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### **Study on students' readiness and satisfaction with the use of online information technology capabilities as a tool for control and assessment in chemistry and environmental protection education**

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**Abstract:** *Over the last decade, the capabilities of information technology in the field of education have grown significantly. A large number of platforms have been created with different functionality regarding the training, sharing and dissemination of information in the form of reports, abstracts, essays, videos, etc., as well as for carrying out different forms and types of control and evaluation. Some of these platforms are Google Drive, Moodle, Ucha.se, etc. Particularly noteworthy are those who provide opportunities for the teacher's personal intervention in creating relevant, tailored, and taught teaching content to form an appropriate testing and evaluation. However, education in the various disciplines of the high school curriculum becomes more and more inconceivable without the inclusion of the broad possibilities of the IT tools. In this paper, we report the results of our study on the attitudes students in high school education in the course of chemistry and environmental protection to use information technology tools as a tool for learning and controlling and evaluating academic achievement. Some conclusions about the degree of student achievement in the implementation of electronic forms of control and assessment have also been done.*

**Keywords:** *electronic tests; control and evaluation*

#### **Introduction**

The current rapid development of science and information and communication technologies, as well as changes in the socio-economic situation in the country, are increasingly posing a number of problems and challenges for education. Modern techniques and technologies lead to the creation and introduction

into practice of new forms, methods, techniques and means of training and upbringing, to a new way of pedagogical thinking and pedagogical attitude. The development of traditional subjects in the compulsory high school education course seems almost unthinkable without the use of information technology capabilities, especially if the purpose of this training, apart from mastering the compulsory material, also involves attracting attention and creating lasting interest in learners. Each discipline in the compulsory curriculum can be made more accessible, attractive and develop greater opportunities for teaching, learning and self-assessment, with the intervention of the IT toolkit. Unfortunately, the use of this tools, especially in its control and evaluation part, is poorly practiced. Useful developments and examples regarding the application of various accessible online platforms in the assessment process of trainees in various fields of natural sciences are almost absent in the scientific literature. The examples available in the literature are mainly related to the developed distance education courses in higher education [1, 2].

A poorly used practice in modern high school is the use of electronic tests to control and evaluate students' knowledge and skills. It is still rare to use a tablet, computer or smartphone as a test tool, and providing electronic tests to students on-line is a near-non-existent practice. As an assessment tool in the course of chemistry and environmental protection, the application is considered in this development of electronic tests as a means to improve the organization of control and assessment of students' knowledge and skills and increase their average success. The Google Drive free online platform was used to create the self-assessment tests in this survey.

The purpose of this study is to demonstrate the capabilities of the Google Drive online platform for the development of electronic chemistry and environmental testing tests as a means of improving the process of control and evaluation of students' knowledge and skills and increasing their average performance.

### **Theoretical statement**

Information technologies used to collect and evaluate responses in education are extremely applicable when they are introduced in on-line platforms. They make possible student access to tests, surveys, worksheets, etc. at anytime, anywhere. In addition, they can be used to monitor students' progress, facilitate feedback, and empower teachers to evaluate and adapt their teaching strategies and support decision-making. Some results of a study by Natasha Koleva show that Bulgarian teachers have not yet taken advantage of these opportunities, but have been informed of their potential [3]. The most common online platforms for collecting and evaluating answers are: Google Forms, Microsoft Forms, Quizzes, Envision play, etc. Google Forms add-ons help the workflow and facilitate the evaluation and processing of results: Flubaroo, Form Limiter, Teacher Rubric, etc. The first two supplements support the collection and evaluation of responses, and the third - the compilation of a summary/review. The rubrics actively encourage the self-assessment of the trainees, even while working on the assignment. They help teachers to justify the assessment [4].

Working with Google electronic forms significantly changes the habits of teachers' digital skills. Collecting answers from students in this way is unparalleled in previous ways, through tests, worksheets, test papers or classroom papers. Gathering answers through multi-mouse sessions or with real-time remote devices is different from doing tests with GoogleForms, namely - the question at one point is one for the whole class and is projected onto the wall, i.e., all students answer one question at the same time, which affects objectivity [5]. The model for working with an electronic form consists of the following steps: 1) Creating the electronic form; 2) Distribution; 3) Collection of responses; 4) Evaluation; 5) Publishing individual or summary results [5].

There is a wide variety of tools for each of the stages. Particularly interesting are the distribution opportunities, which is also attractive to students: e-mail, social network, social gated group, special site, virtual classroom, QR code, additional resource on the page of e-textbook, etc. For the teacher the methodical benefits are the following: evaluation of the response at the moment; group assessment at question level; group assessment at the level of the whole test (teacher's portfolio, entry/exit analysis, etc.); individual assessment at the whole test level; information on difficult issues; the ability to add a summary to the assessment; graphical representation through diagrams of the evaluated answers; the ability to send the evaluated test by email; ability to print the evaluated test individually or summarize the results; ability

to save the evaluated tests as a file; the ability to mix answers at question-level or all questions in the test, or both [5].

Working with electronic forms is a new skill in the digital literacy of pedagogical professionals. In addition, methodological knowledge of didactics in the field of control and assessment of academic achievement is needed, which makes information technology a powerful tool in the process of assessing students' competences.

### Results and discussion

In order to study the applicability of electronic tests as a control and evaluation tool in the course of chemistry and environmental protection, a pedagogical experiment was conducted in the academic year 2018/2019 at the Dr Peter Beron High School in Varna with 9<sup>th</sup> grade students. The interviewed and tested students were 185. A survey model was made including electronic tests on the following sections; "Metals and their compounds", "Non-metals and their compounds", "Hydrocarbons" and "Hydrocarbons derivatives". The purpose of the survey was to examine the opinion and attitude of the students in the application of electronic tests in the process of control and evaluation during the course of chemistry and environmental protection. In order to increase the objectivity of the answers, the survey was conducted anonymously. The questions asked in the survey are as follows:

1. Do you enjoy playing on a tablet and/or smart phone?
2. Do you use modern information technology in other subjects?
3. Do you like lessons that use modern information technologies?
4. Do you think that you acquire knowledge more quickly when presented through the tools of modern information technology?
5. Do you remember more easily what you saw on your tablet or smartphone screen?
6. If you had free access to a tablet, would you play often?
7. Do you prefer the teaching content to be taught and controlled by the teacher using modern information technology over the classical lesson taught only by the teacher and conducting a paper test?
8. Does working with a tablet and a smartphone in chemistry classes improve your practical work skills?
9. Does a person need to be able to work with a computer?
10. If available at home, would you use electronic self-tests?
11. Do you think that you have been assessed impartially by the electronic test?

Each question was given the choice of five different distractors a) yes, a lot; b) yes; c) I cannot judge; d) not particularly; e) no. The students were given the opportunity to choose only one of these distractors.

Our survey has scaling answers on a symmetrical rating scale from 1 to 5: a) yes, a lot –  $X_i = 5$ ; b) yes –  $X_i = 4$ ; c) I cannot judge –  $X_i = 3$ ; d) not particularly –  $X_i = 2$ ; e) no –  $X_i = 1$ .

After mathematical processing of the results on the symmetric scale system, we obtained data on the frequency of the answers ( $f$ ), the relative frequency of the answers ( $f\%$ ) and the weighted average of the answers to a question ( $X_{pr}$ ), which also determined the conclusions for the opinion of students for using electronic tests as a means of control and evaluation of course of chemistry. Specific results after processing the questionnaire were obtained in the following aspects:

For the attitude of students to modern information technologies - the value of  $X_{pr} = 3.97$  and is calculated on the basis of the formula:

$$X_{pr} = \sum X_i \cdot f / \sum f, \text{ where:}$$

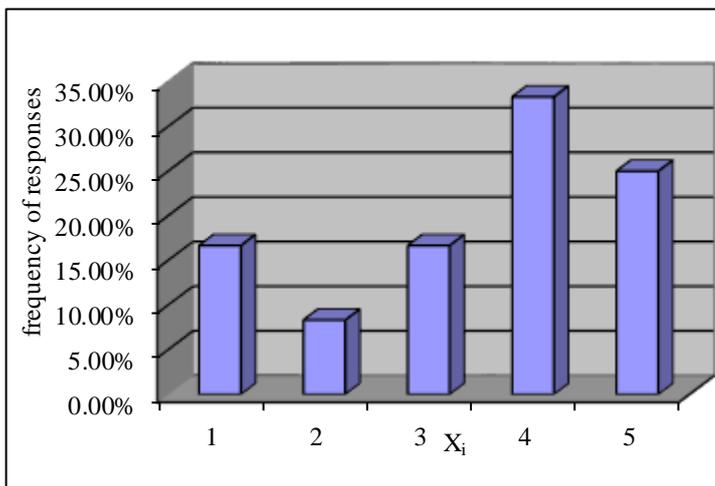
$\sum f$  - sum of the frequency of the answers encountered;

$\sum X_i \cdot f$  - the sum of the product of the number of students, whether the corresponding answer and the value of the corresponding  $X_i$  of the rating scale.

$X_{pr}$  values on this issue (3.97) reveal a positive attitude of students towards modern information technologies.

For the students' attitude towards the use of information technologies in the educational process, the data are presented on figure 1, reflecting the relative frequency of the respective answers.

$X_i$	f	F%	$X_{pr}$
1	2	16.67	3.42
2	1	8.33	
3	2	16.67	
4	4	33.33	
5	3	25.00	

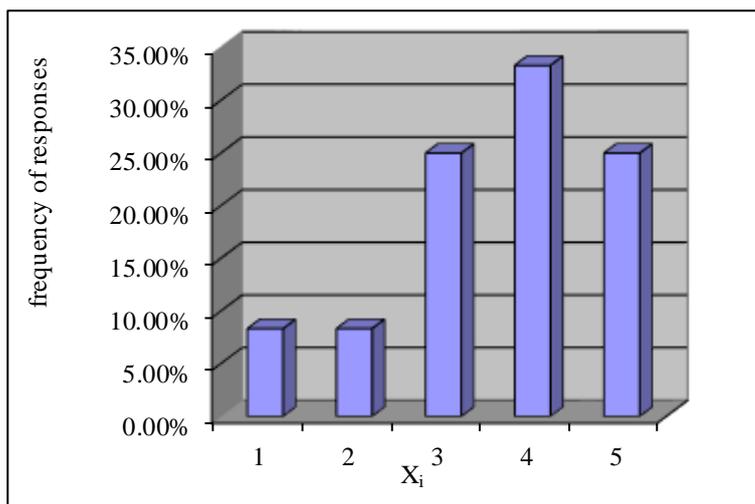


**Figure 1.** Using of information technologies

The processed results confirm our observation that when conducting an electronic test, students like this control method, consider it more impartial and prefer it to a paper-based test.

For the speed of perception of the received information the data are presented on figure 2.

$X_i$	f	F%	$X_{pr}$
1	1	8.33	3.66
2	1	8.33	
3	3	25.00	
4	4	33.33	
5	3	25.00	

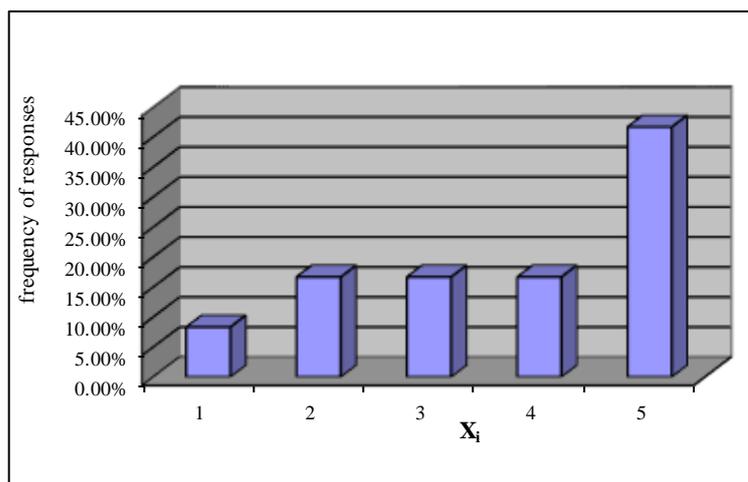


**Figure 2.** Speed of perception of the received information

The results show that 58% of students find their knowledge easier and more relaxed if the test is performed with a tablet or smart phone.

In order to develop practical skills, the survey data shows that students have a good command of information technology and chemistry lessons are elementary to them and do not carry additional practical skills. Only 33.33% of the students think that their skills are improving, 25% cannot judge, and about 42% believe that their skills are not improving. This leads us to believe that the potential of students has not been fully utilized and it is possible to increase the share of working independently with a tablet and a smart phone in chemistry and environmental protection classes. It is also possible to switch completely to self-study through appropriately tailored training programs. The results are presented on figure 3.

$X_i$	$f$	$F\%$	$X_{pr}$
1	1	8.33	3.50
2	2	16.67	
3	2	16.67	
4	2	16.67	
5	5	41.66	



**Figure 3.** For the development of practical skills

When analysing the results of the survey, it is noticeable that those students who have expressed a positive attitude towards the tablet and smart phone and their application in education, more easily perceive and remember the knowledge taught and controlled through modern information technologies.

The research we conducted on the possibilities of using electronic tests as a means of control, self-control and evaluation gave positive results. The average success of students in conducting electronic tests increased, their knowledge and skills improved. The students showed a positive attitude towards conducting tests with an "impartial" assessor in the face of a tablet and smart phone. In addition, they expressed a positive attitude to the ability to use the test as a self-control at home when the test is being performed on-line in Google classroom.

### Conclusions

Nowadays in the dynamic information technology environment, the learning process needs to be innovative in terms of methods, tools and technologies so as to prepare young people for a different environment of realization and quality of life. The use of electronic didactic tests in chemistry and environmental protection course leads to an increase in success and improvement of the level of knowledge and skills of students in the subject matter taught, contributes to the more lasting absorption of knowledge and skills and their future application in practice.

Independent use of a tablet and smart phone during the test leads to improved quality of control by introducing an "impartial" machine that assesses students' knowledge and skills, which makes the control objective and gives students a positive attitude towards the material taught and the learner. Last but not least, conducting electronic tests via a tablet and smart phone improves students' digital competence in completing their high school education.

Of particular value to the dynamic electronic test is its ability to be used as a means of control simultaneously by a group of students, as each of them receives a separate set of questions randomly selected from Google Drive, and in the event of a coincidence, no exchange is possible between students because the order of distractors in the test changes with each restart. In addition, the test can always be supplemented with new questions.

The ability of the online test to be used as a tool for self-study or self-control by students makes it a modern learning tool, which should be applied in the new modern school of the 21<sup>st</sup> century.

The experimental work carried out and the results obtained from the pedagogical research justify the following conclusions:

1. The course of Chemistry and environmental protection in grade 9<sup>th</sup> degree provides opportunities for the use of electronic tests in the learning process and for generating interest in the subject.
2. The goals set at the beginning of the study were met above 80% in conducting the electronic tests, with the average student achievement in the experimental group having increased to the Very Good 5.34, which we take as a measure of the effectiveness of the method.

3. Conducting electronic didactic tests increases students' interest in the subject because it positively influences their view that their knowledge and skills are properly and impartially assessed by the computer and not subjectively by the teacher.

4. Selective answer questions are appropriate to test students' knowledge of the first level of competence. This type of task is preferred by the students.

5. It is of particular interest to use the test as a tool for self-study and self-control, especially by students who were absent from teaching the relevant teaching material. This quality of the test has another positive side - it can be used by self-study students who for health or other reasons do not attend the classes, i.e. the test is a "harbinger" of the possibility of organizing distance learning in the high school stage of secondary education.

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