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ENHANCED TESTING FOR EDUCATION IN EMERGENCIES

The COVID-19 pandemic completely changed the context in which traditional education had taken place. There was an urgent need to find efficient techniques to solve the problem of engagement, performance and academic motivation. For this reason, the researchers designed a learning model based on enhanced web-quizzing. The paper depicts the experience of exploiting the web-quizzing with the aim of investigating its potential in the emergency educational setting.

The purpose of the article is to describe the testing procedure and the impact of the suggested sets of specially designed course-related web quizzes on students' learning. The paper provides a detailed analysis of a set of cloud-based tests generated in various online applications, divided into 4 main groups according to their purposes and places in the educational process.

In summary, the authors conclude that thoroughly designed continuous enhanced testing proves to be not only a technique for assessing learning progress and skill acquisition but primarily an effective teaching and learning tool facilitating students' engagement in the altered learning environment, reinforcing understanding and active learning the target material, stimulating various cognitive mechanisms and boosting retrieval and long-term retention. The results of the experiment demonstrate a strong positive effect of enhanced testing on academic performance and students' achievement, proved by the fact that the scores obtained by the students on formative tests correlate with the final summative examinations. The use of web-quizzing and access to digital learning resources in an online classroom setting characterized by the combination of teacher-guided, collaborative and personalized learning helps students to develop self-confidence, reduce anxiety and fear, and overcome the difficulties of the altered reality, arise the interest of students in learning and increase academic motivation in conditions of emergencies. This methodology can be interesting for teachers struggling to cope with the difficulties concerning education in emergencies caused by the Russian aggression.

Key words: *testing effect, academic performance, engagement, motivation, education in emergencies.*

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РОЗШИРЕНЕ ТЕСТУВАННЯ ДЛЯ НАВЧАННЯ В НАДЗВИЧАЙНИХ СИТУАЦІЯХ

Пандемія COVID-19 повністю змінила контекст, у якому проходила традиційна освіта. Виникла нагальна потреба знайти ефективні методи розв'язання проблеми залучення, результативності та академічної мотивації. З цієї причини дослідники розробили модель навчання, засновану на розширеному використанні вебтестування.

Стаття описує досвід використання вебтестування з метою дослідження його потенціалу в надзвичайних навчальних умовах.

Мета статті — описати процедуру тестування та вплив запропонованого набору спеціально розроблених вебтестів для навчального курсу студентів. У статті наведено детальний аналіз набору хмарних тестів, створених у різних онлайн-додатках, розділених на 4 основні групи відповідно до їх призначення та місця в навчальному процесі.

Підбиваючи підсумки, автори дійшли висновку, що ретельно розроблене постійне тестування виявляється не лише технікою для оцінювання прогресу навчання та набуття навичок, але насамперед ефективним інструментом викладання та навчання, який полегшує залучення студентів до зміненого навчального середовища, зміцнюючи розуміння та активне засвоєння програмного матеріалу, стимулюючи різні когнітивні механізми та посилюючи пошук і довготривале збереження матеріалу у пам'яті. Результати експерименту демонструють суттєвий позитивний вплив розширеного тестування на навчальну успішність і досягнення студентів, що підтверджується тим, що бали, отримані студентами на формувальних тестах, корелюються з результатами підсумкових іспитів. Використання вебтестування та доступу до цифрових навчальних ресурсів у онлайн класі, що характеризується поєднанням навчання під керівництвом вчителя, спільного та персоналізованого навчання, допомагає студентам розвинути впевненість у собі, зменшити тривогу та страх і подолати труднощі зміненої реальності, викликає інтерес студентів до навчання та підвищує навчальну мотивацію в умовах надзвичайних ситуацій. Ця методика може бути цікава викладачам, які намагаються долати труднощі навчання в надзвичайних ситуаціях, спричинених російською агресією.

Ключові слова: ефект тестування, успішність, залучення, мотивація, освіта в надзвичайних ситуаціях.

Problem statement. The COVID-19 pandemic completely changed the context in which traditional education had taken place. The new one was initially chaotic and challenging for both teachers and students that came across various problems – unfamiliar software, disengagement issue, psychological difficulties, etc. Educationalists even predicted considerable learning loss (Kuhfeld et al., 2020). The new circumstances also strongly influenced students' assessment as testing in a remote format was less controlled and could not provide the integrity of obtained scores. There was an urgent need to find efficient techniques to solve the problem of engagement, performance and academic motivation. For this reason, the researchers designed a learning model based on enhanced web-quizzing. It was suggested that regularly administered online-generated tests utilized as a learning tool could support learning in various ways. The recognized potential of the testing effect could benefit students' achievements in the final test through better understanding and repeated exposure to the learning material during the course, the immediate feedback could change their attitude towards the activity, and the applied flipped class approach could improve engagement.

Recent research and publications. The testing effect phenomenon is understood as the finding that test performance is better after repeated retrieval than after repeated studying (Karpicke, 2009). It is attributed to the fact that, in testing, information processing and retrieval are essential, they stimulate various cognitive mechanisms, which in turn influences learning and long-term retention (McDaniel et al., 2007; Karpicke, Roediger, 2007). Grimaldi and Karpicke state that even inaccurate retrieval can improve later retrieval, thus improving test scores (Grimaldi, Karpicke, 2012).

The potential of testing effect in the educational context is studied in a substantial amount of research which admits that regular testing improves understanding and active learning (Halamish, Bjork, 2011; Ong et al., 2021) as well as influences academic performance (Galizzi, 2010; Brown, Tallon, 2015). Some scholars study the correlation between the results obtained on formative tests and the final summative tests (Galizzi, 2010; Butler, Roediger, 2007). Various research observes two types of the testing effect. The backward testing effect shows that testing consolidates retention of studied information (Yang, et al., 2018; Roediger, Karpicke, 2006; McDaniel, et al., 2012; Roediger, et al., 2011). The forward testing effect improves learning of new information (Pastötter, et al., 2013; Yang, et al., 2018).

The theoretical framework explaining the testing effect phenomenon includes several theories. Additional Exposure Theory suggests that enhanced learning and retention are the results of regular exposure to the target material and available feedback feature promotes engagement and students' autonomy (Butler, Roediger, 2008; Szupnar, et al., 2007). Retrieval Effort Theory states that failure in previous tests stimulates students to retrieve information in subsequent tests and more demanding retrieval practice improves long-term memory (Karpicke, Roediger, 2007). Motivation theory proposes that frequent testing makes students apply more effort to learning which leads to improved attendance and better preparation for new classes (Yang, et al., 2018). Transfer-Appropriate Processing Theory claims that acquisition tests and final assessment tests demand similar mental processes that is why testing is more beneficial when the test formats of the two stages are similar (Chan, 2018). Frequent testing can help reduce the anxiety

that students may experience during a test (McDaniel, 2007).

Consideration of the potential of the testing effect in the design of new instructional approaches can promote successful teaching in emergencies-altered education.

The purpose of the article is to describe the testing procedure and the impact of the suggested sets of specially designed course-related web quizzes on students' learning. This methodology can be interesting for teachers struggling to cope with the difficulties concerning education in emergencies caused by the Russian aggression.

Research course. The researchers conducted an experiment with the aim of investigating the potential of educational web quizzing tools. For this purpose, a set of cloud-based tests generated in various online applications was designed. The tests were divided into 4 main groups according to their purposes and places at the educational process. The main test types exploited during the research to motivate students, to evaluate and assess learning progress and skill acquisition and reinforce learning were the following.

Diagnostic tests were aimed at placing before lessons and contained new information of upcoming lessons to test students' prior knowledge on the topic, their understanding of the basic concepts, their assumptions and to boost their interest in the target material. The value of diagnostic tests lies not in the quantitative assessment of students' knowledge, but in predicting further tutor's actions in the class. The diagnostic tests were ungraded, being a measurement tool for educators, the interpretation of their results and immediate feedback to students' answers served the educational aims, enabled researchers to shape the teaching process, to arrange the course content efficiently and to save time – during the further classes they could concentrate on the points which were more difficult or controversial.

An initial baseline test, an example of diagnostic tests, with 2 to 3 open-ended, 5 to 6 short answer, or 6 to 10 multiple-choice or true-false questions was exploited by the researchers to assess the students' knowledge level in all the groups. The screenshot of the true-false diagnostic test prepared on the Kahoot platform and taken in Zoom is shown in Figure 1.

At the end of the course researchers referred back to the baseline test results to analyze student progress in the benchmark assessments.

2. *Formative tests* were given during classes in an ongoing format or after them with the purpose to monitor students' learning progress, their understanding of the material under study, to identify weak points and to address them immediately by provid-

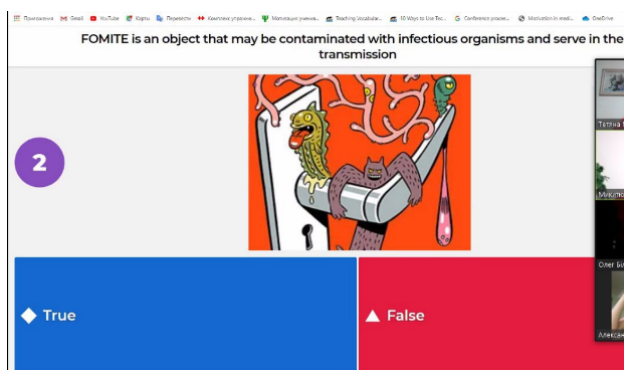


Fig. 1. A true-false diagnostic test created using Kahoot

ing immediate feedback indicating which aspect they have to focus on. We consider that carefully arranged questions of the tests with obligatory repetitions promote deeper understanding of the topic and refining of course knowledge and skills. Formative tests were designed to improve teaching and learning simultaneously.

The researchers applied formative assessment strategies, in particular, “admit slips”, “exit slips (or “exit tickets”)", clicker questions, weekly quizzes, 1-minute reflection writing assignments, tests for assigned readings to define their educational effects in the experimental groups in comparison with the control groups where such strategies were not used. The authors of the research exploited the abovementioned assessment strategies before, during and after a lecture or a class period depending on the purpose they wanted to achieve. They tried not only to arise interest in the experimental groups but to create relevance for students' academic needs. The screenshot of the multiple-choice formative test prepared on the Vocabulary.com platform is shown in Figure 2.

Among the formative assessment strategies used by the researchers in their corresponding experimental groups were the following.

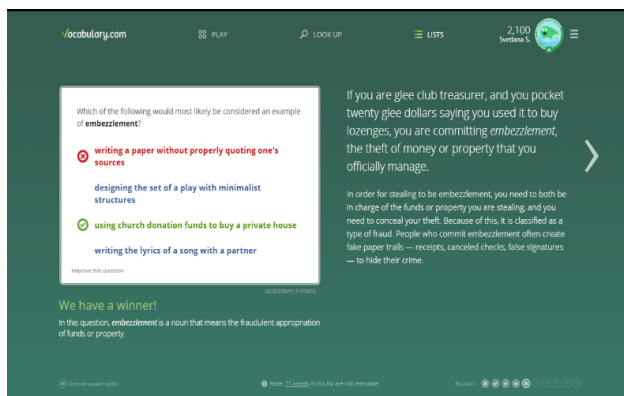


Fig. 2. A multiple-choice formative test created using Vocabulary.com

a. “Admit slips” was a strategy used at the beginning of a class or a lecture where students responded to a question to determine what students had retained from previous learning experiences.

b. “Exit slips (or “exit tickets”) was a similar strategy where students responded to a question, solved a problem, or summarized their understanding after a particular learning experience at the end of a lecture or class period. Feedback indicated how to modify the next lecture or class material and to address notions that students had failed to comprehend or skills they should develop. The screenshot of the short-answer test prepared on the Quizziz.com platform is shown in Figure 3.

c. Clicker questions. Posing a question, giving students time to think about it and record their answers via clickers of the Student Response System, and then displaying the results happened to be an effective way not only to assess students’ knowledge but to foster meaningful engagement among students in lectures and seminars. Results showed that inserting clicker questions activities during a lecture maintained students’ attention, stimulated active student involvement and lecture attendance, while during seminars this strategy promoted a class-wide discussion and collaboration, created a friendly atmosphere for shy and unsure students. Compared with the method of asking questions traditionally in the control groups and answering by one student, this approach gave all students time to think about and answer, setting the stage for greater discussion participation. The researchers concluded that the strategy assisted in assessing student comprehension and developing classroom activities.

d. 1-minute reflection written assignment, a short writing activity within the classroom in which students generated answers in response to questions asked by the tutors regarding the material under study.

At the beginning of a lecture, the questions covered the material taught in the previous class and

checked for understanding and retention of the material or served as an opening question and stimulated the students’ to anticipate for and prepare them for the upcoming class. A feedback assisted the lecturers to decide whether to proceed with the class or to correct any misunderstandings of the topic.

During the lecture or at the end of it the strategy helped to preserve the key points of the lecture and enabled students to reflect on them before proceeding to the next point, served to overcome the monotony of the class proceedings and to regain the attention of all the students. The researchers reported that application of minute papers in the classroom stimulated students to reflect on the lesson taught and learned and provided feedback which helped to plan for the next class, increased class attendance and attentiveness.

e. Weekly quizzes, a kind of assessment performed once per week, were chosen by the researchers to examine the learning potential, to ascertain if students taking weekly quizzes performed better in the final achievement tests. The researchers conducted various studies regarding the effect of frequent testing on the students’ learning and achievement: they studied the influence of frequency of testing on the students’ results, effects of frequent testing upon long-term retention of content, the efficiency of the quiz length.

In one pair of groups the experimental group received weekly quizzes and the control group received one mid-term, the students of the other groups were divided into two groups in which the experimental group was tested weekly, while the control group was given tests once a month. In another study, the experimental group was given six tests; each consisting of 30 questions, while the students in the comparison group received two tests each consisting of 90 questions. One more comparison was made between the group of learners who took quizzes online with the one who was not given any quizzes. In all the pairs of groups the content of the course, teaching methodology, assignments and final exams were identical.

The results of the multivariate analyses suggested that: frequent quizzing had a beneficial and significant influence on student performance, led to efficient learning, resulted in better performance on final achievement tests. The researchers concluded that frequent quizzes helped students to retain the material for longer periods and testing through short tests given more frequently to the students resulted in better performance than the longer ones. The results obtained here provided evidence that the group with weekly quizzes performed better than the group without quizzes. The experimentalists underlined the importance of taking tests regularly, as students

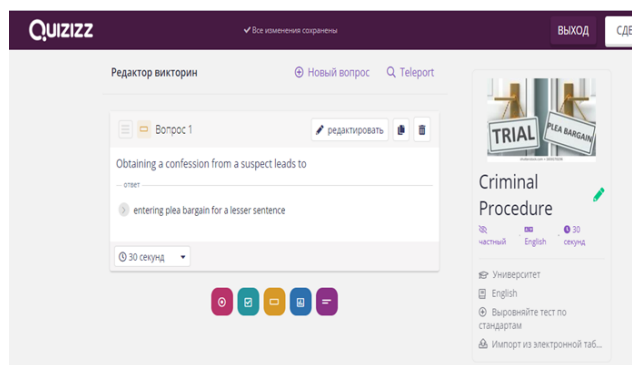


Fig. 3. A short-answer formative test created using Quizziz.com

became accustomed to tests, so their sense of test anxiety was reduced.

f. Tests for assigned readings (assigned textbook and outside readings, home reading assignments outside the class on the topic), an effective teaching strategy for encouraging reading compliance and student learning.

The researchers suggested the students of the experimental group read the material ahead of time and then take the online test (a quiz at the beginning of a class or a take-home quiz). Tests for assigned reading were available to students several days in advance. Moreover, students were allowed to take each test more than once to gain greater mastery of the reading materials (the duration of each attempt was 60 minutes), but the number of attempts was limited to three to prevent students from simply guessing the answers. Time limits on the online testing (60 minutes) encouraged students to read the material ahead of time and then to take the online test. The tests were closed to students one week before the exams, but a week before they were available for students preparing for exams.

The results of a research revealed that online outside of class tests for assigned readings ensured a number of positive learning outcomes: while encouraging students to read they saved in-class time for active learning activities (discussions, role plays, debates) in comparison to the typical lecture or class format. The researchers found that more students in experimental group participated in discussions and offered more specific comments and informed opinions on the assigned reading material comparing with control groups.

3. *Benchmark tests.* They were placed at the end of a unit/module to gauge test-takers' knowledge on the studied material, provide tutors with periodic information about student progress. Results of the benchmark tests assisted to identify students' strengths and weaknesses and modify instruction to enhance student learning. The screenshot of the benchmark test with constructed-response assessment prepared on the Edpuzzle.com platform that is based on a video unit from YouTube is shown in Figure 4.

The findings of the research were ambiguous: one experimental pair of groups found no significant differences between experimental group using benchmark assessments and control group not using such tests. The other pair of groups proved that benchmark testing fostered students' learning progress, increased student engagement and motivation. However, even with the lower effects, we supposed that positive test results helped to develop students' confidence, reduce anxiety and increase their satisfaction with the study-

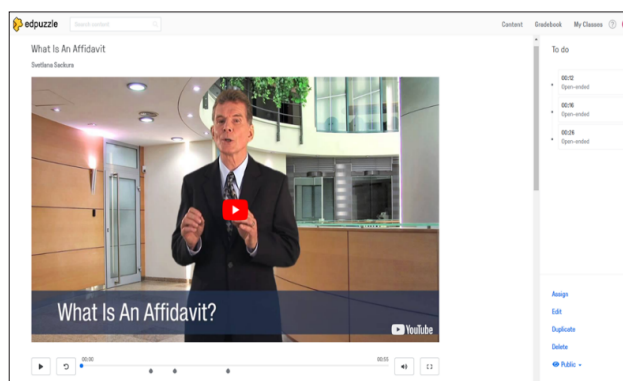


Fig. 4. A benchmark test with constructed-response assessment based on a video unit created using Edpuzzle.com

ing process and that benchmark tests could still provide for improved student learning.

4. *Summative tests.* These ones were taken by students at the end of the course as a final test in which they had to demonstrate their overall knowledge on the subject and acquired skills at a level prescribed at the programs.

The tests formats and types, the volume of the tested materials varied across different units, topics, modules etc. depending on the difficulty and length of the academic material, students' needs and educational aims.

The findings of the research suggested that summative assessment happened to be the result of the previously conducted formative tests. The researchers witnessed that students of the experimental groups who took formative tests regularly succeeded in performing summative tests. Through engaging with formative tasks, they gained experience with their assessments, mastered their skills and obtained better grades in the summative assessments.

As some formative tests (e.g. weekly tests, frequent quizzes) exposed students to the material learned regularly during the semester, they were closed to students one week before the summative test. But during the week before students were allowed to review all the questions and answers, thus they became more test-wise and prepared for the kinds of questions to be included in the summative test. In addition, when taking the summative test, the students who took tests regularly experienced lower level of test anxiety compared with the students of control groups who did not take tests.

We concluded that formative assessments boosted the learners' summative test performance, while summative online assessment fosters students' digital and subject literacy and prepares them for life after education.

Conclusions. All the studies reviewed lead to the following conclusions. Thoroughly designed continu-

ous enhanced testing proves to be not only a technique for assessing learning progress and skill acquisition but primarily an effective teaching and learning tool facilitating the students' engagement into the altered learning environment, reinforcing understanding and active learning the target material, stimulating various cognitive mechanisms and boosting retrieval and long-term retention. The results of the experiment demonstrate a strong positive effect of enhanced testing on the academic performance and students' achievement, proved by the fact that the scores obtained by the students on formative tests correlate with the final summative examinations. The finding of the present exper-

iment, also consistent with the study carried out by the researchers during the pandemic period (Kuhfeld, et al., 2020; Ong M., et al., 2021; Mykytiuk, et al., 2022), is that the use of web-quizzing and access to digital learning resources in a simulated classroom setting characterized by combination of teacher-guided, collaborative and personalized learning helps students to develop self-confidence, reduce anxiety and fear, and overcome the difficulties of the altered time, arise the interest of students in learning and increase academic motivation in conditions of emergencies such as coronavirus pandemic and the war caused by the Russian aggression.

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