INNOVATIVE APPROACH FOR EASSESSMENT IN INFORMATICS EDUCATION: A CASE STUDY

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Abstract: *Nowadays, the digital world and formation of the digital society is reality and Informatics education contributes to its further development. Students expectations about the proposed teaching, learning and assessment in a course of Informatics are increased, because of their existing digital competences. The paper presents the results of the performed piloting experiment according to the TeSLA project with 150 students enrolled in the Informatics course from different faculties at Technical University of Sofia. An analysis and discussion of the developed and verified eAssessment model is provided.*

Keywords: Informatics, eAssessment, TeSLA, Higher education, blended-learning.

1. Introduction

A report of the joint Informatics Europe and ACM Europe Working Group on Informatics Education explains the importance of studying digital literacy and Informatics for all European citizens [1]. While digital literacy includes knowledge about usage of computer tools and Internet, Informatics steps at higher level revealing to students the huge possibilities of information technologies for creation of complex and advanced solutions and their applications in a wide variety of areas. Fourman defines Informatics as a science studying information presentation, processing and communication among systems [2]. The author reveals that the Informatics includes many aspects connecting different disciplines with their own conceptual bases and methodologies. So, Informatics programs and courses vary according to the university requirements and the level of study. Several scientific papers explore the specifics of studying Informatics. For example, Tıngöy and Güllüoğlu examine the students' attitude towards studying Informatics technologies [3]. After the course, the students' survey shows positive attitude as well as improvement of their learning and confidence in Informatics technologies. Other authors discuss the difficulties that students faced when studying programming languages [4]. Among the main difficulties are mentioned: not easy understanding of concepts behind programming structure, not easy learning of programming language syntax and difficulties in program design to accomplish a particular task.

Informatics education is seen as a key factor for development of the digital world and formation of the digital society. Competences obtained during Informatics courses and programs could be seen as a driving force for research, innovation and inventions. Knowledge and skills achieved in Informatics subjects are useful for students' professional development and successful realization at the market place. Anyway, to be familiar to Informatics concepts, many of students have to make more effort. Appropriate assessment tasks given to students could facilitate their learning and learning performance. Then, the emerged need for innovation in assessment process is discussed by several researchers [5] and the role of innovative practices in assessment in Higher education is shown in research papers [6]. The TeSLA project that is supported by European Commission according to H2020 program aims to develop an innovative solution for eAssessment with functionalities of students' authentication and authorship verification.

The aim of this paper is to present a model of eAssessment that enhances students' learning and assessment environment in the course of Informatics. It is verified with 150 students from different Faculties of Technical University of Sofia (TUS) during the winter semester of the 2017/2018 academic year.

2. Assessment in Informatics

The assessment of the students in the course of Informatics I in the machine faculties at the Technical University – Sofia is realized as ongoing assessment according to the curriculum. The students' knowledge changes and at definite periods during the semester is being tested. Formal assessment of students' level of knowledge uses tests, control tasks and homeworks [7].

The testing and assessment of the achieved knowledge in the course of Informatics I of the first-year students at Faculty of Power Engineering and Power Machines, Faculty of Mechanical Engineering, Faculty of Transport and Faculty of Industrial Technology is being performed in two stages. The topics of the course are being distributed evenly for the assessment of the theoretical and practical knowledge of these students. The practical part of the testing and assessment is being represented by problems to be solved – source code should be written in the programming language C. The theoretical part is represented by theoretical questions.

Up to the first and second test students are allowed after they have developed a first and second homework. It is assumed that if students for 2 months with the help of textbooks, lectures, laboratory exercises and consultations with colleagues and friends have mastered the necessary theoretical knowledge and acquired the skills to solve problems and have written more or less self-assignment tasks for homework , it is expected that they will cope with the tasks of the controllers and will successfully pass the theoretical test.

Assessment can be defined as "a method by which knowledge is found, which the student has" [8]. According to academic standards, the way in which the assessment and the assessment process are formed should determine the extent to which the objectives are met, taking into account the following two important elements:

• What the student should know, be able to do to pass the threshold of positive assessment;

• What the student should know, what he should be able to do to get a good (4), very good (5) and excellent (6) mark.

The analysis of the results according to the assessments done for each student can give us information about the student's complex preparation, competencies and personal qualities, and the ability to synthesize the obtained knowledge and the results of the student's group as a whole, i.e. about the level of their preparation and acquiring the necessary knowledge in the discipline [9].

Figure 1 shows a histogram of the success rate of a representative sample for the Faculty of Industrial Technology students, during the winter semester of the 2017/2018 academic year.

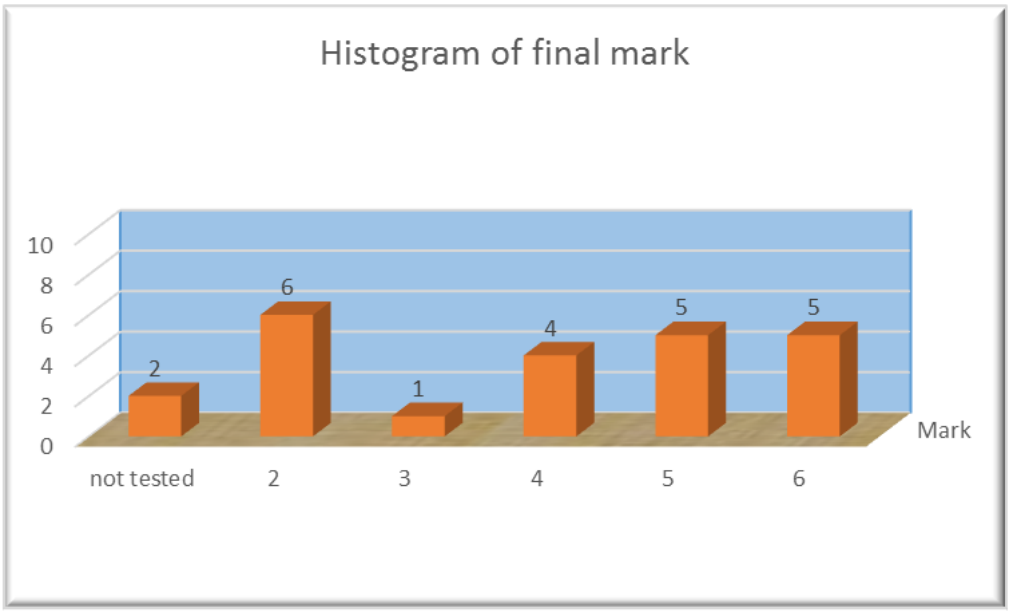

Fig. 1 The histogram of the Faculty of Industrial Technology students' success

From the data presented in the figure, it is clear that the majority of students trained successfully with the ongoing control, from which we can conclude that the used training model and the assessment method are suitable and successful for the students of the machine-building faculties.

3. Challenges in Informatics course

The lecturers in the course of Informatics in higher education institutions face new challenges - an avant-garde increase in the amount of information flows leading to the necessity of annual adjustments in curricula and the introducing of of new training methods related to new adaptive and interactive educational technologies [10].

The discipline of Informatics is one of the basic courses for the students at all Universities in the world. The different topics inside the discipline differ according to the definite faculty. All of the faculties of mechanical engineering education propose a course in Informatics and the topics inside the course are similar [11].

The necessity of studying the scientific discipline of Informatics is at the core of the globalization of the information society in theoretical and practical aspect. Although the specialty of the students has an important significance in determination of the tangible areas of study, the general principles, methods and approaches are common and do not depend on the particular application. In the modern dynamic world, the informatics as a scientific and academic discipline comes to be a driving factor in addressing the challenges of information technology [12] and information society as a whole. That means that a system of approaches and methods for acquiring knowledge and skills (acquired at the time of the education and training of students), appropriate to modern circumstances turns to be a necessity.

The challenges in the course of Informatics come also with the wide use of the e-learning activities. Some of the main tools for achieving quality and efficient e-learning are the modern multimedia learning environments [13]. Application of computer technology in conjunction with other media such as audio and video equipment create conditions for the organization of mixed architectures and their automatic control in dialog mode. In the spirit of the latest technologies, developing very rapidly may be reviewed the Top 10 Global Trends in ICT and Education [14]: Mobile Learning, Cloud Computing, One-to-One computing, Ubiquitous learning, Gaming, Personalized learning, Redefinition of learning spaces, Teacher-generated open content, Smart portfolio assessment and Teacher managers/mentors.

These trends are expected to continue and to challenge many of the delivery models fundamental to formal education as it is practiced in most countries. It will be interesting for us, for the goal of the project, to get feedback from the teachers for the information resources which they used in their practices [13].

4. Innovative approach in Assessment

In the scope of the TeSLA project an innovative solution in students’ assessment in the Informatics course was applied to face several of above mentioned challenges:

(1) The environment of assessment was technology enhanced – the system TeSLA for online assessment with functionality for e-authentication and authorship verification was adopted.

(2) The assessment scenarios were re-designed and improved – the offline assessment was transformed into blended assessment combining offline and online assessment activities.

(3) The online assessment activities were precisely designed with aim the suitable match between curriculum tasks and tested TeSLA instruments to be found.

A model for eAssessment was developed to provide adaptable, flexible, high-quality formal assessment environment to support students in their assessment activities and learning during the Informatics course (Figure 2). The eAssessment were performed in Moodle Learning Management System where the TeSLA system is integrated in the form of plugins with five instruments: face recognition (FR), voice recognition (VR), keystroke dynamics (KD), forensic analysis (FA) and plagiarism check (PL). During the course Informatics all these TeSLA instruments were tested considering the specificity of the course tasks and assessment activities. Three assessment activities were re-designed to fit the TeSLA system functionality.

The first assessment activity was explorative one, focusing on preparation of a technical report at home. It should summarize students' knowledge about a given topic in the area of programming. Learning objectives were: students to be able to extract important information related to a given topic, taking into account the course materials and all additional resources and to be able to write a scientific report. This activity contributes to the students' competency to be able to conduct research on a given topic and to prepare the report in ethical way. The teacher's role was to consult students in the researched domain and to instruct them how to perform this activity in Moodle and TeSLA. She/he supervised the submission of individually prepared report when it is submitted from the university. Two instruments were used: FR for students' authentication and PL for authorship check. Typically, this activity in the face-to-face scenario is performed in the following way: the students send via email or print their reports for evaluation by the teacher and usually, the teacher does not use software for plagiarism to check the students' work. The TeSLA system in this case gives possibilities for students' authentication and for plagiarism check to prove the work uniqueness. The assessment activity combines formative assessment, giving feedback to students and teachers and summative assessment, contributing to the achieved results with 25% of the final mark formed at the end of the semester.

The second assessment activity was designed in the form of an online quiz and the students had to answer a given question to check their new knowledge. The students had to explain their understanding on a given topic using received new knowledge during the lecture time. Learning objective of this assessment activity was the students to be able to understand and summarize new knowledge and the applied competency was to be able to understand course theory. The role of the teacher was to monitor the students' activity performance. Two instruments were used: FR and FA. FA was used to prove the originality of the short-written answer of the quiz. FR contributed to the students' authentication. In the face-to-face scenario, the students answer on the posed questions is in written form and the teacher recognizes the students enrolled in the course meeting them in the class room. The TeSLA system gives possibility the students' authentication and recognition of their written work to be performed automatically. The assessment activity used combination of formative assessment, giving information to students and teachers and summative assessment contributing to the achieved results with 15% of the final mark formation at the end of the semester.

The third assessment activity was oriented to the students' self-assessment. The students had to evaluate their course work through comparing the expected and achieved results. The learning objectives were the students to be able to develop a solution of an engineering task applying their theoretical and practical knowledge and skills and to be able to self-assess their work. This assessment activity contributes to the students' competency to be able to make a decision and to the competency to perform self-assessment and critical analysis. The teacher's role was to supervise students during the task performance and its submission. In this assessment activity two instruments were used: KD and VR. They both contributed to the student identification. These instruments allowed students to describe expected and achieved results.

The assessment activity is used for combination of formative and summative purposes and the achieved results contributed to 20% of the final mark formation at the end of the semester.

eAssessment environment – Moodle, TeSLA system

eAssessment scenario – individual tasks

Assessment activity	Student role	Teacher role	Assessment type	Location	Tested TeSLA instruments
1: Preparation of a technical report	-to prepare the report -to submit it	-consults -instructs	formative & summative	-preparation at home -submission at university/home	FR and PL
2: Answering a given question to check new knowledge	-to take the quiz	-monitors the student's performance	formative & summative	at university	FR and FA
3: Self-assessment	-to self-evaluate	-supervises	formative & summative	at university	KD and VR

Fig. 2 eAssessment model applied in the Informatics course

4. Conclusion

The paper summarizes the gained experience during the provided experiments with the TeSLA system in the Informatics course. A model for eAssessment is developed to facilitate the teachers and students' activities. It is verified with 150 students, testing all available TeSLA instruments, carefully chosen to improve assessment activities. The conducted experiment shows that the type of activities requires utilization of one or more TeSLA instruments. Our recommendation is usage of two or more instruments for an assessment activity that will guarantee the correct students' authentication and in parallel verification of the students' work. The TeSLA system is adaptive and could be used in a wide variety of assessment scenarios contributing to the organization of a flexible eAssessment. It is trust-based proposing mechanisms for e-authentication and verification of the students authoring and writing style.

The TeSLA system proposes huge possibilities for applying innovation in real educational practice improving the eAssessment environment, students' experience and teachers' pedagogy as well as the educational quality at whole. Technical University of Sofia as a blended institution, preparing engineering professionals, taking the advantages of offline and online assessment activities through precise design of assessment scenarios considering the applied context and the specific characteristics of every course. The Informatics education benefits the modern approach for eAssessment with the TeSLA system, including contemporary software technologies and pedagogical emerging practice.

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ИНОВАТИВНО РЕШЕНИЕ ЗА ЕИЗПИТВАНЕ В ОБУЧЕНИЕТО ПО ИНФОРМАТИКА: ИЗСЛЕДВАНЕ НА СЛУЧАЙ

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Резюме: *Понастоящем, цифровият свят и формирането на цифрово общество е реалност и обучението по Информатика допринася за неговото развитие. Очакванията на студентите относно преподаването, обучението и изпитването са повишени, поради техните съществуващи компетентности за работа в цифрова среда. Статията представя резултати от извършен пилотен експеримент по проекта ТеСЛА със 150 студенти, включени в курса по Информатика от различни факултети на Технически университет - София. Извършен е анализ и дискусия на разработения и верифициран модел за еИзпитване.*

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