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Research article

Optimising Physical Education Classes in Schools Using Technology: The use of mobile apps for active participation of medically exempt students with a focus on skill development and medical rehabilitation

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Abstract: The literature focuses more on healthy students, and the methodologies for organising physical education lessons do not address in depth the problem of physically exempt students who, with time, transform from exempt students into possible patients.
This research aims to develop the application "Info-Scutit-Efort" in physical educa-tion lessons to facilitate learning, assessment of medically exempt students and their en-gagement in directed/adapted effort recovery programs in the physical education lesson.
The research also aims to extend the use of the application to cover a broader range of needs. This study highlights the usefulness of the "Info-Scutit-Efort" app to actively and consciously engage 55 medically exempt students (58.2% of the total and 42.8% partially) in physical education lessons.
The app, in an enhanced form, offers free and flexible access to different functionalities, in line with all the content of the curriculum and the Medical Checklist, transformed into questions so that the exempted student can access information about previously taught homework, homework taught in real-time, or information about general or particular medical recommendations depending on the diagnosis.
In the assessment section, students can access tasks and tests to assess their knowledge, and in the self-assessment section, they can use tools to track their progress. The assessment provided by the app after the session can give the student a grade for previously taught information if they access the homework from the lessons covered, or it can provide a grade for the current assessment to test active and conscious participation in the lesson just taught as well as information about the indications, recovery programs, received from doctors for various conditions for which students have received medical exemption.
The results of the simple linear regression analysis revealed that the relationship between the time spent accessing the application (minutes = 18.60±4.821) and the grade received is significant ($p < 0.05$), with a regression coefficient of 0.241 and an R^2 of 0.762, which means that the time spent accessing the application explains 76.2% of the variation in the grade received.

Keywords: optimizing, physical education, technology, mobile Apps, medical rehabilitation

1. Introduction

Students with medical exemptions have limited participation during physical education classes. In most cases, these pupils have to sit on the sidelines, away from the activities during the lesson and with their peers. Because of this, they feel isolated and withdraw independently, as they cannot participate in physical exercise due to their restrictions.

The application "Info-Scutit-Efort" [1], in an enhanced form, offers free and flexible access to different functionalities, in line with all the content of the curriculum and the Medical Checklist [1], transformed into questions so that the exempted student can access information about previously taught homework, homework taught in real-time, or information about general or particular medical recommendations depending on the diagnosis.

Doctors who issue exemptions do not make recommendations on the back as specified in Article 16 of the Annex to the Order of the Minister of Education, Research, Youth and Sport No 3462/19.03.2012 [2], the teacher does not draw up an exercise program adapted to the diagnosis of the exempted pupil because he/she has no competence. Everything is passed on to the pupil.

Whether fully or partially exempted, students are excluded for a certain amount of time from activities during the lesson, which leads to a loss of interest in the subject and an accumulation of gaps in theoretical knowledge. These theoretical gaps can later affect their motor skills development.

In physical education, students' engagement with tasks covers cognitive (students' degree of engagement in learning and self-regulation), affective (students may be enthusiastic, careless or experience negative emotions such as boredom) and behavioural (students may be active or passive during lessons) aspects [3]. Actively involving students in play tasks and performing physical exercises provides teachers with information that they can more or less easily observe and monitor.

In the literature, there is a lack of information and resources on appropriate methods to approach physical education lessons for students with medical exemptions. The focus often falls on healthy and physically active students, and the needs of exempt students are neglected.

A study raises concerns about the abuse of medical exemptions and suggests that they may be used to hide low self-esteem and other psychological problems [4]. The main research findings indicate that medical relief (is often used as a protective layer for underlying emotional problems such as low self-esteem, poor emotional well-being and severe personality disorders. The study highlights the importance of physical education in stimulating and enhancing individuals. The findings highlight the need for further studies in this area and the importance of raising awareness of the potential abuse of medical exemptions. However, some examples show that this problem can be tackled differently.

For example, an article analysing physical education and physical activity policies and programs in U.S. schools at the state, district, school, and classroom levels highlights key findings from the Centers for Disease Control and Prevention's Study of School Health Policies and Programs that it presents at 6-year intervals.

The research presented above mentions the need to provide physical activity opportunities at school to help young people achieve physical activity recommendations and develop healthy lifestyle habits. For students who have been temporarily excused from physical education for medical reasons, there is a need to provide support for their reintegration into the regular physical education program after recovery [5]. This support could include monitoring their medical progress, adjusting their activity level and providing resources to help them recover physical skills. The goal is to ensure these students return to physical activity safely and effectively [5].

Higher education plays a vital role in implementing the Sustainable Development Goals set out in the United Nations' 2030 Agenda, a topic addressed extensively in a study.

Goal four of this agenda focuses on ensuring quality and equity in higher education through teacher education, which becomes essential to provide future teachers with transformative learning experiences and high-quality educational programs in every educational institution.

The use of gamification in education is highlighted as an innovative method in physical education aimed at evaluating students' opinions and teachers' thoughts [6].

Gamification involves integrating game elements into educational contexts to motivate behavioral change in students. There is much research in the literature focusing on creative thinking, creativity and innovation [7–9], nutrition education, adapted remedial programs [10–13], and postural re-education programs [12,14–18].

One research [6] defines "Gamification" as a framework for promoting transformative learning, with attention to game design and its impact on student motivation and engagement in learning.

In Croatia, a study suggests that introducing educational video content into physical education lessons can improve students' knowledge of health and health literacy and their perception of the usefulness of these lessons without affecting their satisfaction with the lessons. This indicates that integrating educational videos that connect exercise with theoretical health knowledge can benefit daily physical education lessons [19]. These findings suggest that using educational video technology can improve the quality of health education and contribute to student development more holistically without negatively affecting their satisfaction with lessons form.

Research-based on Self-Determination Theory (S.D.T.), which argues that meeting the fundamental psychological needs of autonomy, competence, and connectedness is critical to the development of autonomous motivation and positive outcomes, has highlighted how teachers' support for student autonomy in physical education influences well-being, knowledge, performance, and intentions to maintain physical activity outside of physical education classes [20].

The survey results speak to students' positive perceptions of physical education teachers as mentors, compassionate and caring [20]. It can be said that students see physical education more as a means to have fun, enjoy themselves and move freely[21,22].

Linking the above idea to our topic, we ask rhetorically the question: what is the perception of the medically exempted student towards the physical education teacher in the context in which the student is isolated on the bench, spectator in class, and the teacher coordinates the activity of the non-disabled students?

The *purpose* of this study is *to build the application "Info-Scutit-Efort" for use in physical education classes in order to enhance learning, the evaluation of students who are medically exempt from physical education, and the student's involvement in directed/adapted effort recovery programs during physical education classes. The study also intends to broaden the application's scope of usage to satisfy a greater variety of requirements.*

2. Materials and Methods

2.1. Working hypotheses:

In the present research, we have assumed the hypothesis that the use of the Info-Scutit-Efort app during physical education classes may have a significant positive effect on the increase of active and conscious participation time of medically exempt or physically unfit students and on the grades students obtain after accessing the app, fostering skill development and improved health.

2.2 Participants

Our study subjects were 55 middle school students (age=11.29±1.84) who were medically exempt (58.2% total and 42.8% partial) and used the info-Effort app in physical education classes during the exercise exemption.

The app offers free and flexible access to different functionalities, in line with the curriculum's content, transformed into questions so that the student can access

information about previously taught homework, homework taught in real-time, or general or particular medical recommendations depending on the diagnosis.

In the assessment section, students can access tasks and tests to assess their knowledge, and in the self-assessment section, they can use tools to track their progress.

The actual typing time of the application was recorded, precisely how long it presented interest to the student by accessing the fields presented, and the average was 18.60 minutes, which can explain active and conscious participation.

The small number of subjects is because there may be only one, two or three pupils in an exempt class. Furthermore, it should be noted that our application is in the testing and endorsement phase and, therefore, not yet freely available on the Internet.

2.3. The organisation of the research

The Info-Scutit-Efort application was designed, developed and tested at the Human Performance Research Centre of the Faculty of Physical Education and Sport of the University "Dunărea de Jos" of Galati between November 2021 and September 2023.

Data for this article were collected between December 2022 and September 2023 with the involvement of physical education teachers, physicians, and physical therapists.

Medically exempt students who tested the app in physical education classes were asked if they wanted to use it without being given additional information to assess the flexibility and accessibility of use.

The study complied with the principles of the Declaration of Helsinki and the ethical rules for research involving human participants.

Statistical Analysis

Statistic calculations were performed through the SPSS software (I.B.M. Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: I.B.M. Corp). The analysis focused on the relations between the dependent variable (post-accessing mark) and the independent variable (accessing time) by simple linear regression.

Initially, we calculated the descriptive statistics of these two variables we are concerned with in the first place: accessing time and the test mark after accessing the application. Then, the Pearson correlation was calculated to see if the model was accurately selected. We performed a variance analysis through ANOVA to find the model's significance. The regression coefficients were recorded for the dependent variable "mark obtained after accessing", upon which the graph showing the variation of the dependent variable was drawn.

2.4. Realisation of the Info-Scutit-Efort Application Concept

This application was initially developed for integrating the medically exempt student into the physical education lesson and was later updated for this article. The following technical resources were used: the multi-platform development software Unity [23], the free development platform Visual Studio [20-21], the Microsoft Visual Studio Code 2019 program [24], the Mono platform [26] and Adobe Photoshop graphics editor [27].

The architectural structure of the application is based on a three-tier architecture, including the following components: **User Interface:** This component is the visual and interactive part of the application, through which users interact with the whole system. Within the Info-Effort Info application, the user interface provides access to various functionalities and modules developed for physical education for students with partial or total exemptions from the effort. **Integrated Development Environment:** The integrated development environment (IDE) provided by Unity and the Visual Studio and Visual Studio Code 2019 programs were used to build the application. These IDEs facilitated the code writing and testing process. **Programming Code Structure:** The core component of the app consists of the programming code that implements the functionality and logic of the app. This code is written in the programming language corresponding to the Unity platform and is managed through the mentioned IDEs.

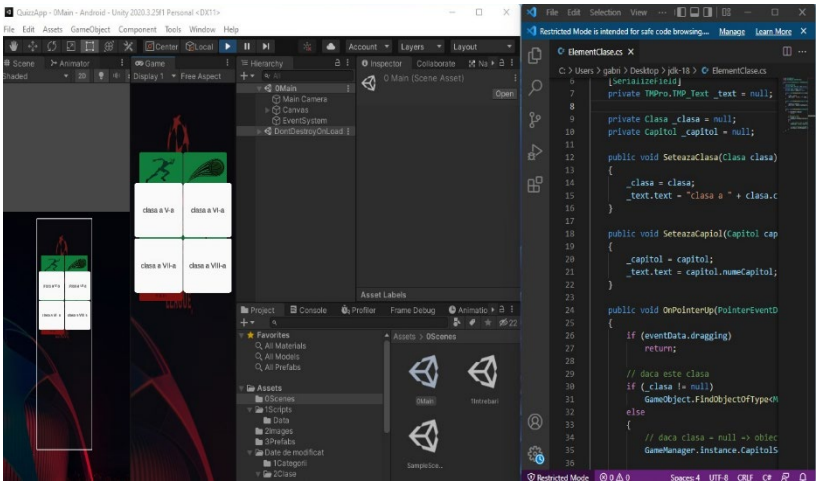

Figure 1. Screenshot after Unity platform - accessing curriculum content

Figure 1 provides a visual representation of the application components, and Figure 2 shows how to use it and the facilities it offers.

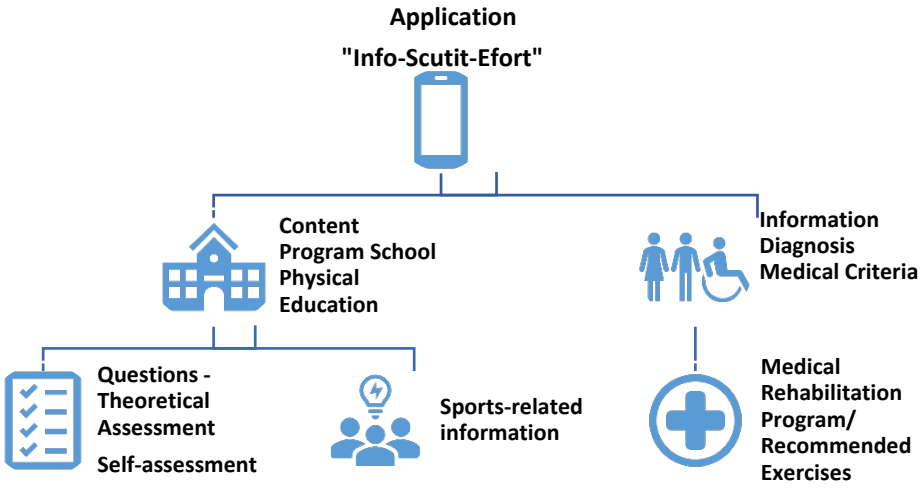

Figure 2. How to use and facilities offered by Info-scutit-efort

The medically-exempt student can access a curriculum content in physical education, turned into questions, from the app with teacher acceptance. Usually, he/she chooses the sports discipline presented in the ongoing lesson.

Before working on the topic, they can listen to the topic of the lesson that is taking place and then assess their knowledge by working on the same topic discussed in the gym.

The student can select their grade level or access lower grades for self-assessment. The teacher can indicate the topic from the categories "Technical elements and procedures", "Technical-tactical actions", "Rules and regulations", or "Sporting information" for its integration into the lesson. For example, the pupil can be a referee's helper after the "Rules and regulations" session [28].

There is an information menu in the app for general sports information. The worksheet contains ten questions, each with three answer options, only one of which is correct.

Incorrect answers are marked in red, and correct answers in green immediately after ticking. The final assessment is based on the correct answers, each adding one mark to the final mark at the end of the working session. For example, "Congratulations, you have answered 8 out of 10 questions correctly" equals a mark of 8.

In the "Medical Recovery" section, the student can access the Medical Checklist [1], select the condition or group of conditions and choose either "Medical Information Bar" with information about the diagnosis they have on their medical exemption or they can open a work session with questions and answer choices to test their knowledge about their health condition.

In the "Medical Rehabilitation Program" section, the student can follow the individualised recommendations given by the physician who issued the exemption (if the physician has agreed to give recommendations regarding the effort) or follow a general program with minimal dosages.

The physical education teacher has little intervention and only supervises the correctness of the exercises if necessary.

The content of the exercise program and the dosage are indicated by the doctor who issued the exemption.

The teacher can tick in a separate box if the pupil has completed the remedial program in the physical education lesson, thus counting the number of days the program has been in place and can be an indicator of progress or regression for the specialist at a new reassessment.

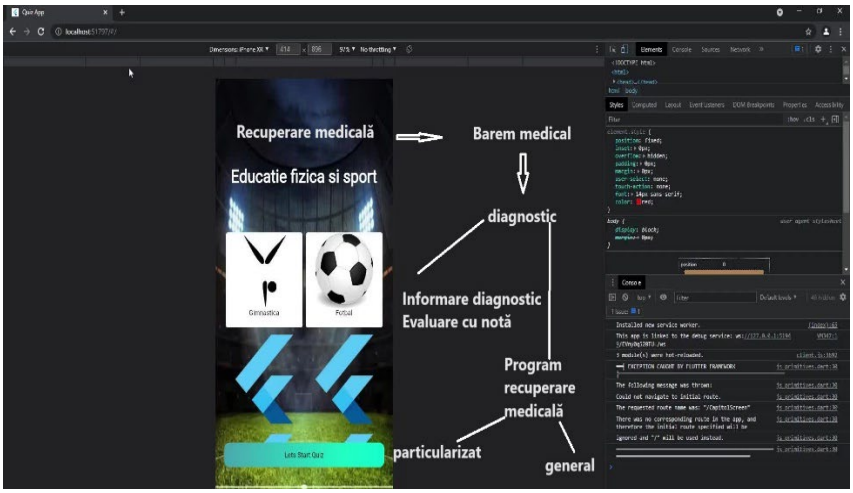

Figure 3. Screenshot after Unity platform - How to access medical recovery content

The development and implementation of the application at the national level could help closely monitor the total number of medically exempt, unfit pupils and provide data on the prevalent conditions in pupils.

It is structured to serve physical education lessons and is adapted for students with partial or total exemptions from effort.

Therefore, implementing the Effort-Info app involves using technical resources, including development software and programming environments, to build an app with functionality specific to physical education and tailored to the needs of students with effort exemptions.

3. Results

Analysing Table 1 with the descriptive statistics of the two variables, the time spent to access the application and the grade received after accessing it, we note that the minimum time spent to access the application was 8, the maximum time was 26, and the mean was 18.60 minutes, with a standard deviation of 4.821 seconds. These values suggest a moderately concentrated distribution around the average but with some variation between the minimum and maximum values. The minimum grade received by users was 5, and the maximum grade was 10. The mean of the grades received was 8.07, with a standard deviation of 1.331.

Table 1. The descriptive statistics of the two variables

Descriptive statistics for the analysis of the relation between the dependent and independent variables					
	N	Min.	Max.	Mean	Std. Deviation
Time spent to access the app	55	8	26	18.60	4.821
Grade after accessing the app	55	5	10	8.07	1.331
Valid N (listwise)	55				

Table 2 shows that r is the Pearson correlation coefficient, which measures the strength and direction of the linear relationship between the independent variable (time spent to access the application) and the dependent variable (which we are trying to foresee). In this case, r = 0.873 suggests a strong correlation between the two variables.

Table 2. Summary of the regression model for the constant variable time spent to access the application

Model	r	R Square	Adjusted R Square	Std. Error of the Estimate
1	.873[a]	.762	.758	.655

a. Predictors: (Constant), time spent to access the application

R Square is the coefficient of determination, which represents the proportion of variation in the dependent variable that the independent variable and the constant in the model can explain.

Our results indicate that R Sq. = 0.762, which suggests that 76.2% of the variation of the dependent variable may be explained by the time spent accessing the application and the constant in the model. Adjusted R Square considers the number of predictions in the model, unlike R Square, which does not.

In our case, Adjusted R Square = 0.758 indicates that approx. 75.8% of the variation of the dependent variable may be explained by the time spent to access the application and the constant in the model.

Std. Error of the Estimate represents the standard value of the model and measures the variability from the model predictions. In Table 2, this value is 0.655, which suggests that the model predictions are generally set 0.655 units away from the fundamental values of the dependent variable. In other words, this shows how precise the model is in predicting the dependent variable.

Table 3 (Anova) displays the result of the significance test for the value of the regression coefficient R.

Table. 3 Analysis of the variance for determining the significance of the regression model

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Mr
1	Regression	72.950	1	72.950	169.881	.000[b]
	Residual	22.759	53	.429		
	Total	95.709	54			

a. Dependent Variable: grade received after accessing the application

b. Predictors: (Constant), time spent to access the application

As part of this ANOVA result, a regression analysis is performed to determine whether there is a relationship between the time spent accessing an application and the grade received. The ANOVA table has two sources of variation: regression and residual. The sum of squares for regression represents the variation explained by the regression model, while the sum of residual squares is the variation the regression model does not explain. In our case, the sum of regression squares is 72.950, and the sum of residual squares is 22.759.

The number of degrees of freedom for the regression is 1, and the number of degrees of freedom for the residual is 53. The mean square for the regression is 72.950, and the mean square for the residual is 0.429. F-statistics and sig. Test the null hypothesis that the regression model does not explain the variance observed in the data.

In this case, the F-value is 169.881, indicating that the regression model explains significant variation. The sig. value is 0.000, indicating that the probability of obtaining an F-statistic at least as extreme as that observed in the data is very small (less than 0.0001), so we can confidently dismiss the null hypothesis. Thus, we can conclude that there is a significant relationship between the time taken to access the application and the score received after access ($p<.0005$).

Table 4. Regression coefficients for the dependent variable "grade received after accessing the application."

Coefficients[a]								
		Unstandardised Coefficients		Standardised Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Mr	Lower Bound	Upper Bound
1	(Constant)	3.589	.355		10.103	.000	2.876	4.301
	Time taken to access the application	.241	.018	.873	13.034	.000	.204	.278

a. Dependent Variable: grade received after accessing the application

Note: column B -coefficient value; std Error- standard error of the coefficient; Beta-value of standardised coefficient; t- coefficient significance test statistics; Sig-test critical probability

It can be seen that the time spent accessing the application has a significant positive effect on the grade received after accessing (Beta = 0.873, $p<0.001$), which means that, in general, the more time one spends accessing the application, the higher the grade received after

accessing. The constant value was 3.589, which means that the grade received after accessing would have averaged 3.589 if the time spent accessing the app had been zero. The t-test showed that both coefficients were statistically significant (t=10.103 and t=13.034 for the constant and time spent accessing the app, respectively) at the 0.05 significance level. The 95% confidence interval for both coefficients does not include zero, indicating that the estimates are more precise. These results suggest that time spent accessing the app is a strong and significant predictor of the grade received after accessing.

To better highlight the relationship between the two variables, we attach the regression line graph below, where R Square is 0.762 (Figure 4), suggesting that 76.2% of the variation in the dependent variable can be explained by the application access time and the constant in the model.

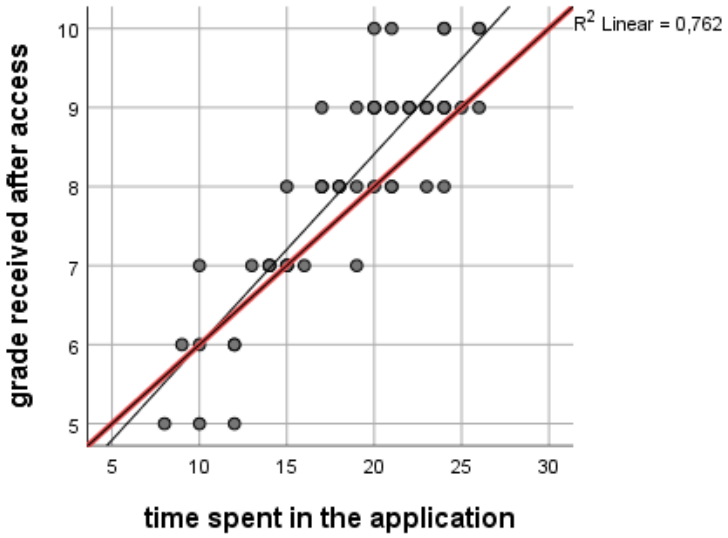

Figure 4. Scatterplot - the graphical expression of the correlation between the grade received after access and time spent in the application

4. Discussions

This study aimed to develop the "Info-Scutit-Efort" application for use in physical education classes to enhance learning, evaluate medically exempt students from physical education, and engage students in directed/adapted effort rehabilitation programs during physical education classes.

It is known that the number of medically exempt students who cannot actively participate in physical education lessons due to their diagnoses has increased significantly in recent years.

Extensive research addresses the topic of the effectiveness of exercise programs in the management of scoliosis and obesity [29–33].

A study from Nigeria [34] also highlights the need to improve school health and physical education programs, identifying barriers such as resource and infrastructure limitations. Significant discrepancies in parents', teachers' and children's perceptions of physical education highlight the need for more effective communication between all stakeholders.

The authors provide concrete recommendations for formulating evidence-based educational policies and programs that support children's holistic development and improve their learning outcomes[35–37]. Finally, integrating health and physical education within the education system is a critical strategy for building a balanced generation capable of contributing to Nigeria's prosperous and sustainable future.

A study of 1636 students from seven different regions in Turkey investigates how students' attitudes towards physical activity are related to their level of life satisfaction. This suggests a connection between active participation in physical activities and students' mental well-being. The results indicate that positive attitudes towards physical activity are associated with greater life satisfaction, highlighting the importance of integrating physical activities into students' lifestyles to enhance their well-being [38].

The teaching styles used by physical education teachers significantly impact children's positive experiences during lessons and their psychophysical health[39–41]. The idea is summarised from a study conducted on 121 subjects to evaluate the effectiveness of an integrated approach in physical education, combining different teaching styles and active reflection. Researchers investigated how this approach influences fitness levels, motor competence, enjoyment, self-perception, physical activity levels and children's perceptions of physical education, with applications in Italian primary schools [42].

In South Africa, a study also highlights the importance of exposing the problems in the education system for learners from different socio-economic backgrounds and learners with disabilities, suggesting that teacher training should address this dimension of physical education. These recommendations include improving equipment and facilities, promoting existing themes and issues to parents and students, and developing teaching strategies for large classes and small spaces [43].Top of form

Another research study focuses on the importance of integrating STEM (Science, Technology, Engineering and Mathematics) education into students' physical education, where it is stressed that young people need to develop modern skills to meet today's educational challenges. Through STEM education in physical education, students learn to think critically, solve problems and use technologies, helping to prepare them for the future[44].

A similar study was carried out in Spain to investigate the effects of a formative and shared assessment approach in the context of physical education on students' perception, motivation and engagement in learning [45]. The authors implemented this approach in a high school in Spain and used several data collection methods, such as focus groups and analysis of teacher and student diaries, to assess the impact of this process.

The study results showed that students experienced a significant increase in motivation and engagement in this participatory assessment. Active participation in the assessment process, including self-assessment and co-assessment with their peers, contributed to developing a positive attitude towards learning and their peer group. This approach to assessment has resulted in greater student engagement in the learning process and improved their perception of physical education.

As in the research we presented, the study's conclusion demonstrated that formative and shared assessment could effectively enhance students' physical education experience, increasing their motivation, task engagement, conscious, active participation and progress. This approach could have positive implications for the quality of physical education and learning in general in schools for students who are active in the lesson but especially for medically exempt students who, due to the exemption from the effort, are sure to lose interest in the subject being discussed.

The application presented by us can be an advanced methodology with a high level of accuracy to facilitate the active participation of medically exempt students in physical education activities. This methodology involves close collaboration between sports doctors, physical education teachers and a dedicated app.

The first objective would be to create a robust methodology through the proposed application for:

- Develop a clear framework for collaboration between sports doctors and physical education teachers.
- Establish clear criteria for assessing the eligibility of medically exempt pupils

to benefit from this methodology.

A second important objective would be to develop a customised application by:

- Build a user-friendly digital platform that allows medically exempt students to access exercise sets specific to their diagnoses, recommended by sports doctors.
- Integrate a progress tracking system and communication between teachers and clinicians to ensure students follow the appropriate exercises and dosages.

Expected benefits:

- Increase the involvement and integration of medically exempt students in physical education lessons.
- Promoting a healthy and responsible lifestyle for all students.
- Significant reduction in the number of medically exempt students sitting passively on the bench during physical education activities.

Collaboration between physical education teachers and sports physicians based on a well-developed methodology and a customised application can significantly impact the lives of medically exempt students. This initiative aims to improve the quality of physical education and health of our students and promote a more inclusive and healthy school environment.Top of the form

5. Study limitation

A limitation of the study was the small sample size, with no more than three exempt students in classes at any time. Due to limited personal resources, we only used one phone on which the app was installed, resulting in a more extended and cumbersome testing period.

Processing and converting a small number of diagnoses into questions and information from the 371 diagnoses presented in the Medical Schedule according to which exemptions are issued.

Without a server to process and store the data, the application may depend on the hardware resources of the user's device, which has led to performance and efficiency limitations in delivering medical recovery programs to the 55 subjects.

The present research revealed that the longer the access time, the higher the test score, which leads us to believe that the app helps transmit skills but could not be tested for health improvement.

However, further studies are needed to confirm whether the time spent accessing the app is correlated with the time spent actively and consciously participating in the information content the app contains.

6. Conclusions

Two main observations can be drawn from this study:

The Info-Scutit-Efort app accessed during the physical education class stimulates the medically exempt student, who is physically disabled, to participate actively and conscientiously (for learning, informing and assessment) for an average time of 18.60 minutes, which represents 41.3% of a 45-minute class, which qualifies as an excellent result.

From the centralised results, it can be seen that the time spent accessing the application has a significantly positive effect on the grade received after accessing (Beta = 0.873, $p<0.001$), which means that, in general, the more time one spends accessing the application, the higher the grade received after accessing. The relationship between time spent accessing the application and the grade received is significant ($p<0.05$), with a

regression coefficient of 0.241 and an R^2 of 0.762, which means that the time spent accessing the app explains 76.2% of the variation in the grade received.

In conclusion, the time spent accessing the application strongly correlates and significantly influences the grades received after access. The longer the access time, the higher the grades received in general, and we can say that the application facilitates the transmission of skills. Statistical analysis, significance tests and regression coefficients support this.

The approach to physical education for students with medical exemptions requires special attention and individual adaptations to ensure an inclusive and beneficial learning experience for all students.

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