penalties and about some MCQ, these students also provided some concerns about it, *"The issue of having penalties in each incorrect question is a little distressing"* (R10) and *"This new method caused me a little more anxiety and nervousness, because I was afraid that I had not prepared enough. And because* [the test] *is of multiple-choice questions, it can sometimes get more complicated."* (R3).

However, overall, the students have positive feedback on the eMCQ quizzes stating that "*I like this type of evaluation."* (R13; R14), since it is *"More intuitive and fair*" (R154), and it provides "*A more objective and practical evaluation."* (R181). A student also mentioned that this type of assessment is "*Interesting"* and "*Stimulating*" (R207), while another said it is "*More fun and practical*", "*Logical*", and "*Dynamic*" (R83).

As well as the feedback provided by the students in the interviews about V2 - **Assessment and Skills (Student's random answers matching the correct answer** and **Better marks than the correspondent knowledge)**, the respondents stated that "*In a certain way it facilitates, since the answer is there.*" (R41) and that *"by luck, it is not difficult to choose the correct answer."* (R89). But they also mention that it can be helpful *"because it has options when we are not sufficiently prepared"* (R108). And that *"it becomes easier to know which the correct formula is by having various choice options* [since] *among these … is the correct one.*" (R16), so there is a "*higher probability of success*" (R182).

When asked if the eMCQ quizzes can evaluate the **Skills/Competences/Attitudes** properly, the respondents, as well as the interviewed, agree with the importance of projects to reinforce the knowledge. In their opinion, with the eMCQ "*the students do not put into practice the knowledge of Access learned in the classes.*" (R60), since it *"does not allow to evaluate the knowledge that students truly have*" (R55). However, some other students express that eMCQ quizzes "*enables a greater learning capacity, due to its practical aspect"* and thus a "*better assimilation of the subject*" (R144). Others express that "*With the evaluation of Excel through Moodle I managed to perfectly test my knowledge in Excel"* (R17*)* and that "*With this type of test, the students can put to practice the acquired knowledge about a certain software, in addition to consolidating the same knowledge in a better way"* (R152). Another student pronounces, "*I don't think it reflects the learning and critical reasoning skills. It softens the amplitude of results of the course around the average, in my opinion*" (R210).

In the V3 - Grading process **(Higher objectivity** and **Test homogeneity** categories), most statements provide information on the structure of the tests, the length of the questions, as well as the similarities between questions: "*Similar questions come out*" (R41). This does not offer relevant information on the grading process, but most students mention that eMCQ provides an "*Easier evaluation"* (R139), a *"Fair evaluation"* (R131), that "*It makes the correction easier and clearer"* (R148), and "*In terms of correction, it is practical and faster*" (R163), which is coincident with the opinion of interviews performed with the repeating students.

These opinions show that the eMCQ testing can be fallible and thus state the importance of another method to counterbalance the assessment during the continuous assessment, such as systematic homework or a PBL approach. The PBL method can help the students to consolidate the knowledge learned throughout the semester, as well as improve other skills and competencies. While working in a group, the students must interact with each other, which assists them with communication, leadership, and conflict resolution skills, among others. The collaborative work also makes the students apply the knowledge learned in order to solve the proposed problem, which leads them to engage in their own learning experience. This process is helpful to increase their creative thinking and problem-solving skills. All these skills will be an asset in their professional future.

INTERVIEWS

It was relevant to the study to discover if the students' concerns were somehow coincident with the teachers' concerns presented in Table 2. While performing content analysis to the interviews, there was the curiosity to discover if there were topics in common with the variables/categories (V1, V2, V3, and V4) identified in the summary of the concepts resulting from the teachers focus group analysis. To pursue this objective, we also conducted interviews with a group of repeating students who had experienced both approaches: eMCQ Moodle quizzes and CCAA during the 2012/2013 academic year.

Accordingly, a semi-structured approach was adopted with the intention of gaining as much discursive information as possible about students' opinions (see the Appendix for the Interview Guide).

As the researchers cannot proceed to field experiments with the repetition of the experiment in both conditions (Moodle quiz – eMCQ and traditional assisted assessment - CCAA) with the same students for the same topics, the next best thing would be to have people who experienced both assessments in different years. With this in mind, in the pilot study's questionnaire, students were inquired about any failure in a previous edition of the same course.

Under such approach it was possible to elicit factors that can introduce the bias in students' opinions, namely, a different teacher during the two experiences or variation on the effort among the years (usually more working hours will result in better achievements). By excluding factors that could induce students to misinterpret their final results, it was possible to, considering Table 2 (V1; V2; V3), understand their opinions and complaints about the new e-assessment process. It was also easier to gather information about their perspective on the differences between the traditional assessment method (CCAA) and the new one (eMCQ), especially if the same skills (V2) are presented in the two methods of assessment.

Among the six students who were repeating the course in 2012/2013, three of them agreed to be submitted to an interview. The interviews were recorded with the awareness and agreement of the students. Three participants, two female students (S1, S2), and one male student (S3), agreed to be interviewed after two different experiences in the same course. In both, they attended the same teacher's classes, therefore personal characteristics and different teaching styles are not variables to be considered. The students S1 and S3 succeeded in the continuous assessment, S2 only in the final exam. Nevertheless, every stage of the continuous assessment was performed by the three students, except the project defence which S2 did not perform.

After being recorded, the interviews were transcribed, and finally translated from Portuguese to English, enabling the researchers to be immersed in the data details. After monitoring, the data were coded according to the categories found in previous research focused on teachers' opinion about eMCQ (Babo & Suhonen, 2018). It should be noted that although the interviews were conducted in 2012/2013, the data obtained were only processed more recently when the researchers decided to analyse all the data they had.

Starting from the student's unbiased answers, the data was analysed, selected, and organised into three main variables, which definition was based on the participants' opinions about the new e-assessment procedure. These variables are aligned with those found in the teachers' focus group, namely Student's Attitudes (V1), Assessment Process and Skills (V2) and Grading Process (V3). Obviously, the variable Work Load/Question Bank (V4) is exclusive to teachers as it concerns questions design and database organisation. The same applies to the topic "Less effort in the grading process" of the Grading Process (V3). The themes that emerged from the interviews with the three repeating students were included in Table 5, where each one of the categories includes the specific topics intended to clarify the ideas under consideration in the present study, as follows.

Table 5. Summary of students' interviews considering Table 2 variables/categories

Variables/ students	S1	S2	S3
V1: Students' attitudes			
Random students complain about the new type of assessment	*"… I was concerned about the penalties, therefore I preferred not to answer some of the questions."*	*"… without the project the student is nothing. The project is the base of the course due to its practical nature. Without the project, people can know how to use a formula, but it is not the same as putting all the work together."*	*"If I was (working) in a company, I would choose the student that had direct contact with Excel, and not the one that had done MCQs tests"*
		"The only disadvantage is that some mistakes can happen online, and some of the tests may be lost due to computer errors."	
		"MCQs are tricky, and sometimes may compromise some students"	*"There are some people who may not cope well with multiple-choice quizzes… These people will probably be a little constrained for not having the traditional computer assisted assessment."*
V2: Assessment Process and Skills			
Students' random answers matching the correct answer	*"The sheer luck factor may exist with the MCQ's. … I may answer some of the questions randomly and achieve good marks."*		
Better marks than the correspondent knowledge	*"The great advantage is that there is no need to know the subject 'so well'"*	*"With MCQs it is possible to answer the questions correctly without studying a lot, meaning you are able to guess the correct answer by excluding the other options".*	*"In case of any doubts, it is easier to achieve the correct answer, by analysing the several options."*
	"With this type of assessment, we are able to not answer all questions, because they are not connected, consequently is easier than the traditional assessment"		
	"We do not need to build the formula in order to achieve the correct result."		

Variables / students	S1	S2	S3
Assessment skills are the same as the traditional assessment	*"Probably I would have had the same results in the first years if I had gone to all the classes."*	*"Last year I had worse marks because I didn't study as much as this year. That's why, this year, I had good results. I think that if I had studied, the evaluation results would have been similar".*	
	"I'm not saying that the new method of assessment it's easier than the traditional one, because I believe that during this academic year, I devoted myself more than in the previous one."	*"Although it is two completely different kind of assessments, any student can achieve the same mark, because the difficulty level is similar. A student cannot achieve a better mark in a test than in another. I think that the evaluation is equivalent."*	*"The difficulty level is basically the same between the two assessment methods. If you know how to do it in practice, you are able to answer the MCQs correctly."*
		"If you answer a MCQ correctly, that means you know how to do it in practice. ... The answers are built in a way that it is possible to commit mistakes due to little details, therefore you need to study a lot in order to answer correctly."	
	"This type of assessment covers all subjects, which is really important."		
V3: Grading Process			
Higher objectivity		*"By being online, "things" work faster. For instance, the evaluation process is more efficient and quicker than with the traditional assessment"*	
Test homogeneity		*"Although it is two completely different kind of assessments, any student can achieve the same mark, because the difficulty level is similar. A student cannot achieve a better mark in a test than in another. I think that the evaluation is equivalent."*	
		"Although the questions were randomly assigned, I think that any student or class could be benefited"	

From Table 5, it is possible to understand some of the students' perceptions on the new assessment method. Student S1 was concerned about the penalties in case of answering wrong, thus during the MCQ quiz assessment, S1 preferred not to answer some questions. All three students consider that it is possible to "guess" the answer by analysing the options, nonetheless all affirm that the assessment results are equivalent on both methods of assessment, CCAA and eMCQ. The penalty system was introduced to avoid the 'luck factor' (Babo & Azevedo, 2013; Triantis & Ventouras, 2012) and to make the assessment fairer and more reliable.

The need for practical assessment using the software is reinforced by students S2 and S3, and S2 points out the importance of the project in the development and application of knowledge.

Web failures as mentioned by S2 were related with the servers' instability and occurred in the year 2012/2013. These problems were solved in subsequent years.

Student S2 highlights the homogeneity through different tests and the reduction in grading time, considering the eMCQ assessment "more efficient and quicker."

The students interviewed appreciate the new kind of assessment and agree in the difficulty is similar in CCAA and eMCQ. One of the students stated that for the average student maybe "multiple-choice quizzes can be easier." All of them agreed that with the same amount of effort the results would not be different.

As lecturers and researchers expressed along the study, another question has emerged in our minds: Does this kind of assessment evaluate the same knowledge? What about competencies and skills? Would changing the assessment type deliver the same results?

Some respondents affirm that this type of test does not assess the true knowledge of the students, as stated by Nicol (2007) and Johnstone and Ambusaidi (2000), who say it encourages memorisation instead of factual recognition. These authors also discuss arguments in favour of this assessment type, which is in line with some of the students' opinions, since other respondents state that eMCQs quizzes are capable of assessing higher cognitive levels of learning (Johnstone & Ambusaidi, 2000) and the "proficiency" to apply knowledge (Cerutti et al., 2019, p. 2), as well as allowing the students to "self-regulate their own learning" (Nicol, 2007, p. 54). These opinions state a contradiction on the efficiency of eMCQ.

In order to answer the questions above, one of the main points of the interviews was related to the acquisition of skills and competencies through eMCQ, since one of the goals of the course is to develop soft skills, namely, time management, leadership, conflict resolution, communication, cooperation and collaborative work, problem-solving, creative thinking, and good cognitive ability. These skills are crucial because they will be required in students to be successful workers and citizens in the knowledge society of the 21st century (Ananiadou & Claro, 2009; National Research Council, 2011; Ontario Ministry of Education, 2016; Stevens & Norman, 2016). In order to reach such skills and based on the benefits diffused by several authors about problem-based learning (PBL), this learning methodology was implemented in the course.

As it was mentioned above, several researchers have studied the effects of PBL on students, and the conclusions are similar to the ones achieved in the present study. It has been recognised that active learning methodologies such as PBL approaches can support deeper learning and transfer (Becker, et al., 2017; National Research Council, 2012), are able to stimulate student engagement (Prince, 2004), and promote the twenty-first-century skills of communication, negotiation, and collaboration (Bell, 2010). For instance, Tiwari et al. (2017) carried out a study with a pilot group constituted by 99 students, in which the main conclusion was that students "admitted to have enhancement of knowledge on the topic taken, searching review for that topic, improved communication skills, and analytical and presentations skills" (p. S5). Side by side to Tiwari et al. (2017), Hall, Palmer, and Bennett (2012) also noted that students, while facing a scientific project or experience, were more engaged in their own learning experience. Furthermore, PBL enables students and teachers to plan their learning/teaching easily (Mahasneh & Alwan, 2018).

When asked about the importance of the group project, all the students agreed that the project is necessary to consolidate the application of the knowledge as stated:

> *"I think the project is essential."* (S1)

> *"… without the project the student is nothing. The project is the base of the course due to its practical nature. Without the project, people can know how to use a formula, but this is not the same as putting all the work together. … Despite being two MCQs tests, the project complemented them."* (S2)
>
> *"The know-how to do skill is completed with the project. It is essential in complement to the multiple-choice quizzes."* (S3)

This finding is aligned with teachers' opinion on the same subject (Babo & Suhonen, 2018) and reinforced the idea that eMCQ assessment needs to be combined with other methods of evaluation in order for the students to achieve the competencies and skills, namely problem-solving skills, critical thinking, and communication skills.

DISCUSSION

This study aims to understand student's opinions and perceptions about e-assessment when the assessment process was changed from the traditional computer assisted method to a multiple-choice Moodle based method. The results presented in the sections above show that when the assessment was first shifted from CCAA to eMCQ, the students liked it and were enthusiastic about it (Figure 4 – Q1: 2012/2013). One of the reasons for this may be because they had previously experienced MCQ quizzes, to evaluate theoretical topics, from other courses. In those tests, the concerns stated in the literature review, namely the 'luck factor', may have helped them achieve higher grades without the necessary knowledge (Babo & Suhonen, 2018; Llamas-Nistal et al., 2013; Maier et al., 2016; Sorensen, 2013).

Students talk between themselves, so 'word of mouth' can influence how they come to expect certain tasks. When the second generation (2013/2014) of this process tried the eMCQ, these students had previously talked with the students of 2012/2013. In the first year, there were still some problems to be fixed and in general the students liked this type of assessment. The respondents also perceive it as a manner to achieve higher grades, as can be seen by the higher mean in 2012/2013 on Q5 of Figure 2. For this reason, the following classes assumed that the tests would be very easy and thus could achieve higher grades without hard work. Then, when that did not happen, the respondents considered that with CCAA they would probably achieve the expected grades. As expressed by the decreasing mean in Q5 (Figure 2), across the years.

Over the years, the team responsible for implementing the eMCQ quizzes as an e-assessment process made several studies to gauge the opinions of students and teachers involved. In particular, Babo and Suhonen (2018) researched the teachers' opinions and experience with this process. In that study, the teachers participating in a focus group stated that the eMCQ testing had several benefits for the students, since eMCQ can motivate them and assure regular study (Babo et al., 2015; Babo & Suhonen, 2018). It can likewise be proven beneficial to the teacher, having as its main advantage the automatic marking of the tests, since it decreases the time and burden which are associated with the grading process, as well as allowing a greater accuracy of the marking process (Babo & Azevedo, 2013; Babo et al., 2015; Babo & Suhonen, 2018; Douglas et al., 2012; Ferrão, 2010; Llamas-Nistal et al., 2013; Sorensen, 2013).

The teachers were also asked about the quality of the questions in the quizzes, and if they felt that the students could achieve better grades than the knowledge acquired. It was stated that with the "improvement in the questions from the database bank, by introducing questions with two difficulty levels" and the integration of a penalty system, the 'luck factor' was almost eliminated (Babo & Suhonen, 2018, p. 24).

The improvement of the question bank and the penalty system has made these tests not as effortless as the students expected, which allowed the assessment of the actual knowledge learned by the students and eliminate the 'luck factor'. Hence a probable reason why the surveys show an increase in

the preference for CCAA instead of eMCQ, presented by the increasing agreement with Q4 (Figure 2).

The students also admitted to preferring tests similar to the homework (CCAA), as mentioned in the surveys about the V1 – Students Attitudes, where was stated that the respondents *"… think it would be better to do the evaluation as the exercises done in the class*" (R1) and that "… *find it difficult to know if it is better to do the course with this type of evaluation or to do the exercises directly in Access …"* (R21). These statements reinforce the increasing means on Q4 and Q8 (Figure 2) throughout the years. These results can be explained twofold: on one hand, by the changes implemented in the penalty system described above and, on the other hand, by the students' feelings about the MCQ flaws concerning the assessment of their skills and competencies, as stated in the "absence of the ability to evaluate other types of skills/competencies" (Babo & Suhonen, 2018; Llamas-Nistal et al., 2013).

Such as discussed in Babo and Suhonen (2018), the teachers expressed first-handed these concerns, stating that the assessment with eMCQ can only be a valid assessment "when combined with other types of assessment, such as problem-based learning" (p. 26). The implementation of a PBL method is an added value to assist the teachers and students in assessing the skills and competencies complementing the eMCQ. It also allows the students to improve the skills learned during the semester and acquired competencies relevant in their future. Thus "the complementary use of these two types of assessment plays a significant role in the quality of the assessment process." (Babo & Suhonen, 2018, p. 26).

Overall the respondents believe that the assessment with eMCQ quizzes is fair, seeing that the opinions about it, expressed in Q2 (Figure 2), have been gradually increasing towards a general agreement after the decreased mean in the year 2013/2014, as well as the opinions on the easiness of the eMCQ, which have been increasing since 2014/2015, as shown by Q1 (Figure 2).

STUDY LIMITATIONS AND FUTURE WORK

The focus of this paper is to ascertain students' opinions about the e-assessment implemented in the IS department at ISCAP and to compare this information with one obtained from previous research with teachers. Despite its strengths and important findings, there are some limitations that should be addressed in future research. First, although there is a high number of students involved, they belong to the same institution, ISCAP. For future research, it might be interesting to compare the findings in this study with results from other institutions and similar/non-similar courses. Second, the number of questions in the survey is relatively small and there are other relevant aspects that can be included, namely with regard to specific competencies and skills developed in both approaches eMCQ and CCAA mentioned on teachers and students' interviews. Thus, some questions could be added to the survey in order to clarify and deepen this point. Another interesting view would be to obtain the opinions of a particular set of students which perform two tests, where one of the tests is in eMCQ while the other is performed through the CCAA method.

A comparative analysis regarding the grades obtained by students who performed one or another type of assessment (eMCQ and CCAA) is a natural extension of the present study and was left for future work.

CONCLUSIONS

This study investigates the e-assessment with multiple-choice questions in higher education. It is part of a broader research study on shifting the CCAA to eMCQ in the IS department at ISCAP, which focuses upon students' opinions about the subject. A high number of students were involved during five school years. Surveys and interviews were the instruments used to collect data. A quantitative data analysis was performed in ordinal variables in the survey. From a previous qualitative study (focus group) (Babo & Suhonen, 2018) that was carried with teachers, a set of variables resulted: "Students Attitudes" (V1), "Assessment and Skills" (V2), and "Grading process" (V3), (Table 2). These

variables were also elicited from the repeating students' interviews (Table 5), as well as from the open-ended questions in the surveys.

Important findings concerning the subject under analysis in this paper were obtained. Namely, this study concludes that the students involved appreciate the eMCQ assessment method and perceive it as fair. However, they demonstrated a contradictory opinion regarding the preference of the assessment method. In the first year of the study, students seem to prefer eMCQ over CCAA, but this opinion was changed across the years. Why is the first year different? A possible explanation relates to the fact that in the first year, even though the increase in the amount of work, the lecturers implicated in the process were the boosters of the assessment change and thus possibly more engaged and motivated, transmitting these feeling to the students. Whereas in the following years, this method was applied to more courses and the number of people involved in the process was broadened. Whenever change occurs, there are always some setbacks, and not every person has the same coping mechanisms; and some lecturers may have been less motivated, which may have been passed on to the students. There were also the improvements in the question bank that added a combination of bonuses and penalties in the set of MCQs, as well as the categorisation of questions as basic or advanced, according to the difficulty level. These improvements led to the nullification of the 'luck factor'. Despite all these changes, configuring a higher rigour to eMCQ assessment, it can be shown in the figures that throughout the years, students appreciate the eMCQ assessment and consider it fair.

A concern revealed in the interviews and open-ended responses relates to the need to complement the e-assessment based on MCQ quizzes with a problem-based learning (PBL) environment. Although the eMCQ quizzes are used with success in the assessment of theoretical topics, the same is not in evidence regarding practical topics, where the know-how is expected as a learning outcome. Therefore, a complementary approach to assess these skills and competencies is advised (Babo & Suhonen, 2018; Douglas et al., 2012).

The PBL method has several advantages since it can help the students consolidate the acquired knowledge, as well as contribute to the development of other valuable skills and competencies, such as cognitive engagement, problem-solving, process, and content skills (Frank & Barzilai, 2004; Khoiriyah & Husamah, 2018; Loyens et al., 2015; Alias et al., 2015). Since it is a method in which the students have to collaborate to achieve a solution to a problem, they also acquire soft skills, namely communication, cooperation, leadership, autonomy, analytical, and presentation skills (Tiwari et al., 2017). These skills and competencies are crucial to their future as citizens of the 21st century (Ananiadou & Claro, 2009; Stevens & Norman, 2016).

Some authors affirm that MCQs "are adaptable to the measurement of most important educational outcomes" and that "almost any understanding or ability … can be tested by means of multiple-choice test items" (Ebel, 1972, p. 154). However, this study's authors conclude that there are some restrictions when evaluating practical subjects, particularly in technology and information systems topics. Therefore, to assess practical topics, there is the need to complement the MCQ assessment with other approaches, such as a PBL method, homework assignments, and/or other tasks performed during the semester, in order to be able to evaluate the same expected learning outcomes.

Those approaches require the students to develop and apply all the knowledge acquired throughout the semester, and thus supporting the eMCQ assessment of the learning outcomes. Throughout the development of the project, it is not enough to only be able to identify the best solution, technique or formula to solve a certain problem, but rather know how to accomplish the tasks and perform them by applying said knowledge. Thus, the project assessment has been gaining more emphasis in the final grade at this department of ISCAP.

This study contributes to the body of knowledge by providing a reflection tool on how to incorporate frequent moments of assessment in courses with a high number of students without overloading teachers with a huge workload. In addition, our research has analysed the efficiency of assessing non-theoretical topics using eMCQ, while ensuring the homogeneity of assessment tests. Nevertheless,

eMCQ for non-theoretical topics assessment needs to be complemented with other assessment methods in other to assure that the student develops and acquire the expected skills and competencies.

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APPENDIX

Interview Guide

A. Context

1. During the first enrolment year, did you have the same teacher as you had this year (2012/2013)?

2. When opting for continuous or final assessment, which did you choose?

3. If you opted for continuous assessment, did you have good grades in the several assessment components? Were you able to present the final project?

B. MCQ Moodle Quizzes

4. Do you consider that Excel can be well-evaluated with these types of tests?

5. Since you were able to compare different academic years, how do you compare the degree of difficulty between the tests, taken into consideration that it was the same programme content?

6. Do you consider important to have access to Excel during the test? Did you use it to answer any question?

7. Put yourself outside the role of student and think that you are working in a company. From what you have learned (and not learned), are there any disadvantages in this type of tests, in relation to the learning process, for example? / What are the advantages of this type of tests? And the disadvantages?

8. Do you think that the same student would have approximately the same grade in a Moodle quiz and in a CAA (Computer Assisted Assessment) test? Given that this student would not have time to prepare and that the tests were performed in the same moment or at different times, but very close in time?

9. Considering a course with the same kind of content, practical and non-theoretical, if you were given the opportunity to choose the type of test, what would you prefer?

C. Project Development

10. Do you consider that you would not be well-evaluated in knowledge and competencies, if there was not the development of a project, for example?

11. In your opinion, does the practical work (the project) complements the knowledge and competencies assessment of this type of tests?

12. Do you think that, without the project, you would not be well-evaluated?

13. In order to improve the assessment for the years to come, should we have intermediate dates for the project assessment?

D. Overall assessment

14. To what extent do you think that this type of test, along with the development of a project (PBL), can evaluate the same knowledge and skills, as the previous test model?

E. Suggestions/Opinions

15. Considering a course with the same kind of content, if you were given the opportunity to choose the type of test, which would you prefer? Why?

16. Since this is the pilot project, this type of assessment was only used in one class. Do you ever feel any sense of foreboding among the pilot students and the other classes' students?

17. Concerning the next academic year of this course, do you think that if this type of tests is implemented, the student's assessment will not be favourer nor jeopardised, neither will they be evaluated in an incorrect manner?

18. Do you have any further comments on the type of evaluation (about what went well and wrong, what would you change, ...)? Your input is important, because without students' opinions, we cannot improve the process, or decide whether we should abandon or continue with this type of assessment.

BIOGRAPHIES

Rosalina Babo is a Coordinator Professor at the Porto Accounting and Business School/Polytechnic of Porto (ISCAP/IPP), Portugal. Since 2000 she is the head of the Information Systems Department and was a member of the university scientific board for 12 years (2000-2012). Rosalina Babo was one of the founders (2006) of CEOS-PP (former CEISE) research centre and its director until 2011. Having several published papers in conferences, journals and books, her main areas of research are e-learning, usability, e-commerce and social networks.

Lurdes Babo has a Ph.D. in Applied Mathematics and she is senior lecturer at ISCAP, the PPORTO Business School and researcher at CEOS.PP. She has experience in lecturing mathematics and statistics. Her research interests include Technology in Teaching and Learning in Higher Education, Learning Analytics, Time Series Analysis, Simulation and quasi-Monte Carlo methods. She is co-coordinator of the project MatActiva (http://paol.iscap.ipp.pt/matactiva/) since 2007. She participated in the 2014/2015 Didactic Innovation project - "MatActiva - Divulgação de Experiências de Inovação Didática em Matemática com recurso às tecnologias", supported by the Science and Technology Foundation (FCT/8213/18/9/2014/S). Her work "MatActiva Project – A Mathematical Dynamic Environment to Engage Students in the Learning Process" received a Certificate of Merit in "The 3rd e-Learning Excellence Awards" in October 2017. Lurdes Babo is author of several publications in the domain of ICT, new teaching methodologies in higher education and learning analytics. She has been reviewing some scientific papers.

Dr. Jarkko Suhonen holds a research manager position at the School of Computing, University of Eastern Finland. He received his MSc (Computer Science) from University of Joensuu, Finland in 2000 and his PhD (Computer Science) from University of Joensuu in 2005. Dr. Suhonen has published 100 peer-reviewed articles in scientific journals, conferences, workshops, and chapters of books. His research interests include online and blended learning, design science research, computing education, and ICT for development. He has served on committees for international conferences and special issues of journals, and acts as a reviewer in several scientific journals.

Professor Markku Tukiainen has been a Professor in Computer Science in the Faculty of Science and Forestry, the University of Eastern Finland since 2004. He earned his Ph.D. in Computer Science from the University of Joensuu, in 2001. Professor Tukiainen is a leader of the research group Interactive Technologies at the School of Computing. Tukiainen has conducted empirical studies in human visual attention, the psychology of programming, and games studies, and has extensive experience with human-computer interaction research, software engineering, and digital accessibility. Professor Tukiainen has published over 90 scientific publications and participates in national standardization work in Finland (through Finnish Software Measurement Organization FiSMA ry) and at an international level (trough ISO International Organization for Standardization). He has been involved in the work of ISO JTC1/SC7 Software and Systems Engineering under Working Groups WG6 Software product Quality Requirements and Evaluation (SQuaRE) and WG20 Standardization of the Software