On-line testing in computer science as an opportunity to enhance the independent work of higher education institution students

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ABSTRACT: Student-centred education enables students to develop skills and attitudes, including self-determination that are crucial for their future studies and later for their productive participation in society. The emphasis in skills development is on being independent and motivated, which will be beneficial once the graduates undertake work as qualified specialists. The purpose of this study was to develop a model for organising on-line testing in computer science for students in higher education institutions to enhance their independent work. The methods deployed for this study included a survey of students on the factors that activate their independent work during training, pedagogical observation and expert evaluation of the effectiveness of the developed model for on-line testing of computer science students. The findings indicate that the developed model will support the effective training of computer science students. The new arrangement for on-line testing will enable students to develop high self-esteem, initiative and a goal-oriented mindset that will contribute to their successful future career.

INTRODUCTION

Currently, on-line testing is an important component of the educational process, which has become even more relevant in view of distance education. It has a special role in the methodological foundations of pedagogy; it is used to generate and assess results, which are an indicator of the assimilation of the material by students. On-line testing optimises the educational and evaluation process, and it allows for analysing students' level of knowledge in a shorter time [1]. There are different forms of computer testing, and they differ from each other, depending on the technological framework of the tasks involved. However, the capabilities of modern technology and science allow creating conditions within that framework for the development of motivation required in independent learning of students [2]. Considering that, there is a need to create a form of on-line testing that will not only assess the actual knowledge of students, but also their attitudes and values. That type of testing would create a proper direction for future professional activity and will allow timely adjustments to the learning process. It would focus the teacher not only on gaps in students' knowledge, but also on their behavioural traits [3][4].

Computer science is an extensive area with various special tools enabling on-line testing that can activate students' independent work, thus positively impacting on their motivation increasing confidence in their professional skills, and creating opportunities for self-realisation The teacher should monitor, analyse and encourage this development that would strengthen the professional qualities of the student [5][6]. However, the available methods of on-line testing do not necessarily allow the teacher to observe and evaluate the reactions of students during on-line education and testing, therefore, there is a need to organise the testing in such a way that would allow proper in-depth knowledge assessment, as well as assessment of personal characteristics and qualities crucial for successful professional activity in the future society [7]. Hence, the purpose of the study outlined in this article was to develop a model for on-line testing in computer science for students in higher education institutions to enhance their independent work.

MATERIALS AND METHODS

The methods deployed in this study, included surveying students on the factors that could enhance their independent work during training, which clarified issues regarding their motivation and the need for independent activity. Also, were deployed pedagogical observation and expert evaluation of the results of the developed on-line testing model in computer science.

The survey of students was focused on identifying specific features that strengthen their aspirations and motivation, and also on general characteristics that encourage them to be independent, which encompasses good self-regulation of emotions and actions, ability to control themselves, being calm and focused in situations related to the educational process and during on-line testing.

Thus, a detailed analysis of the survey data, pedagogical observation and further expert evaluation of the results of student' independent work made it possible to determine the criteria necessary for creating a model for on-line testing in computer science. Standard mathematical methods were used to calculate the results, which were tabulated for better analysis and comparison.

The experimental base of the study comprised two higher education institutions Russia: the National Research University Higher School of Economics (HSE University) and Siberian Federal University. The survey was conducted among 83 students in their 3rd and 4th year at the two universities, including 21 females and 62 males. The age of the respondents was within the range of 20-25 years. The study was carried out in three stages:

- at the first stage, a theoretical analysis of existing methodological approaches was carried out for organising on-line testing to enhance independent work in philosophical, psychological and pedagogical scientific literature, dissertations on the problem, as well as the theory and methodology of pedagogical research; the problem, purpose and research methods were identified, an experimental research plan was drawn up;
- at the second stage, a survey of students was conducted, indicators were clarified and criteria formulated for developing a model for organising on-line testing in computer science to enhance the independent work of higher education institution students; experimental work was carried out, the conclusions obtained during the experimental work were analysed, verified and clarified;
- at the third stage, the experimental work was completed, the theoretical and practical conclusions were consolidated, the results obtained were generalised and systematised.

RESULTS

In the survey, the data of higher education institution students were obtained reflecting indicators necessary for the identification of personal motivation for independent work, such as motivational targets, content, procedure, performance-evaluation and structural types of them.

In general, professional activity is a multidimensional and multilevel engagement. It is influenced by both personal qualities and acquired motivational directions, which enhance the overall personal attributes of the future specialist. The deepening and strengthening of these qualities should be aimed at the activation of independent work of students and other persons [8][9].

This aspect has an associative connection with work performance at present and in the future. Knowledge of common motivational elements is important for developing a model for on-line testing in essentially any subject, including computer science. That type of testing would positively impact on the professional activity of a higher education institution students, as well as their personal and social activities [10].

In this study, the emphasis was placed on the patterns necessary for the development of a model based on the selected criteria in terms of the students themselves and their personal motivation in enhancing their independent work. Thus, these components of the study, combined and comprehensively considered, supported the development on-line testing aimed at activating independent work of students.

The expected result of the study was a functional model of on-line testing in computer science, stimulating personality-oriented development based on the activation of independent activity in the educational process.

A total of 83 students from two higher education institutions studying computer science were included in the study. Based on the diagnostic survey's results, crucial indicators and criteria were identified that affect the development of motivation and activate the need for independent work. The factors indicated by respondents included:

- possibility of creative implementation turned out to be an important factor for the majority of respondents - 79 students (95%);
- absence of various distracting features in the testing program, such as animated objects, a time indicator, unwanted pop-ups and other things, everything that is accompanied by movement, interactivity - 83 students (100%);
- no time boundaries, so that it would be possible to think, create, analyse, and proper conditions for a balanced emotional background - 83 students (100%);
- ability to demonstrate one's extensive knowledge in the field of computer science and programming, and not only the knowledge within a narrowly asked questions - 75 students (90%);
- understanding the reason behind spending time and performing independent work within the framework of on-line testing - 83 students (100%);
- provision of conditions and certain comfort necessary for their fruitful independent work and activity (for example, ability to leave the computer for 15 minutes or walking around the room, taking a sip of water, which would contribute to more productive thinking); thus, they need a test either without a time limit or with the possibility of stopping the time indicator of work performance, which implies breaks within the task of analysing and comparing facts, and clarifying points based on their knowledge of theoretical and practical aspects - 64 students (77%);

- ability to return to previous levels of the answer in order to supplement it in connection with the analysis conducted - 83 students (100%);
- absence of external distractions, which, according to students, are often present at the testing, or rather in 99%, these include supervising teachers' conversations, explanations to a nearby student, a teacher talking on the phone, the sound of a lawnmower coming from a window or shouting in the corridor;
- absence of irritated and angry comments from teachers before testing, which can decrease students' self-esteem and cause anxiety, preventing them from being calm and doing well in on-line testing - 83 (100%);
- a clear description of the assignment in understandable and simple wording is necessary, and for better performance in on-line testing, a large set of programming and creation tools is also required - 83 students (100%);
- an aesthetic interface background suitable for testing and professional tools are needed to pass the test - 76 students (91%);
- interest in the test was important for all students 83 (100%).

The main criteria or conditions required by students for passing on-line testing are included in Table 1.

Table 1: Students' main criteria for on-line testing as part of the activation of their independent work.

	Percentage of students
Good technical equipment	100%
Creativity	95%
Lack of interactivity on screen	100%
Ability to reflect on decisions - time	100%
Emotional testing background	100%
No strict time limits	100%
Self-development, self-realisation during the test	100%
Relevance of the test task to the individual	100%
Ability to fulfil personal needs during the test	77%
Ability to go back to a previous task	100%
Absence of external interference	100%
Clear form and method of presenting the task	90%
Aesthetics	91%
Interest	100%

The factors that influence the formation of students' motivation for independent work reflect the need for psychological health preservation and show intellectual, creative and attitude elements that need to be fulfilled at the personal level. The implementation of the outlined criteria may contribute, in a longer term, to the discovery of personal talents, status and prestige formation among colleagues, fellow students and broader society and, most importantly, may enable the creation of healthy and productive work culture for future specialists in their professional field of activity.

The data obtained at each of the three stages of this study were analysed as shown below.

At the control stage of the study, the developed model of on-line testing was checked and the data revealed on the formation of motivation and interest in independent work among respondents. The obtained data from a repeated survey of 83 students made it possible to conclude about the effectiveness of the on-line testing model in the form of independent, individual creation of a Web quest, taking into account the identified criteria for students.

Creating a Web quest to pass the test was interesting for 83 students (100%), but a third of them - 27 students (32%) had difficulties with some of the tasks, which indicates an insufficient level of their knowledge, while 74 students (89%) noted that they fulfilled their potential based on the creative component.

Increased motivation to pass such on-line tests without a time limit and with the preservation of the above conditions was evident in 83 students (100%). Even those students who found it difficult to work on some aspects while solving tasks said that they would study these topics independently and would again try to pass this type of testing, which shows that the model for on-line testing activated independent work.

All students noted that they appreciated the value of such testing and the criteria that increase their self-realisation since the on-line tasks were created and grouped with guiding elements to create a Web quest. Through those quests, students could express their creativity and their potential considering the great opportunities and variations of topics and directions in the Web quest they generated.

The effectiveness of this on-line testing was also determined by the indicator of extensive knowledge and skills required for creating a Web quest, which was assessed for quality during the testing (Table 2).

Table 2: Formation of the attitude for independent work after testing within the framework of the developed model.

	Percentage of students
Desire to be tested again	100%
Assessment factor of knowledge and skills	100%
Self-realisation	100%
Interest	100%
Motivation	100%
Creativity	89%

The obtained data indicate that the identified factors and the model of on-line testing in computer science can activate the motivation for independent work among students in higher education institutions. In the future it will help them to express themselves at the expected level during the educational process by taking an active part in it. The correctness of the study was ensured by proper matching in regard to the characteristics and data parameters of the questionnaire and the developed criteria. The analysis of the research results demonstrates the effectiveness of the developed model in enhancing independent activity of higher education institution students.

DISCUSSION

In modern education, it is important to consider psychological and pedagogical aspects in preparation for any type of testing, including on-line [11]. Therefore, the organisation of on-line testing should also be comprehensive and include physical, psycho-emotional and social factors related to the student. In this study, motivation was considered an essential component of self-study and independent work aimed at deepening students' knowledge and self-realisation, thus preparing future graduates for further independent work in their professional field. The independent approach to learning can also increase the effectiveness of interaction with, and between students, as each one of them can be viewed as an individual with unique characteristics. In this context, independent classes can be organised to ensure that all multi-level factors affecting students' future professional work are properly addressed. [12].

Effectiveness and success in professional activity is connected to the entire learning process including pedagogical support and trusting interaction of all participants in the educational process from the student to teacher [13][14]. The selected aspects of psychological and pedagogical support of testing have several directions: individual motivational, psychological and therapeutic, training.

Some factors/criteria, that emerged during the on-line testing in this study, and which were related to situations and concepts important for students, could have a psychological and therapeutic effect. They could increase students' motivation for learning and self-studying in an environment that allows maintaining a sense of harmony, and a calm psycho-emotional state conducive to knowledge acquisition and its implementation with an analytical and deliberate approach to long-term consequences. This approach to testing allows to identify deep-level criteria for evaluating knowledge and skills within the framework of the developed model.

The training aspect of this model of testing refers to the actual creation of a personal Web quest, during which students need to apply all the gained knowledge in the field of computer science at its high level. The testing results demonstrate the ability to use one's knowledge and skills for successful application in practice. During the testing, positive personal attitudes are strengthened and self-esteem, awareness of one' own significant potential as a future specialist increase. This in turn, enhances motivation for further training and self-education, and thus encourages and activates the independent work within the chosen field [15-17].

Analysis of the mistakes made during testing is necessary to generalise the situations and tactical factors for creating, such as in this case, a Web quest. The teacher should also explain how best to act in a particular situation, speak respectfully to the individual and find reasons for praising each student [18-20].

In view of the psychological, pedagogical and other considerations outlined in this article, teachers and the entire staff of higher education institutions, who accompany students during their studies, should be mindful of their behaviour, words and actions as these could determine the state of affairs related to studies, as well as affecting students' personal and future professional life. When practicing their profession, graduates must take full responsibility for their performance within the chosen profession to create conditions for the development of society to improve its quality of life, level of well-being and health protection at all stages of life [21].

Teaching staff have to master the skill of identifying not only general, specific requirements of an individual student, taking into account personal, emotional and volitional characteristics. Individual styles of learning and presenting information will, in the future, be manifested in their professional activities [22].

The continuity of psychological and pedagogical support based on the identified indicators will allow to correct any shortcomings throughout the educational process. This support should strengthen students' personal qualities, including concentration, personal perception, proper assessment of one's capabilities, the pace and rhythm of assimilation of

information, knowledge, and skills acquisition. This will create conditions for the realisation of the potential of each individual, both at present and in the future [23].

The qualities described above also depend on the formation of the ethical traits of the student's personality, which will be seen in the motivational and value orientation of the created Web quest. In creating a Web quest, certain personality traits will be manifested, such as self-criticism, suspiciousness, the general intensity of emotional experiences, attitude to personal successes and failures, the presence of emotional breakdowns during training, suggestibility, and others. Those traits should be considered and, if needed, compensated for through psychological and pedagogical support during the educational process. At that time, students will get familiar with methods of self-regulation, which will have a therapeutic effect and contribute to the strengthening of their personal qualities useful in solving many controversial situations that may arise in their future professional career [24].

The tasks included in the developed on-line testing model are diverse, and directed at stimulating and sustaining students' interest in passing the test. Thus, evaluation of the model's effectiveness includes cognitive activity of students, the speed of assimilation of new information, flexibility and coordination of their mental activity, as well as other indicators, including those formed during training [25].

It is important to note that these indicators can be determined specifically during the outlined form of on-line testing, which is different to other forms of testing, as it has to be based on the identified criteria described earlier and on creating a Web quest.

CONCLUSIONS

It was found that the application of the on-line testing model with the creation of a Web quest will contribute to successful education and future professional career of computer science students in. With this arrangement of on-line testing, including psychological and pedagogical support, students will develop higher self-esteem, creativity, motivation that will prepare them better for professional challenges in the future. Based on the selected principles that strengthen the motivation to study and pass the test, according to the survey of students, it was possible to create a fully-fledged model of on-line testing for training highly qualified specialists able to contribute to society at all levels.

The considered form of on-line testing will have a strengthening effect on the psychological health of students and will contribute to increasing and preserving their professional capacity in the future. The identified and considered features of the on-line testing model allow students to realise their personal potential through competent psychological and pedagogical support. The model is a powerful tool for achieving positive results in the educational process that is focused on individualisation. Every teacher and student should understand that without an individual approach and competent psychological and pedagogical support, it is impossible to achieve great success.

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