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MOBILE APPLICATION TO SUPPORT E-LEARNING AND QUIZZES DURING COVID-19

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Abstract:

The COVID-19 pandemic has changed the way we are taught in all types of schools. However, education has significantly affected those universities where there is also a form of practical verification of knowledge, such as in medical faculties. We selected 3 studies that discuss e-learning in medical schools during the pandemic. We made the selection based on different cultures as well as religious customs. We used the mentioned experience in the design of a mobile application, which was used by medical students of the Medical Faculty of Comenius University in Bratislava for the subject of Biochemistry in the form of e-learning and quizzes. Subsequently, we modified the application for the general use of any object. The modified application is in testing at the Faculty of Informatics, Pan-European University.

Keywords:

COVID-19, Quizzes, testing, e-learning, applications in medicine.

ACM Computing Classification System:

Document types, communication hardware, interfaces and storage, network architectures, real-time systems, software creation and management, life and medical sciences.

Introduction

By a survey of publications in scientific journals using the keywords ‘covid‘, ‘quiz‘ and ‘e-learning‘ we found 16 relevant articles in Scopus and 5 articles in the Web of Science. With further selection concerning our intention to create an e-learning mobile application for medicine, we have selected three articles that are from different cultural and religious backgrounds. Medical students are the most affected by having no practical experience during this pandemic for more than a year. The first article, "Remote electronic examinations during the Covid-19 pandemic: A cross-sectional study of student preferences and academic dishonesty in medical schools" describes a study from Jordan [2]. It examined the factors for preferred teaching and testing methods as well as their benefits and potential for abuse. The result of the study shows that while distance e-exams and submission of written reports are the least preferred teaching methods, so far 30% of students prefer a combination of exams and quizzes. The second study from the Faculty of Medicine of the University of Geneva entitled "Asynchronous distance learning in the range of stroke scales during the COVID-19 pandemic (E-learning vs Video): Randomized controlled study" compares the effectiveness of the study by watching traditional didactic videos and interactive e-learning videos [3]. The highly interactive module group performed better than the video group. The third article is "Teaching and Studying Postgraduate Medical Physics Using Internet E-Learning During the COVID-19 Pandemic - A Case Study from Malaysia" [1]. The study evaluates feedback from students.

This shows that e-learning has its limitations and the future is hybrid (combined personal and e-learning) learning. These facts also correspond to our experience with a mobile application, which is used to create a quiz for medical students during the COVID-19 pandemic.

Full-time teaching at the Medical Faculty of Comenius University in Bratislava was interrupted in the second week of the winter semester of 2020. It continued in a distance form using the Moodle system and e-learning. Lectures, exercises, and exams take place online via the Internet. Students watch prepared lecture videos of teachers and study from books, scripts, other electronic or paper teaching materials. For example, the students print out the biochemistry test questions without correct answers and exercise the correct answers on paper. They have to sign up to various platforms to access the online learning tools and scientific databases. Teaching and examination create high demands on both high-quality internet connection and computer skills of medics.

Supporting education with a mobile application for learning and testing in the form of quizzes can facilitate the acquisition of the subject and preparation for the exam. The chosen pilot subject is biochemistry which due to the complexity and volume of required knowledge is one of the most demanding subjects of a medical study.

1 Technological Environment of the Application

For the development of the mobile application, we have chosen a specific subject of Biochemistry from the Faculty of Medicine of Comenius University. The application is called BiochemTest. The Android platform was selected. Android is one of the most used operating systems for mobile devices. The native integrated development environment (IDE) Android Studio and Java programming language were used. The most used languages for Android Studio are Java and Kotlin. Google currently recommends Kotlin as the first language for Android but continues to fully support Java and C ++ [6]. The structure of a Java project in AS is shown on the BiochemTest application (see Fig.1).

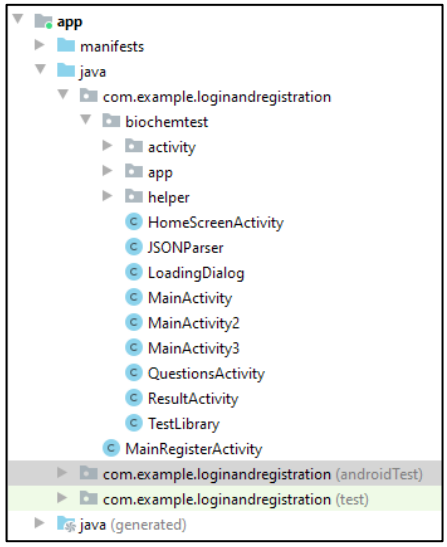

Fig.1. Structure of the BiochemTest project in AS (Android Studio, 2021).

The front-end (UIX) application is implemented on a mobile terminal, which is connected to the back-end relational MySQL database via the Internet. Communication between the database is in JSON format using a PHP interface.

Fig.2. Communication diagram of the application.

Login and registration are implemented according to R. Tamada: Android Login and Registration with PHP, MySQL, and SQLite [4]. The application provides CRUD operations in a distributed REST environment on a Volley database session. The application generates a unique user id in PHP using the 'uniqid' function. Encrypted passwords are stored using the base64_encode method. Each password must have two columns to store in the database. One is the storage of an encrypted password and the other is the storage of a series of random data - cryptographic salt [4] [5].

2 Testing

The functionality of the application was tested by analytical tools, such as the Android Profiler. This provides real-time data on how the application uses CPU, memory, network, and battery resources (Android Developers, 2021).

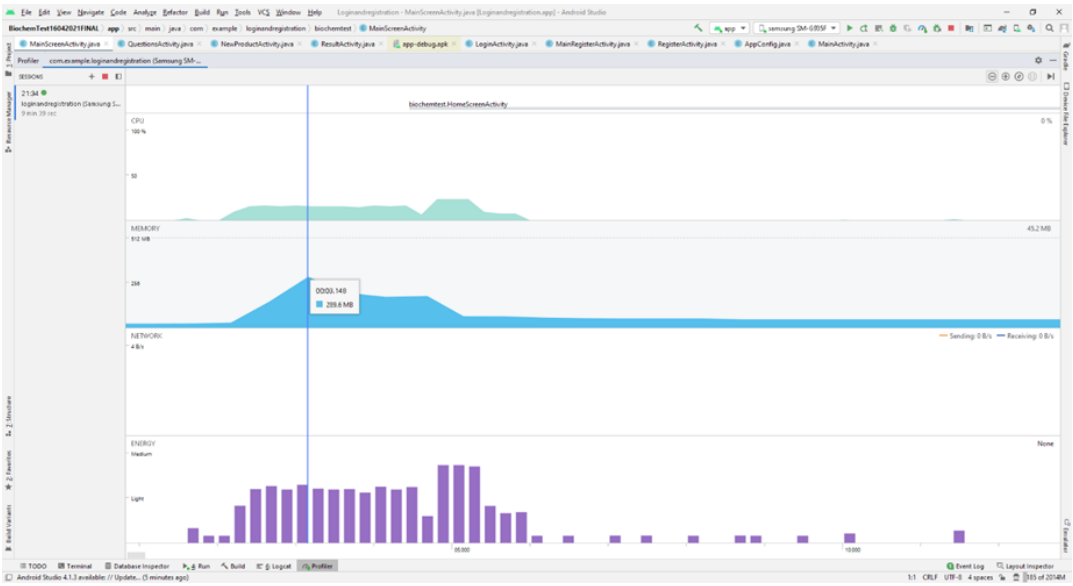

Fig.3. Test output from Android Profiler in Android Studio.

The recording of the BiochemTest starting process after uploading from the ASUS Model X751L notebook to the Samsung Galaxy S7 Edge smartphone shows that the CPU load of the smartphone is less than 25%. The maximum usage of the operating memory of 289.6 MB represents more than half of the memory capacity. After ca 5 seconds it drops to a value of up to 10% of the memory. No network communication was recorded during the start-up process.

The network communication was active later during the communication with the database. In the fine-tuning the parsing processing time measurement was implemented into the code: 'elapsedTime = System.nanoTime () – startTime'. Parsing of text files beginning at a size of several hundred kB had a significant impact on processing time. Measurements of energy consumption showed low to medium data with a decrease to zero.

3 Usage Methodology and Graphical User Interface

Students prepare themself for the biochemistry exam by watching videos from lectures and online presentations, studying books, other study materials, and exam tests. The implemented test of Biochemistry in the BiochemTest application has 984 questions and multiple correct answers out of 8 possible for each question (current test file from the Faculty of Medicine of Comenius University 2021). Each answer is scored separately. The verification on paper is very time-consuming. During the real exam, the students are stressed by time pressure and inaccuracy (about 1 minute for the correct answer for a question with 8 answers). BiochemTest can provide them an effective tool for studying and practicing correct responses.

The target group of the BiochemTest application is medical students and teachers. Users can use the application for the subject of biochemistry in four different scenarios:

Scenario I. – the student will use the application to study, master, and understand biochemistry (see Fig.4). By clicking on the STUDY button, the student will go to the selection of a thematic unit. After pressing the button of the selected topic, the student first reads, analyzes, and then clicks only on the correct answers. The boxes with the wrong answer must be left blank. Clicking the NEXT button will display all the correct answers with an indication of the correctness of the given answer. The student verifies and corrects the incorrectly ticked answers from the available study materials with an emphasis on understanding instead of memorization.

Scenario II. – the student will use the application to practice quick answers, the goal is to increase speed and precision. The student proceeds as in the first scenario, intending to practice answers to 100% success. It is recommended to make a note of critical questions/answers where mistakes occur and find a way to eliminate them.

Scenario III. – the student verifies his knowledge, the goal is to determine his readiness, monitor his progress, and finally take an exam. The student authenticates / logs in to the application with the LOGIN button. If the student does not have login details, he must register first by the REGISTRATION button. By pressing the TEST button, the student goes through the individual test questions and clicks on the correct answers. He must supervise the one-minute time limit per question. At the end of the test, the student presses the RESULTS button and the evaluation screen appears which consists of the CORRECT ANSWERS, INCORRECT ANSWERS, FINAL SCORE. The result can be sent by clicking SEND RESULTS.

Scenario IV. – the teachers/students will use the application for learning and testing. The current result is presented on the activity screen of the application. The historian data is accessible for teachers and students from the MySQL database via an Android or Windows application.

The BiochemTest Graphical User Interface is intuitive and user-friendly. It allows to control the activity screens and to interact with the application using interactive pixels and buttons. The feedback in learning mode is immediate, when moving on to the next question, the correctness is displayed, and the success of the answers is evaluated. Another group of users is teachers, who can use the application to learn and test their student's knowledge. A user-friendly environment is important for them, to create or modify existing questions. The results of the pilot testing by medical students show an improvement in the repeated tests. This gives evidence that the educational target of the application is met.

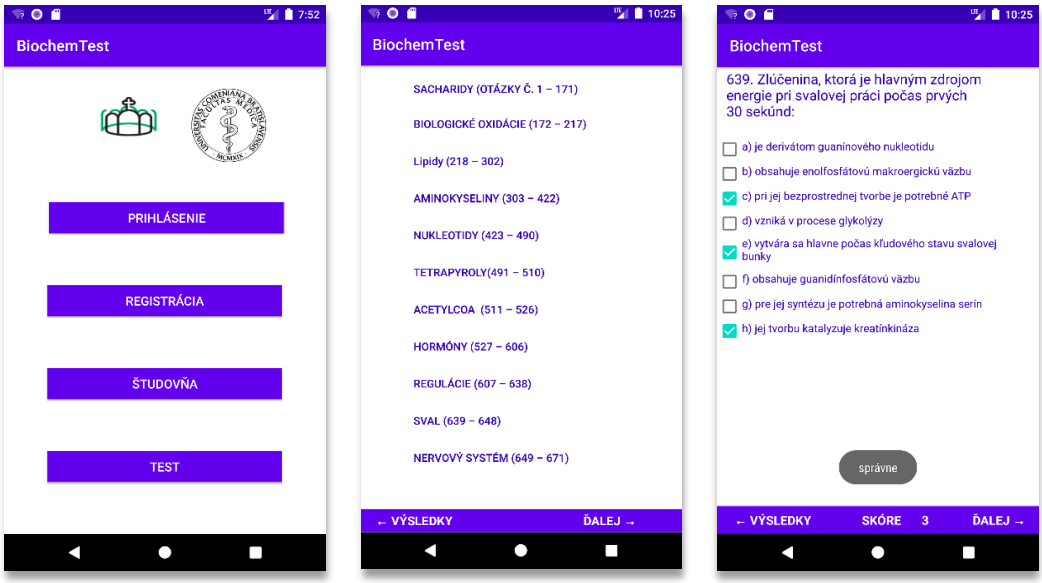

Fig.4. Graphical User Interface of the application.
Left side - four buttons: Login, Registration, Study room, Test.
Right side: A question 639th with a grey evaluation label on the bottom: Right.

4 Enhancements for Any Subject

The BiochemTest application can be used for any other subject as well. This requires changing the database on the local or remote web hosting Wampserver. Loading a new database can be done by phpMyAdmin for MySQL database management. After creating a new database, the Import function and the new data file must be selected. The correct character set has to be adjusted and the data has to be loaded up. The import process was verified by using PHP interface, SQL, CSV, XML, JSON, and Open Document Spreadsheet files.

A file sample (CSV) for direct import of a question into the prepared MySQL table "test_sacharidy" [7]:"

"1", "1. Main substances in the form of which glucose is introduced into the body:", "(a) are monosaccharides such as glucose", "0", "(b) are polysaccharides such as cellulose present mainly in fruit" , "0", "c) are polysaccharides containing alpha 1,4-glycosidic bond", "1", "d) are disaccharides which are absorbed from the GIT into the blood in unchanged form", "0", "e) are disaccharides, eg sucrose, cleaved in the stomach "," 0 "," f) are polysaccharides hydrolysed by pancreatic amylase "," 1 "," g) is a disaccharide containing 1,2-glycosidic bond "," 1 "," (h) are polysaccharides which, after hydrolysis, are absorbed in the form of monosaccharides "," 1 "

Another possibility of inserting new data was tested by a specially developed Java application via MySQL Connector / J in the Apache NetBeans environment. Finally inserting and modifying data from a specially created Word document was tested as well.

5 Further Research

Further research and development are recommended for the extension of the application database for images and videos. We propose to improve the e-learning application with an explanation of the answers with a link to the relevant study resources.

The application BiochemTest allows us to design a more comprehensive educational and testing system that will provide extended functionalities, such as reporting test results. This allows evaluating the performance of the students and the class. The teacher will be able to determine which parts of the course are the biggest problem in the education of students (see Figure 5).

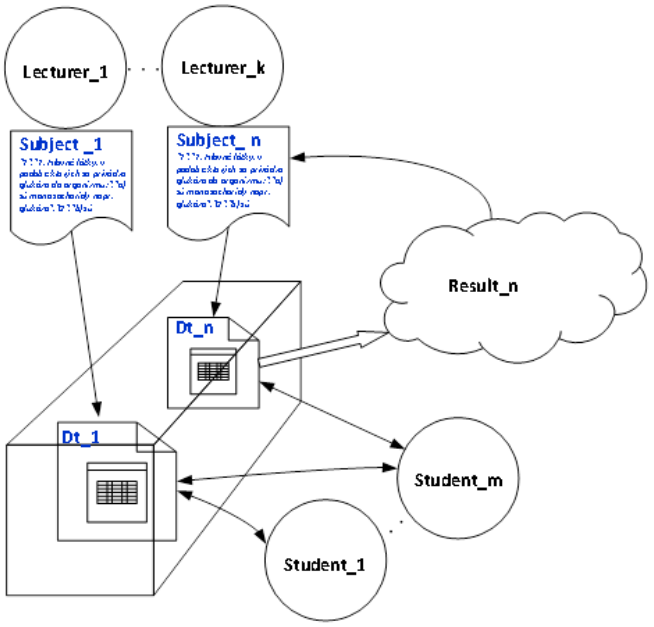

Fig.5. Comprehensive teaching and testing system.

Teachers (1, ..., k) can enter subjects (1, ..., n) into the tables of Dt databases (1, ..., n). The students can learn from the tables or test themselves. The test results will be accessible for the teachers and the students as well. Teachers can evaluate the activity of the whole class and monitor the progress of the individual students. This will improve the learning process and thus the quality of education.

In the future, it will be possible to extend the application so that a list of publications on this topic is available on the Internet for each question or section. A list of publications dealing with the disease after COVID-19 is given in the article [8]. At the Faculty of Informatics of the Pan-European University, we deal with applications of virtual reality in medicine, which can play an important role in the post-COVID-19 syndrome [9].

Conclusion

The selected articles from the survey show the importance of education through tests at medical schools. The mobile e-learning application BiochemTest was developed for the subject of biochemistry of the Faculty of Medicine of Comenius University. The application enables interactive learning in the form of questions and multiple correct answers. It also provides an opportunity for training, self-testing, monitoring the progress in preparation, and testing on exams. The results of the pilot testing by medical students show an improvement in the repeated tests. This gives evidence that the educational target of the application is met. The application database is modifiable for any subject. Currently, the modified application is being tested for the subjects of Applied Informatics at the Pan-European University. We recommend further development of the BiochemTest application towards a comprehensive system for teaching and testing various subjects based on e-learning and quizzes.

Acknowledgement

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References

[1] Azlan Ch. A. et al. 2021. *Teaching and learning of postgraduate medical physics using Internet-based e-learning during the COVID-19 pandemic – A case study from Malaysia,* Retrieved 05-04-2021, from https://www.sciencedirect.com/science/article/abs/pii/S1120179720302453

[2] Elsalem L. et al. 2021. *Remote E-exams during Covid-19 pandemic: A cross-sectional study of students preferences and academic dishonesty in faculties of medical sciences*., Retrieved 05-04-2021, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7825891

[3] Suppan M. et al. 2021. *Asynchronous Distance Learning of the National Institutes of Health Stroke Scale During the COVID-19 Pandemic (E-Learning vs Video): Randomized Controlled Trial,* Retrieved 05-04-2021, from https://www.jmir.org/2021/1/e23594

[4] Tamada, R. 2017a. *Android Login and Registration with PHP, MySQL and SQLite*, Retrieved 2021-04-03, from https://www.androidhive.info/2012/01/android-login-and-registration- with-php-mysql-and-sqlite

[5] Tamada, R. 2017b. *How to connect Android with PHP, MySQL*, Retrieved 2021-04-03, from https://www.androidhive.info/2012/05/how-to-connect-android-with-php-mysql

[6] TechCrunch. 2017. Techcrunch.com, Retrieved 2021-04-03, from https://developer.ibm.com/technologies/mobile/articles/os-android-networking

[7] Zona.fmed.uniba.sk.2020. *Náplň biochémie v otázkach s odpoveďami 2020*, Retrieved 2020-12-03, from https://zona.fmed.uniba.sk/uploads/media/ napln_biochemie_v_otazkach_s_odpovedami

[8] Sramka, M., Masan, J., Slavik, J., Ruzicky, E. (2020). Possible consequences of Covid-19 on the nervous system. Neuroendocrinology Letters 2020; 41(4): 101–107.

[9] Sramka, M., Lacko, J., Ruzicky, E., Masan, J. (2020). Combined methods of rehabilitation of patients after stroke: virtual reality and traditional approach. Neuroendocrinology Letters 2020; 41(3): 101–111.

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