BALNEO RESEARCH Balneo and PRM Research Journal English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Integration of medically-exempt students in the physical education class by implementing a quiz application created according to the school curriculum

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Citation: Pârvu C., Harabagiu N., Alistar G. D. - Integration of medically-exempt students in the physical education class by implementing a quiz application created according to the school curriculum, Balneo and PRM Research Journal 2022, 13(3): 514

Academic Editor(s): Constantin Munteanu

Received: 10.08.2022
Accepted: 20.08.2022
Published: 01.09.2022

Reviewers:
Elena Valentina Ionescu
Gabriela Dogaru

Publisher's Note: Balneo and PRM Research Journal remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract ***Background:*** Considering the increasing number of students that are medically exempt from physical education classes, it is imperative to find solutions that are centered on their needs. ***Purpose:*** To design a quiz app that can solve the problem of assessing exempt students and help their active and conscious integration and participation in the physical education class. ***Materials and method*****:** Before designing and writing the application, a preliminary study was carried out based on a questionnaire distributed on the Google Forms platform to 84 secondary school teachers of physical education in the counties of Galati, Braila, Buzau and Tulcea. The questions were structured in order to provide us data about the actual working time in the lesson of a medically exempt pupil, his/her involvement or non-involvement in the subject, the distribution of working time on class segments, the provisions of the education law in relation to the exemption from effort, etc. Our contribution to this research consists of a quiz-type application, unique at the national level, which can be successfully implemented in the physical education class for medically-exempt students. During the construction of the application, the content of the current school curriculum for grades V-VIII was included in 160 questions for each content area, with multiple-choice answers and images processed according to the content in the curriculum. The application can be accessed by the exempt student regardless of his/her diagnosis, depending on the grade level, subject taught and topic of interest. The app provides an evaluation after accessing the session and contains a folder for information purposes only. ***Results:*** the questionnaire offered relevant data on the issue of integrating the medically-exempt student in the physical education class, showing that: the medically-exempt student participates in the category between 0 and 5 minutes (50% of teachers) and between 5 and 10 minutes (38% of teachers); the medically-exempt student participates only in the first segment (44% of teachers) - 22% answered that in the first and last segments of the lesson, which means that, if we approximate the time allocated to the two components, the student does not exceed 5-8 minutes of active participation; 56% of the teachers interviewed state that students do not participate actively and consciously in the physical education class, and 94% consider that other methods of stimulating interest are needed for those who are exempt; 48% of the teachers confirm that students may have temporary exemptions, which reinforces the idea that we must find solutions so that during the period of medical exemption, the student be at least interested in acquiring the theoretical knowledge that will fundamentally help him/her when s/he becomes fit for making effort. ***Conclusion:*** The implementation of the quiz application among students exempted from the physical effort in the physical education class stimulates the students' interest in accessing the program content, makes them

participate actively and consciously. Thanks to the facilities of the application through the possibility of self-assessment in real-time, and ensures the acquisition of theoretical knowledge through the possibility of evaluation on work sessions in real-time.

Keywords: medically-exempt students; integration; assessment; curriculum; quiz application;

1. Introduction

The increasing number of students that are medically exempt from physical education classes is becoming an essential problem in our field, one that requires special attention from teachers, who have to find solutions for those who cannot make a physical effort.

A student who is totally or partially medically exempt is likely to have significant gaps in theoretical knowledge after recovery and, of course, problems with motor skills. Efforts are being made to find solutions in the teaching of physical education to children with special educational needs, but for pupils who have short-term exemptions, there are no known individualized teaching and assessment programs during the period of exemption from the effort. [1].

Most of the time, the medically-exempt student, due to the diagnosis, is seated at a desk, somewhat far from the group of students who are carrying out their activities. Thus, their active and conscious participation in the lesson topics is disturbed by several factors, such as:

- distance from the collective;
- doesn't hear the teacher's explanations;
- can't see the execution, can't practice;
- loss of interest in the subject taught;
- emerging frustration with the inability to participate in the relay, exercise, or sports game;
- feelings of self-exclusion through the inability to participate in the effort;
- feelings of exclusion due to the teacher's inability to give simultaneous attention to both able and exempt pupils.

Analyzing the "Methodology of organization and conduct of physical education and sports activities in pre-university education", we find that the main function of physical education and sports is to optimize the health of students. Differentiated means, methods and technologies need to be identified so that all students benefit from the effects of these activities, regardless of their skills or movement abilities[2].

The question is, "Who should find/implement these differentiated technologies for the benefit of all students attending classes?". By no means the physical education teacher, as s/he would not have the skills, but s/he could collaborate with the IT specialist as the provider of relevant data so that technology can contribute to the advancement of the field of physical education and health, as it has done in many fields.

The student who participates in physical education class actively experiences the competitive spirit that determines behaviors and emotional states related to experiencing success or failure, feeling in turn: emulation, happiness, collaboration, self-confidence, and fair play. It cannot be said the same of the medically- exempt student, who, in addition to the existing physical condition, may develop feelings of exclusion and self-exclusion.

In Romania, exemptions are total or partial, and according to the period of exemption, they can be for a school year, a semester, or temporary according to the Methodology for issuing medical exemptions and the medical scale of conditions for which medical exemptions from physical education and sports classes are granted [3]. Thus, we find that there are 15 groups of conditions with a total number of 371 types of diagnosis, and for 95% of them, the total exemption is issued.

Studies in Latvia conducted among school students systematize the type of medical certificates according to diagnosis and conditions presented in physical education class

by analyzing over a 5 years the reasons for issuing medical certificates to 1249 subjects. The analysis revealed a critical situation for the field, namely that 50% of the diagnoses raised suspicions among teachers, especially as the doctors recommended total exemption from physical effort without giving the specialist data on reducing the frequency, intensity and the effort duration. Based on a questionnaire to Latvian exempt students, it was concluded that the negative attitude of students towards sport is often the reason why they ask the doctor for exemption from sports activities [4]. Also, in this study, the problem of unfounded medical release from physical exertion for a longer or shorter period of time, is presented, even for diseases for which it is scientifically proven that moderate exertion is a means of treatment [2-5].

A multi-stage survey of 4194 medically-exempt students at Trakia University in Bulgaria reported a discrepancy between the number of truly sick students and the number of medically-exempt students and highlighted the need for a standard for issuing medical certificates. In this 10-year research, the Bulgarian authors only managed to achieve improvements in the last two, when they imposed a new approach in their work with exempt students, emphasizing attendance, recommending individualized lessons according to diagnosis, assessing theoretical knowledge, and directing those with serious illnesses to chess, darts and essay submission [7].

In Poland, extensive studies on this topic show some basic reasons why students offer medical exemptions for sports class, such as low attractiveness of the lesson correlated with low qualification of the teacher, feeling of shame towards own body while performing physical exercises correlated with fear of getting a low grade and spoiling the overall average[8]. In our documentation of the reasons for issuing medical exemptions, a study from Serbia of 5226 students in which links were reported between a student's choice to submit a medical exemption and trauma with sexual overtones caught our attention [9].

Although some specialists in the field are against the implementation of technological systems in increasing interest in physical education classes among students, most authors are convinced that this implementation can play an essential role in increasing the interest in physical education classes among students without neglecting their involvement in other types of activities[10–12].

There are increasing problems in the education system in terms of physical education due to the conditions students suffer from, their physical health, level of motor skills, and lack of technologies to help in the formation of knowledge, skills and abilities of students [10-11].

Starting from the main purpose of the physical education and sports class, which is to contribute to the strengthening of health, ensuring the harmonious physical development of students, and the acquisition of skills and motor skills useful in daily activity, we propose to introduce a software application - quiz (Info-Scutit-Efort) in the physical education class to integrate the medically-exempt student in the rest of the group, to stimulate him/her to participate actively in the physical education lesson for a longer period of time.

It is necessary to have a complete package in physical education classes (competent teachers, to-date with modern technologies, necessary equipment and more recently, new technologies - Android apps, smart watches) in order to have better results, to increase the medically-exempt students' interest in physical activities.

With the designed app, we want to find solutions applicable for medically-exempt students in the physical education classes, facilitate the transmission of theoretical knowledge and the active integration in the lesson, and give the teacher a tool (app) that can be helpful in the evaluation of the student.

There is currently no known working procedure/methodology for teaching physical education to medically-exempt students. Practice and studies have shown that the medically-exempt student is more often than not just a spectator in class, is not involved in the activities of the lesson, and is far away from the collective (outside the playing space)

,which can create the right environment for the development of the feeling of exclusion and unconscious participation in the content of the lesson.

2. Materials and Methods

2.1. Working hypothesis

By creating and implementing a quiz-type application in the physical education class, with contents synchronized with the curriculum, for medically-exempt students, can we stimulate their active and conscious participation in the content taught so that we integrate them for a longer period of time?

2.2. Participants

The subjects of the preliminary study were 84 physical education and sports secondary school teachers working in several schools in Galați, Brăila, Buzău and Tulcea counties.

The questions were distributed via a link and responses were counted on the Forms platform from November 2021 to June 2022.

In the third phase of the research, the subjects were 25 medically-exempt students who received and tested the application during physical education classes. The student's actual working time on the app's fields was calculated without any prior indication from the teacher. The time students showed interest in testing the app was recorded and averaged 17 minutes.

A small number of subjects and teachers were deliberately chosen to test the application as we are still in the testing phase, and the procedure of hosting the application on the university server has not been finalized. The application is not freely distributed online at the moment.

2.3. Organization of the research

The writing and testing of the application were carried out at the Human Performance Research Centre of the Faculty of Physical Education and Sports in Galati from November 2021 to June 2022. The stages of the study complied with the ethical rules related to research involving human subjects, according to the Helsinki Declaration[15].

Implementing such an app, we believe, encourages the medically-exempt student to participate in the physical education class actively. By going through the application fields, students acquire theoretical knowledge and can be evaluated at the very hour when they only assist seated at the desk.

2.4. Data statistical analysis

The statistical calculation in the fixed percentages provided by the Google forms platform was represented in charts or text since our contribution in this article was writing and implementing the application named "Info-scutit-efort".

The resources needed to create the quiz application were: Unity Multi-Platform Software[16], the free Visual Studio[17], Microsoft Visual Studio Code 2019 program[20], the Mono platform[18] and Adobe Photoshop[19].

All the scripts/systems of the application were created using Microsoft Visual Studio 2019 (the most stable version in making a quiz application together with Unity using version 2020.3.25f1).

Results and contributions

Out of the six questions in the questionnaire, two were concerned with measuring the amount of time in which the medically-exempt student is actively involved, and the others highlighted data on the need for modern means of stimulating interest in the lesson, the type of exemptions and the tasks of the medically-exempt student.

To the first question, "*How long does the medically-exempt student participate in the physical education and sport class?"*, 50% of the 84 teachers answered that an exempt student participates between 0 and 5 minutes, 38% - between 5 and 10 minutes and 5% answered that the exempt student participates between 30 and 45 minutes.

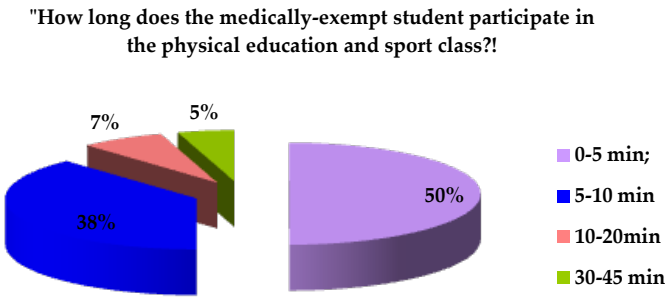

Fig. 1. Graphical representation of the active participation in the lesson of the medically-exempt student per minute

To the question "*In which part of the lesson does the medically-exempt student participate? (participates=exercises)",44%* answered that the student participates only in the first segment of the lesson, 22% answered that only in the first and last segments, and 20% of the teachers consider it appropriate for students to participate only in the segment "*Selective influence of the locomotor system*", and 14% answered that in the first three segments.

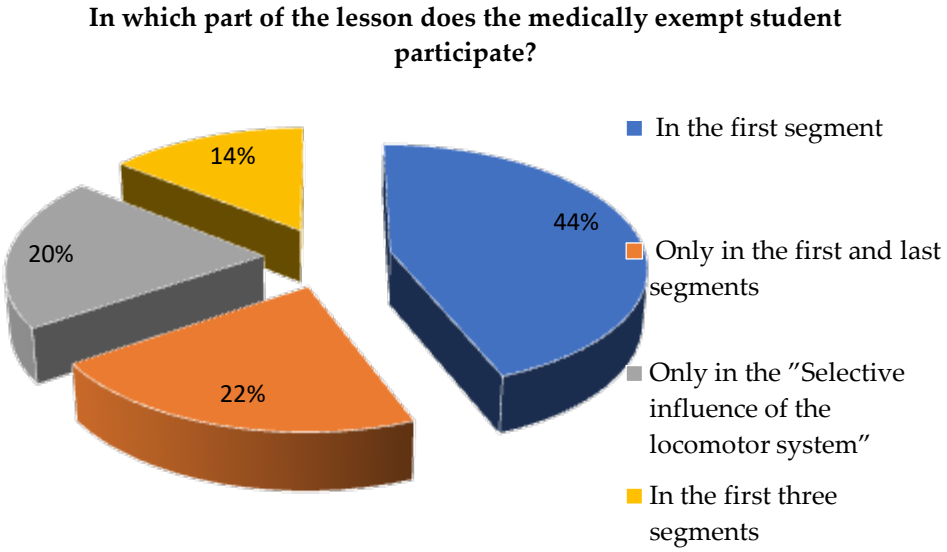

Fig. 2. Graphical representation of the active participation of the medically-exempt student to the segments of the class

Analyzing the approximate time allotted for segments and the teachers' answers, we once again emphasize the short time of active participation of the medically-exempt student in the physical education class. There is a close connection between the first two questions because both refer to the actual working time of the medically-exempt student but in a different form (structure on segments that have the almost standard duration and distribution of minutes). Their answers have been represented graphically to better highlight the need to find solutions so that the student's attention is stimulated by active and conscious participation for a longer duration of time in the 50 minutes allocated to the PE lesson.

- The medically-exempt student participated only in the first segment (44% of teachers), and 22% of them answered "in the first and last segments of the lesson", which means that if we approximate the time allocated for the two segments, the student does not exceed 5-8 min of active participation;
- 56% of the teachers surveyed say that medically-exempt students do not participate actively and consciously in physical education classes, and 94% believe that other methods of stimulating interest are needed for their involvement;
- 48% of teachers confirm that students have temporary exemptions, which reinforces the idea that we need to find solutions so that during the medical exemption period, the student is kept interested in at least acquiring the theoretical knowledge that will fundamentally help him/her when s/he is fit for effort again.

In the second phase of the research, the content of the curriculum was transformed into multiple-choice questions to be processed in the application designed for each grade (5th, 6th, 7th and 8th grades)[20].

We transposed the contents of 13 sports subjects, each with 40 questions per grade (grades V-VIII) and related answer choices, which means a total of 2080 questions contained in the application, which we consider optimal for more active participation of medically-exempt students and integration into the lesson.

We detail the example of the sport game of volleyball, taught from grade 5 to grade 8, whose content elements in the curriculum were divided into four categories: technical elements and procedures, technical-tactical actions, rules, and sport-related information.

Just for the example shown, 160 questions with 480 answer options were entered into the application , and 106 images were processed according to the program's content.

In what follows, we explain how to implement the application and give details of the application structure, the main modules, and the components used to build it.

This application is designed on the basis of a 3-level architecture, where each architecture depends on the correct functionality of the levels below it. The 3 levels are: 1. Client interface; 2. Developer interface; 3. The programming code interface;

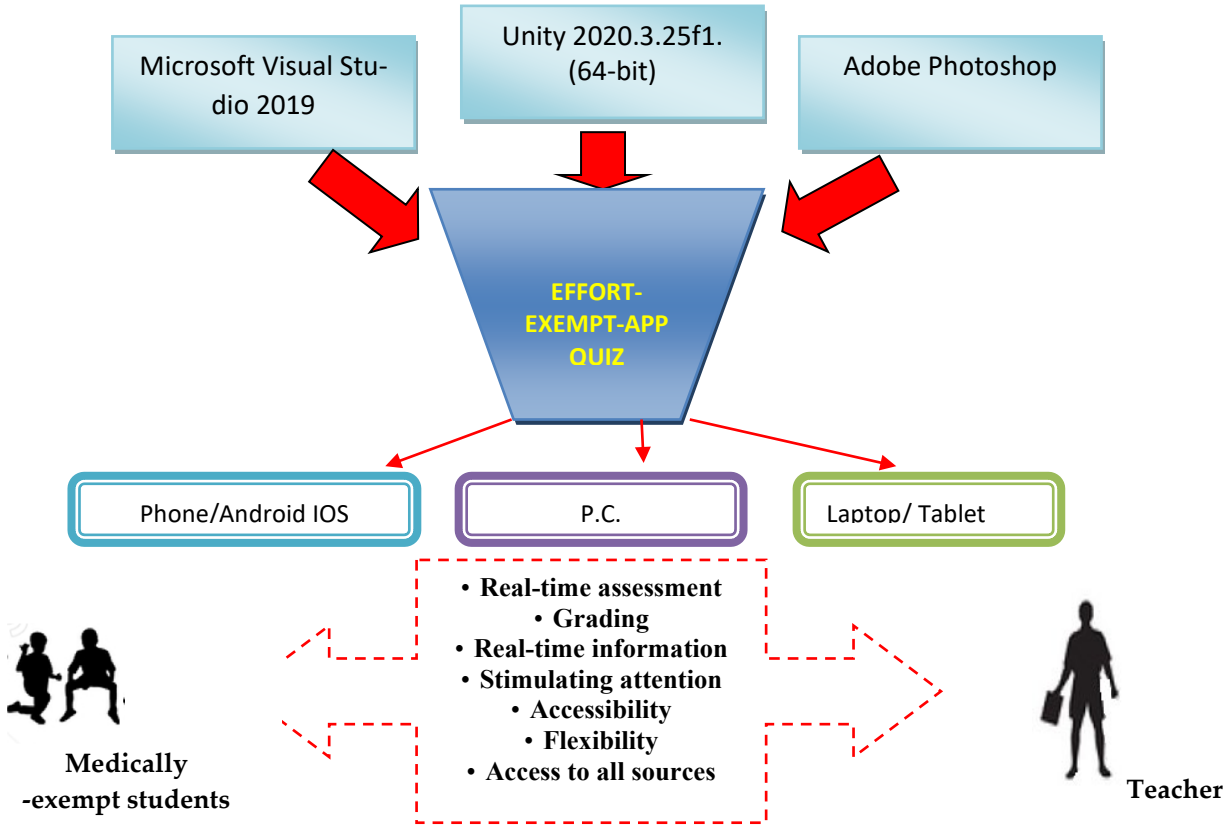

Fig. 3. How to implement the application

The INFO-SCUTIT-EFORT application implemented on the Unity platform has a very simple graphical interface. At the same time, it presents a range of functionalities that allow the physical education and sports teacher to follow the progress of medically exempt students and check the knowledge acquired by each subject. It can test the understanding of the information taught in the same lesson or evaluate the knowledge from previous lessons and moreover it can also provide a piece of information by accessing the field "Sports information".

Following the Unity platform implementation of the quiz app, we can use the app on any type of device, both Android with a minimum version of 4.4 KitKat[21]and on iOS [22] and other operating devices in the Universal Windows area (regardless of the version installed), Linux operating systems are also compatible.

The main menu is the most important part of the user interface as it is the first thing teachers/students see when they start the app.

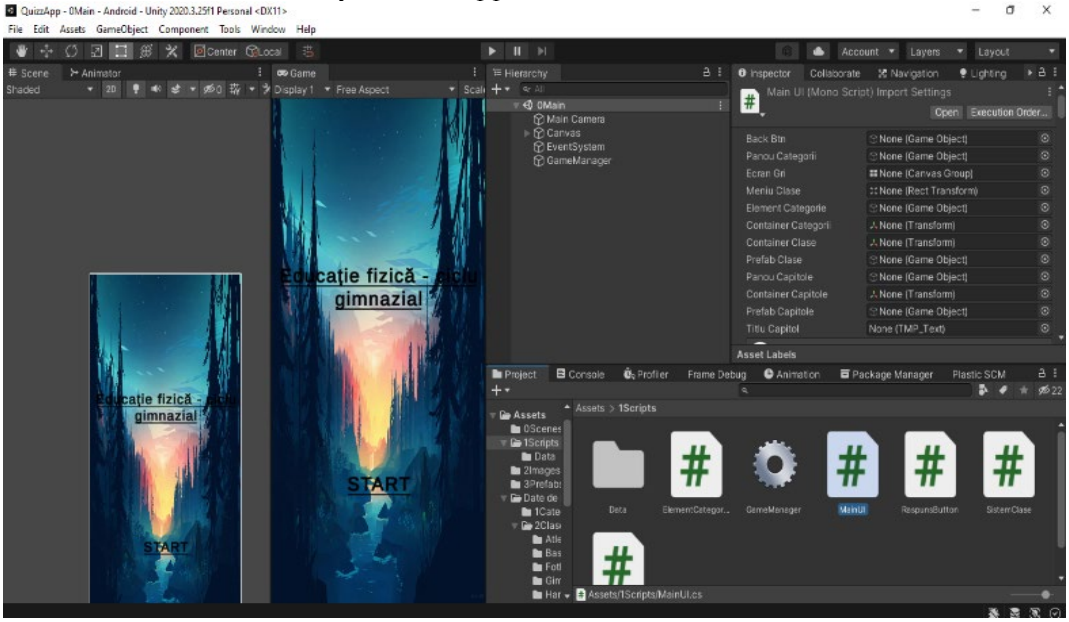

Fig.4. Main menu design

In the main menu, the window with the name of the subject "Physical education - secondary school" opens. By touching the "Start" button we can start the test, evaluation or information session on the application.

We choose the game or content of interest, related to the lesson topic that the students are playing on the field in real time, or we access other content from past lessons for a broader assessment of theoretical knowledge.

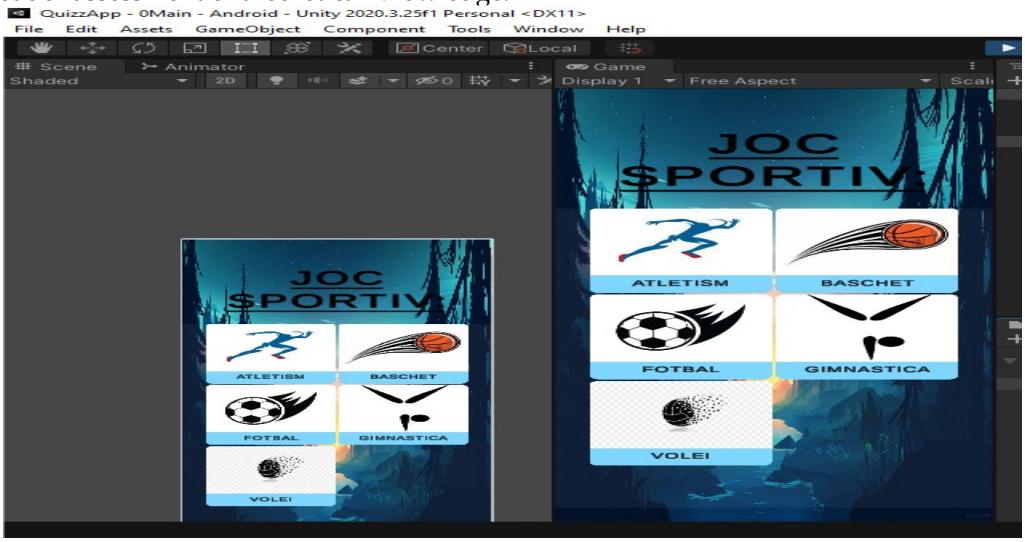

Fig.5. Content access menu physical education area

We choose the sport game Volleyball and the window with the contents of the curriculum for the four classes in the secondary school opens. You can choose the current grade and level of the student. The 5th and 6th graders cannot go through the content of the higher grades for testing purposes but can access the information in the fields "Sports information" and "Rules".

For medically-exempt students in grades 7 and 8, additional sessions of work on the application may be requested by accessing fields in lower grades, either for testing purposes or just information.

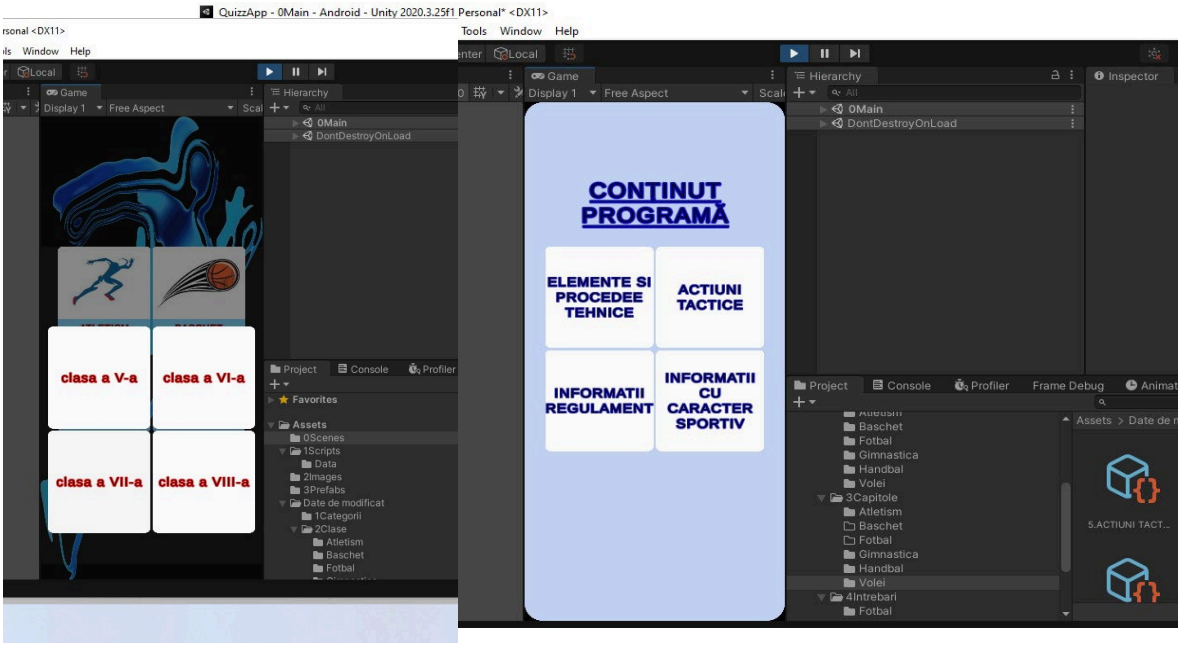

Fig. 6. Content access menus by grade and topics of interest

Selecting one of the four fields "Technical elements and procedures", "Technical-tactical actions", "Rules" and "Sport information" opens the work session for the evaluation of theoretical knowledge. We can start either the evaluation or the information activity.

After the sessions, the student receives feedback in the form of self-assessment based on the grade given by the application. In the picture below, after a 10-question working session, the application has sent the message "You have answered 4 questions" and offers the possibility to retake the test by clicking on "Try again" or the option to go to "Main menu" to other fields and contents. The application also records the time taken to access the fields from the start until the application is closed.

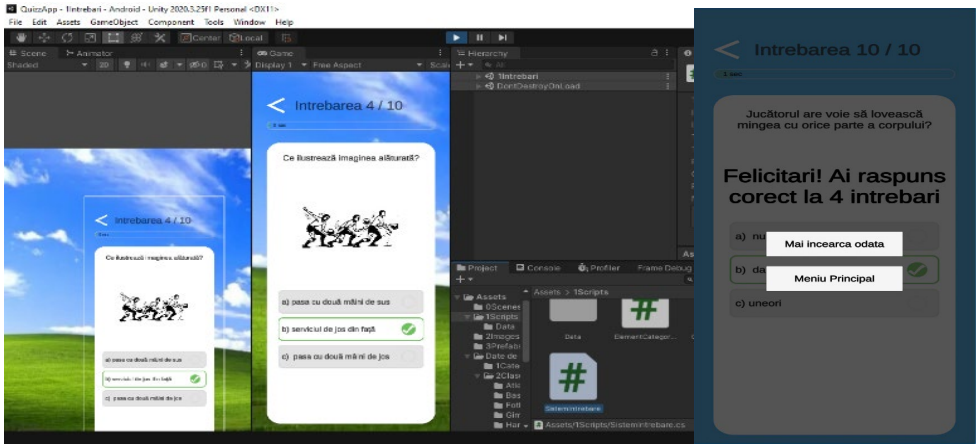

Fig. 7. Work session menus and evaluation

4. Discussion

Advances in research based on applications in performance sport using technologies for team play analysis, movement analysis, effort measurement, progress assessment, health assessment and cognitive accessibility beneficial to coaches, teachers, athletes, healthy and disabled students are increasingly promoted [23–25].

From the information gathered in the documentation, there is a multitude of software solutions applicable in physical education and sports at the international level but the situation is different at national level.

In other countries, solutions for motivating students to participate in physical education and sports have been found through STEAM (Science, Technology, Engineering, Arts and Mathematics) programs initiated in the United States and adopted in South Korea, where the emphasis is placed on self-directed learning, motivational and cognitive strategies [27].

In our country, there are no such programs that emphasize the involvement of the student who is medically exempt (partially or totally) in the PE class.

The use of quizzes in majors such as sociology, foreign languages, history and anatomy has shown their effectiveness among students, with research concluding that students are more interested, and intrigued by quizzes than by using books, paper and pencil [27–29]. Investigations of digital platforms used by business, education and engineering students at universities in Hong Kong have demonstrated that the frequency of using mobile apps enhances learning activity[30]. A study conducted on students in Latvia shows that apps used in education provide a safe environment for training and progress because mistakes made by incorrect typing can be corrected immediately, which arouses motivation and more active participation[31]. The information presented motivates us to look for solutions for our field of activity by implementing an app in the physical education class for medically-exempt students. It is known that modern technology in other fields helps students to understand the content taught more quickly. For this reason, postgraduate digitalization courses are made available for physical education teachers in Singapore, Ecuador, and Europe, to help them in the differentiated assessment of students with learning disabilities [32–35]. Modern applications used by students in their free time have started to be increasingly implemented in education and are undoubtedly helping [39-40] a teacher's career, as the lessons become more interactive, attractive and easy to assimilate[40–43].

The information detailed by this extensive research confirms the results of our study, that the number of medically-exempt students is increasing, suspicion hangs over the release of exemptions, students experience feelings of exclusion from the group, do not actively and consciously participate in the class, are not involved in any way, there are no programs and solutions to address any of these problems.

5. Conclusions

We believe that the implementation of the app in the physical education lesson for medically-exempt students has achieved its goal of stimulating students to actively and consciously participate in the content taught in class. The 25 subjects who tested the app had the opportunity to use it for 2 weeks i.e. 4 classes (50 minutes each). The subjects who tested it used the app for an average of 17 minutes without guidance from the teacher, evaluated themselves, and went through fields such as rules, sports information, etc. We consider this to be a good result, considering the data from the preliminary study which showed that a medically-exempt student actively and consciously participates in the lesson for between 5 and 8 minutes. "Info-scutit-efort", an application that facilitates the learning of theoretical knowledge during the period of medical exemption, can also have beneficial effects on the motor skills when the student becomes fit for physical effort because:

- It can be used by the exempt student for information and assessment while the teacher teaches the same content (a technical procedure or rules notions);

- When s/he becomes fit for effort, s/he knows the information support;
- One can test the app on one's PC, notebook, tablet or phone;
- It can also be used by teachers as an assessment tool – on rainy days, for example, or in other instances when he/she has to conduct the lesson in the classroom;
- Facilitates understanding of the content taught in the curriculum;
- Stimulates the interest and participation of the medically-exempt student;
- Can encourage emulation between 2, 3 medically-exempt students trying to get higher grades on tests and work sessions;

We believe that the app can be developed according to the groups of conditions for which the medical exemption is issued, and can also provide the doctor's instructions on what the student should do in physical education class (video, exercise dosages in relation to the diagnosis that ensued the exemption).

Author Contributions: "Conceptualization, P.C.; methodology, P.C. and H.N.; software, A.D.G; validation, P.C. and A.D.G; formal analysis, P.C. and A.D.G.; investigation, P.C; resources, P.C. and A.D.G.; data curation, P.C; writing-original draft preparation, P.C; writing-review and editing, P. C and H.N; visualization, P.C. and A.D.G.; supervision, P.C. and A.D.G.; project administration, P.C. and A.D.G.; funding acquisi-tion, P.C. and A.D.G.; All authors have read and agreed to the published version of the manuscript." **These authors contributed equally to this paper as senior authors.**

Funding: This research received no external funding.

Institutional Review Board Statement: "The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of "Dunarea de Jos" University of Galati".

Informed Consent Statement: All investigated students agreed to participate in the study.

Acknowledgments: The authors of this study thank the teachers who answered the questions and the students who tested the application.

Conflicts of Interest: The authors declare no conflict of interest.

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