PERCEPTIONS OF FUTURE ENGINEERING TEACHERS ON FORMATIVE E-ASSESSMENT USING THE CLASSROOM RESPONSE SYSTEM

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Abstract: *The new culture of higher education emphasizes the importance of integrating assessment into the training process. E-assessment, a term used to describe technology-facilitated assessment, can be useful and efficient in terms of cost and time, but also of providing an immediate feedback to improve the teaching and learning process. This study investigates students' perception of the effectiveness of using formative e-assessment in teaching activities and the usefulness of implementing a Classroom Response System (CRS) in improving students' learning as future engineer teachers. The study employed quantitative and qualitative research methods by two questionnaires to collect data from 75 second-year students in initial teacher training program, Technical University of Cluj-Napoca, Romania. The results were very encouraging and practically all students engaged in this process felt the e-assessment added value to their learning and they would like to see it implemented in other courses. By encouraging students to correct errors and to receive award marks, it has improved students' learning experience. The results are discussed considering relevant research to suggest recommendations for improving e-learning implementations in initial teacher training.*

Keywords: *formative e-assessment; classroom response system; mobile learning; future engineering teachers.*

1. Introduction

The new culture of higher education emphasizes the importance of integrating assessment into the process of instruction, decisively influencing the process of helping students to learn and understand their progresses in learning. In recent decades, the focus has been on integrating assessment into learning and its role in contributing to the development of this process in a formative way (Bryan and Clegg, 2006; Irons, 2008; Gilbert et al., 2011). Formative assessment is an assessment of the regulation of the training, carried out continuously, systematically, analytically, directly in the service of the individual and his training, which tends to improve it, to make it more efficient and, why not, more enjoyable (Bocos, M.-D., Raduţ Taciu, R., Stan, C., 2016). It can also be seen as an assessment for learning that takes place during training to support learning. Formative assessment activities are intrinsic aspects of training that allow learning to be controlled and training to be changed until the desired learning objectives have been achieved. Formative assessment is applied as a source of continuous feedback to improve teaching and learning (Hargreaves, 2008). Nicol & Macfarlane-Dick (2006) and Hattie & Timperly (2007) stated that feedback is most effective when directly related to clearly defined learning objectives and that effective formative feedback is not based solely on monitoring progress towards these specific objectives, but it must encourage students to develop effective learning strategies. Thus, assessment must now be considered as a learning situation in its proper meaning (assessment for learning or formative assessment), in addition to fulfilling its main function of verifying what students know and what they can do at a moment of learning (assessment of learning or summative assessment).

With the advent of technology and its role in education, a large body of research has developed in investigating the role of technology in the educational process and their effects in improving the interactive educational environment (Irving, K., 2015). Most students today grew up with digital technologies such as the internet, smart phones and tablets. Teachers are under pressure to review programs to provide more efficient and effective training. It is essential to use the training time in the most appropriate possible ways. **E-evaluation**, a term used to describe the evaluation facilitated by the use of Information and Communication Technologies (ICT), can be an useful and efficient way in terms of cost and time to implement formative and ongoing evaluation. Online environments can be exploited to promote assessment as part of learning. Over the past two decades, many online and mixed courses have been developed by higher education programs to respond to 'the various needs and desires of students and the need for longer time to meet growing curricular requirements' (Garrison & Kanuka, 2004). Almost all universities have recognized the potential of online courses that have become an essential strategy in university programs. Even universities that do not offer such courses use learning management systems in various fields. On the other hand, online courses have not only become a destination for many universities, but also the beginning of a new paradigm and a new pedagogical method called mixed or blended learning. In higher education, the focus remains on the summative assessment, while formative assessment receives little attention despite its essential role in promoting learning (Pachler, Daly, Mor and Mellar, 2010; Wang, Wang, & Huang, 2008). In this regard, the researchers recommended a reorientation of the focus on online formative assessment to create student-centred learning and assessment environments. Thus, Pachler et al. (2010) used the term **formative e-assessment** that they defined as 'the use of ICT to support the iterative process of gathering and analysing information about student learning by teachers as well as learners and of evaluating it in relation to prior achievement and attainment of intended, as well as unintended learning outcomes'. In the same sense, Gikandi et al. (2011) define on-line formative assessment as a presentation of formative assessment in on-line learning and blended learning where the teacher and students are detached from time and/or space and where a considerable amount of teaching/learning events are driven by web-based technologies. Pachler et al. (2010) declared the field of formative e-assessment as highly complex, because it is integrated in the teaching and learning process and because the technology 'decides to restructure the context of the teacher-student interaction'.

Extending wireless distance learning has led to the emergence of mobile learning as an 'extension of e-learning' (Brown apud Park, 2011), a new way to obtain, process and transmit information for educational purposes using mobile technology equipment. Pedagogical research on mobile learning as an independent method or learning enrichment tool is relatively new. Thus, mobile learning has emerged as a potential educational method, but also as a supporting tool in the educational process, especially through mobile phones and tablets/iPads.

There are several new technologies and software introduced free or at affordable prices that help teachers with formative assessment during the training process and enhancing learning and evaluation. One of these technologies is the Classroom Response System (CRS). Irving (2015) said these tools 'assist the formative assessment process by supporting classroom environments that allow students and teachers to evaluate learning and to provide mechanisms for presenting information about student learning during training sessions.' Bruff (2009) defined the Classroom Response Systems (CRSs) as 'instructive technologies that enable instructors to quickly collect and analyse students' answers to questions placed during the class'. These technologies include, but are not limited to: Clickers, Kahoot, Socrative, Quiz Socket, Plickers, RecaP, Ombea, Top Hat, VotApedia, Poll Everywhere etc. The common denominator among these technologies is their ability to collect real-time data

from formative assessment that helps the teacher to provide feedback on time. Some use specialized hardware (generically called clickers) to allow students to respond to the questions, some use mobile phones (cellulars), such as Wiley's Click On, Poll Everywhere, VotApedia, and some use web enabled devices like eClicker.

In a study by Dunn et al. (2013), some research is synthesized including the benefits of using a CRS, such as improving students' attitudes towards classes, improving attentiveness, improving attendance, improving engagement in course, enhancing teacher-student interaction by providing immediate feedback, especially in large classes and allowing students to remain anonymous. Research results have shown that CRSs have raised questions and feedback when technology is integrated with pedagogy, increased attendant involvement and had a positive effect on students' attitudes and academic performance. The help given by technology through these systems is seen in activating student thinking, providing immediate feedback, motivating participation and promoting knowledge-centred discussions. Also, essential features of CRSs help teachers to effectively transform the class from teacher-centred to student-centred. This is because CRSs help assess students' learning by questioning the topic, collecting student responses instantly and quickly, and finally projecting the answers of the entire class.

Many CRSs allow different types of questions, although multiple-choice questions seem to be most commonly used. Wilson et al. (2011) found that the use of multiple-choice questions administered by the computer as formative assessment techniques had an encouraging influence on student action. There are arguments about whether e-assessment, especially in the common form of using multiple choice questions, can benefit deep learning (Jordan, 2009). It is recognized that multiple choice tests often do not test upper-level skills or how students apply in practice what they have learned. However, multiple choice and continuous assessment approaches have been observed as assessment techniques favoured by students (Furnham et al., 2011), therefore it is expected that they will increase engagement, motivation and learning.

It has been widely recognized that e-assessment can help improve quality student learning experience, and many researches have been done on attitudes towards e-assessment from academic staff. Relatively little research has recorded students' perspectives on assessment experiences directly, especially the students' perspective as future teachers in their initial teacher training program.

2. Methodology
2.1. Research design
The purpose of the current study is to contribute to the literature on student learning using a CRS technology in formative e-assessment activities at future engineering teachers. The study will try to answer the following three questions in terms of students' perception:

1. What are the future teachers' opinions on the effectiveness of using formative e-assessment to improve learning within university courses?

2. To what extent does the on-line formative assessment vary, depending to gender and faculty profile of future teachers?

3. What is the usefulness of implementing Kahoot as a technology tool in helping formative e-assessment to enhance students' learning?

Descriptive research captures participants' attitudes, behaviours, beliefs and perceptions of current issues and trends. The study was conducted by one of the researchers in the course 'Theory and Methodology of Instruction. Theory and Methodology of Evaluation', for 10 weeks.

The study employed mixed research methods: quantitative by using the means and standard deviations and qualitative by analysing students' responses to four open-ended

questions. In this case, no pre-determined responses were requested, and the participants were free to express their opinions. The researcher gave the quizzes in an online environment called as Classroom Response System, Kahoot, via students' mobile phones. The feedback was immediately given to both the researcher and the students and these feedbacks were taken into consideration during the training. At the same time, we used the digital portfolio that consisted of alternative assessment methods, such as the preparation of semi-structured or free essays, didactic activity projects, evaluation tests with different items in the specialized field.

2.2. Participants

The study sample consisted of 75 students representing second year level attending the initial teacher training program at Technical University of Cluj-Napoca. Out of the 75 participants, 25 are men (33.3%) and 50 are women (66.7%), and 31 subjects are enrolled on the electrical profile, 24 subjects on the building profile and 20 subjects on the mechanical profile.

2.3. Measures

Two questionnaires were presented to them in their classroom. First questionnaire related to the students' general views on formative e-assessment (14 items) within university courses. The second questionnaire used in this study consisted of 10 items on the efficiency of using Kahoot technology with multiple-choice quizzes implemented in this course. For both questionnaires the statements are rated on a five-point Likert scale ranging from one (Strongly Agree) to five (Strongly Disagree). For open-ended questions, only four questions were used to ask students about their perception on how effective is using Kahoot in the classroom in evaluation. The open-ended questions gave the participants the opportunity to elaborate and explain in-depth their perception regarding the use of Kahoot as a tool for formative e-assessment to improve learning. The use of the mixed methods is to allow data collection so deeper understanding can be attained.

3. Results

In this research, descriptive statistics have been used in the analysis of quantitative data, and the results have been evaluated in frequencies, percentages and means.

Aiming to investigate future teachers' perceptions of the importance and effectiveness of using formative e-assessment, it was resorted to calculating of the means for each item of the first questionnaire. The analysis based on observed scores by items, showed a high level of opinions for formative e-assessment (Table 1). The descriptive statistics results showed that the total sample mean score was at high level (M=2.42, SD=0.46). The higher mean was found at the item: *Feedback given is fast* (M=1.58) and the lowest mean was found at the item: *Formative e-assessment favours some students more than others* (M=3.40) (Table 1).

Table 1. Descriptive statistics for the formative e-assessment items

	Items	Means	SD
1.	Formative e-assessment must be an integral part of teaching-learning process.	1.64	0.69
2.	Using technology based formative assessment in the class can add value to my learning.	2.64	0.99
3.	Formative e-assessment helps me to identify the meanings of the different concepts that we strive to understand.	2.46	0.92
4.	Formative e-assessment helps me to form the skills that we acquire with difficulty.	2.50	0.79
5.	Formative e-assessment provides the necessary information to adjust teaching and learning while it happens.	2.44	0.73

6.	Formative e-assessment guides teachers and students in decision-making on how to advance in achieving their goals.	2.46	0.74
7.	Technical problems can make formative e-assessment impractical.	2.68	0.46
8.	The technology used in formative e-assessment is reliable.	2.54	0.82
9.	Online quizzes are more affordable than paper-based assessment.	2.48	0.96
10.	Marking is more accurate, because computers don't suffer from human error.	2.42	1.09
11.	Feedback given is fast.	1.58	0.63
12.	Feedback is easy to understand.	2.44	1.01
13.	Formative e-assessment favours some students more than others.	3.40	1.06
14.	Formative e-assessment goes hand in hand with e-learning (e.g. using Moodle).	2.17	0.64
	OVERALL	2.41	0.82

In investigating students' perceptions about the role of formative e-assessment in their courses, it is obvious from the research data that their responses showed how highly they view the importance of formative e-assessment as an integral part of teaching-learning process (88%). Of the respondents, 41.3% agree that using technology based formative assessment in the class can add value to their learning, while 21.3% believe the opposite. They also agree that this form of assessment helps to identify the meanings of the different concepts that students strive to understand (56%), to form the skills that students acquire with difficulty (57.3%), to provide the necessary information to adjust teaching and learning while it happens (65.4%), to guide teachers and students in decision-making on how to advance in achieving the goals (62.7%). The results also showed that 32% of participants agree that technical problems can make formative e-assessment impractical, while 68% of future teachers are undecided. Almost half of the participants agree that the technology used in formative e-assessment is reliable (48%). Their perception was that online quizzes are better than paper-based assessment (64%). Many respondents agree and strongly agree that marking is more accurate, because computers don't suffer from human error (64%). Also, most of the future teachers seemed to agree that feedback given is fast (94.7%) and is easy to understand (62.7%). Only 21.3% agree that formative e-assessment favour some students more than others, while 54.7% believe the opposite. Of the 75 future teachers, 69.3% of participants agree that the formative e-assessment goes hand in hand with e-learning (e.g. using Moodle).

The results of the descriptive statistical analysis for research question no. 2 showed that future teachers' background variables such as gender and the faculty profile of the future teachers, accounted for very slight differences in items scores, but they were not statistically significant (Table 2).

Table 2. Background variables and mean scores

Variable	N	Mean scores	SD
Gender	Male = 25	2.42	0.467
	Female = 50	2.41	0.472
Faculty profile	Electrical profile = 31	2.39	0.395
	Building profile = 24	2.56	0.529
	Mechanical profile = 20	2.28	0.468

For item 1, 'Formative e-assessment must be an integral part of teaching-learning process', 92% of male students and 86% of female students responded strongly agree and agree. For the same question, the students from the three profiles chose almost the same responses. For item 2, 'Using technology based formative assessment in the class can add value to my learning', 40% of male students and 42% of female students chose similar responses. The intention of introducing or even using the online assessment by the staff of

our university is to enhance the formative role of testing, but its effects on learning efficiency are perceived slightly differently by students in different profiles. It also seems that 76% of male students and 66% of female students responded agree and strongly agree that 'Formative e-assessment goes hand in hand with e-learning (e.g. using Moodle)' (item 3).

The authors of this study have been using Kahoot technology in a university course in the initial teacher training program and were interested in finding out its effectiveness for formative e-assessment to enhance students' learning. Therefore, to further explore the usefulness of implementing Kahoot as a technology tool in aiding formative e-assessment in the classroom, students indicated that they generally agree on the usefulness of implementing this technology (M=1.72, SD=0.44). As students, participants showed that they generally liked to use Kahoot (M=1.61, SD=0.63) and it helped them to check their progress in learning and to master the subjects they learned (M=2.25, SD=0.91). Furthermore, they stated that they plan to use Kahoot with their students when they will become teachers (M=1.54, SD=0.81). Students who participated in this study know the features that Kahoot provides its users, e.g. it is simple to use in the course, it helped students to get immediate feedback about their responses, the feedback is helpful, the scoring was correct, the questions were well written, different questions were offered, with a range of means between 1.26–1.77 and standard deviations between 0.57–0.84. For item 'I prefer to work marked by Kahoot than by a teacher as human tutor' (M=3.1, SD=1.12), 36% of the future teachers responded with disagree and strongly disagree, while 38.7% of them were undecided.

Although, the participants' qualitative responses covered a wide range of aspects, the researchers highlight the most important themes emerged from these responses. In responses to the first open-ended question 'How do you compare the Kahoot assessment with the assessment from other courses?' participants overwhelmingly agree that Kahoot technology is an effective tool in evaluation and the learning process. The assessment provided by Kahoot is objective, interesting, accessible, fast, easy to use and fun. As students, they argue that Kahoot help them to be engaged in the course. One student stated, 'I think it is a fast and efficient method of evaluation.' On the same line, another respondent wrote, 'I think it is a more interactive method that draws your attention and preserves it over the evaluation period.' A third student stated, 'Kahoot is totally objective, and this is not always available for a teacher.' Most students found that using Kahoot is an effective way to interact in large-classes. It is obvious that new generations (millennials) want to use technology in their daily life and using it in the class has a positive effect on students learning as many researchers said (Preszler et al, 2007; Sheill, Lukoff, & Mazur, 2013). Another aspect that the researchers identified in the participants' responses to the question 'What were the things you liked the most at Kahoot?' is saving the learning time. One student wrote, 'I liked the short time I had to answer the questions', and another responded, 'I liked the most that everything was at an alert pace, that it put me the concentration capacity 'in moving' and that it awakened the competitive spirit in me. And I had fun'. Many of the respondents report the speed of feedback and the ease with which Kahoot can be used by several students at the same time. Among the participants' answers to the question, 'What were the things you liked the least at Kahoot?' was the time too short for the answer. One student wrote, 'The response time was sometimes short.' Another respondent wrote 'I didn't like the fact that if you answered later, you received a lower score.' The other participants' answer to the above question is about technical difficulties and problems. For the open-ended question 'What improvements would you recommend to Kahoot?', they indicated a longer response time and a better internet connection.

In analysing and discussing the open-ended responses, the researchers centred their attention on the relevance of the responses to the research's main questions. In other words, to what extent the participants' open-ended responses contribute to the research questions.

Obviously, these responses supported the statements of participants in the first questionnaire when they agreed that using technology based formative assessment in the class can add value to student learning (M=2.64). For example, improving students' engagement by using Kahoot as a tool for formative assessment is a huge factor in creating an effective learning environment that promotes learning.

4. Discussions

The aim of this study was to investigate the perceptions of future teachers about the effectiveness of using formative e-assessment, on gender and faculty profile differences, as well as the usefulness of implementing Kahoot as a technological tool in supporting formative e-assessment to improve student learning enrolled in the initial teacher training program.

As seen in this study's results, the future engineering teachers indicate a high level of opinions for formative e-assessment in their courses. Most respondents give the importance of formative e-assessment as an integral part of the teaching-learning process (88%). Also, most of the future teachers seemed to agree that the feedback given is fast and it is easy to understand, while only 21.3% agree that formative e-assessment favour some students more than others.

The positive student perception towards formative e-assessments is hard to be contested. As it was anticipated, students were positively predisposed towards the use of technology in assessment. This type of assessment sometimes used during the learning process provides the teacher with information required to adjust the teaching methods. On the other hand, students must be informed of the assessment results as soon as possible. The method is very well received if the assessment results are analysed by the teacher, and the style or contents of the course are changed where necessary. Not so much the audio-visual message delivered by ICT is likely to produce educational effects, as its efficient integration into an active didactic strategy, designed by the teacher, whose presence remains necessary.

The feedback obtained from the online tests or quizzes may allow to identify and correct any deficiencies or difficult concepts. It is also important to identify the nature of problems in filling the online quizzes and to eliminate them. Furthermore, in the eyes of the students, online assessment is considered to be more correct than paper-based one. The participating students appreciate the benefits of the online quizzes, the most valued being the possibility of obtaining the results immediately after the quiz is completed by means of feedback, and the possibility of verifying the current level of knowledge. However, in the present study some participants had been familiar with the use of Moodle platform, for example, and this has certainly contributed to their positive stance.

The results of the first questionnaire also indicated that future teachers' background variables such as gender and the faculty profile of the future teacher were not statistically significant. Again, it may come as a surprise to those who might assume gender differences to make them more visible.

To explore the usefulness of implementing Kahoot as a technology tool in aiding formative assessment into a course, students generally indicated that they agree on the usefulness of implementing Kahoot. As students, participants agreed that they liked to use Kahoot, it was simple to use in the course, it helped students get immediate feedback about their responses, the feedback was helpful, the scoring was correct, the questions were well written, different questions were offered. Furthermore, they stated that they plan to use Kahoot with their students when they will become teachers. Students appreciated that Kahoot helped them to obtain instant feedback on their learning. Furthermore, the way in which the researcher used the gathered results to inform the students was also appreciated. In this sense, using Kahoot retained the advantages of using other CRS as reported in the literature.

The positive impact of using technology to add value to the learning process, as presented in the results of this study, is in line with what several researchers have argued (Irving, 2015; Ramsey & Duffy, 2016). One of the main drivers for the introduction of e-assessment is often the claim that it has the advantages of saving time and better use of resources. The participants pointed out that the use of Kahoot in the course provides objectivity, commitment, accessibility, speed, ease of use and even fun, which, eventually, aid the learning process. Another important factor identified by the respondents who expected to improve their learning is that using Kahoot saves the learning time.

The combination of reward points and anonymous responses with instant feedback means that students are free to make mistakes without fear of social embarrassment (in front of peers or the instructor) or fear of adversely impacting their notes. The systems' ability to provide anonymous participation with private accountability is a critical feature of CRSs.

Regarding the problems, challenges and difficulties, most of the participants pointed out that technology resources and support are the main issues. As with any technology, users of Kahoot may experience technological problems sometimes, some due to university-specific issues (the internet connection fails) or computer-specific issues (for example, slow browser response). In the same line, Ali and Elmahdi (2001) stressed the correct integration of technology in training activities, arguing that when technology tools 'are not embedded for the intended use, because of the inability to use them, it defeats the purpose for which they were made available'.

From the comments and results above, it shows that students appreciated and enjoyed online formative assessment. In this way, we saw the use of a CRS such as Kahoot as a practical way of implementing assessment as learning. In the literature, there is a strong agreement that CRSs promote learning when coupled with appropriate pedagogical methodologies. A large part of the students' learning takes place in the class and it is therefore essential that the two modes complement each other to ensure the disadvantages of one mode is outweighed by the other (Gibbs, G., 2006).

5. Conclusions

The main purpose of the current study was to investigate students' perceptions of efficacy when using formative e-assessment and of implementation of a tool in a traditional course through a CRS such as Kahoot in improving students' learning. The students were found to be in favour of formative e-assessment, and they would like to see it implemented in other departmental courses. The results were very encouraging and practically all students were involved in this process. It has been found that online tests have been mainly beneficial to students, helping them to check their progress in learning and to master the topics they have learned, and to provide them with the opportunity to check the key aspects of the material during its time. The most obvious finding to emerge from this study is that using technology-based tools, such as Kahoot, enhances formative assessment and, consequently, improves students' learning. Furthermore, this tool helps in providing individualized learning and engaging students with the feedback which, in turn, leads to creating effective teaching and learning environment and makes the course interesting, informative and fun. Further empirical research is needed to investigate the effectiveness of using technology-based tools for formative assessment on students' achievements and performance.

The current study suggests that future research is necessary in order to highlight the assessment practices undertaken during initial training, as well as teacher actions. As a result of such research, perhaps, teachers and students can learn to use assessment as an active and ongoing process. They can include it into the curriculum as a set of activities, rather than thinking about it as a singular event.

The results of this study can also be supported by teachers' need as instructional designers to design more interactive and engaging courses. However, the results of this study are limited to the extent of their generalization in situations with more advanced educational technology tools and to more innovative and integrated models, from traditional instructional methods to twenty-first century training strategies that guarantee student autonomy.

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