Facilitating the Visualisation of Moving Games by Implementing Augmented Reality in Primary Physical Education Classes

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Abstract **– The use of moving games in physical education has many positive aspects. Unfortunately, it is sometimes difficult for the teacher to explain the rules and the way of playing clearly enough. This paper aims to help visualise these explanations by presenting the implementation of a new technological solution in primary education - augmented reality (AR).**

The main research questions in this study are "What are the key steps in creating effective augmented reality content to visualise moving games in physical education classes?" and "Which software and technology solutions are most suitable for developing augmented reality for learning purposes in primary education?"

The stated hypothesis is that the use of augmented reality platforms to create interactive scenes will enable more efficient integration of video content and facilitate the development and implementation of modern technologies, as well as enhance the quality of visualisation of game techniques.

The methods used are theoretical analysis, involving a review of scientific literature relevant to the examined issues, descriptive method, presenting in detail all the steps in the development and implementation of augmented reality, including software selection and content management processes, comparative method, comparing various software platforms for augmented reality creation, and demonstration, involving the use of videos and augmented reality to visually represent the rules and movements of moving games.

The study results show that the use of augmented reality significantly improves the visual representation of moving games, helping students better understand the rules and techniques through clear video demonstrations. Teachers are also introduced to the possibilities of integrating modern information technologies into the learning process.

Keywords **– Moving games, augmented reality, modern technologies, physical education and sport.**

1. Introduction

Games provide a motivational climate for learning that, by their very nature, evoke positive emotions in students. They play a key role in the promotion of physical education, which aims to develop the socio-emotional well-being of pupils as a basis for the learning process [1]. They have a positive effect on personality development at different stages of childhood. Games have been created by humans for many centuries to develop children's physical qualities as well as qualities such as independence, resilience, cooperation, intelligence, honesty, kindness and caring towards others [2]. By changing the way games are presented, the possibilities for teaching game forms extend beyond structured formal versions of popular adult sports and single-player games [3]. Game-centered pedagogy is effective in simultaneously improving students' basic motor skills, physical activity in the classroom, and decision-making and support skills in play [4].

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However, if a student spends many hours learning and practicing the same type of very similar games, he or she will have less opportunity to spend time gaining other useful experiences [5].

In the 1960s, a paradigm shift began from training as the dominant approach to teaching sports games, which influenced later pedagogical elements of teaching games of understanding [6]. Pedagogical implications for physical education include the idea that active learning of sport skills leads to the development of greater success in skill performance, and that tasks for learning sport skills should closely resemble game situations in order to promote the relationship between information and movement [7]. These games can be of different types, e.g., cooperative, competitive, territorial, modified, etc., whose purpose is to work on one or a few specific parts of the sport through rules in order to approach the complete study of the sport [8]. They aim at the motor, social, cognitive and emotional development of the pupils [1].

In this context, understanding what sport games are also depends on discussing, firstly, why they belong in education and, secondly, what are the implications of including sport in physical education [9]. Games, with their emotive nature, have long been an integral part of human life, diversifying leisure time, educating and encouraging physical activity. Physical games can be found almost everywhere in the school, between classes, at sports festivals, during extra-curricular activities, etc. They are an integral part of a student's growing up. Physical education can be defined as an all-round pedagogical tool, emotionally intense, based on certain rules, satisfying the natural desire of pupils for motor activities and achieving pre-set educational tasks [10].

According to several Russian authors moving games and their dynamic elements are characterised by diversity, multifunctionality, attractiveness, flexibility, and accessibility, thus playing a significant role in physical education and sport [11], [12], [13]. Their value also lies in the fact that their tools can effectively influence not only the student's physical culture but also their mental and functional state. Through the game, students express themselves, engage, socialize, and develop their motor skills and moral-volitional qualities [14]. Other researchers argue that the significance of moving games lies in the acquisition and consolidation of skills, knowledge, competencies, and the development of motor abilities and moral qualities within continuously changing situations and conditions [15], [16], [17], [18]. Or consider that their use may contribute to improving the instructive and educational process [19] because they can be played anywhere and anytime [20].

2. Implementation of the Study

Unfortunately, in many cases it is difficult for the PE (physical education) teacher to explain the rules and the way of playing to his pupils. Therefore, this paper presents an opportunity to improve the visualisation of moving games in physical education in primary schools. This is done by introducing elements of augmented reality into the learning process. Initially, 16 different mobile games were photographed with a drone, played by students of the Faculty of Pedagogy, South-West University "Neofit Rilski", Blagoevgrad, Bulgaria. The following games: "*Hit the Bats, Ivan, Where Are You, Sea Chess, Jump with a Hug, Instant Shooting, Beat the Pass, Crows and Ravens, Challenge me to Chase, Chain Bat, Skip the Stick, Catch the Stick, Two Balls Chase Each Other in a Circle, Baton Baton, Play with the Middle One, Hawk and Quail, What has Changed.*

Possible software solutions for creating augmented reality, and more specifically for launching video files when scanning a specific image, were explored (Table 1).

Table 1. Software applications providing augmented reality opportunities

Name	Hyperlink
Blippar	blippar.com
Layar	layar.com
HP Reveal	hpreveal.com
ZapWorks	zap.works
Vuforia	vuforia.com
ARKit	developer.apple.com/ augmented-reality/arkit
ARCore	developers.google.com/ar
Wikitude	wikitude.com
ViewAR	viewar.com
Augment	augment.com
ARToolKit	artoolkit.org
XR+	xr.plus
uAR	uarapp.com
AR-media	inglobetechnologies.com/ar-media
Catchoom	catchoom.com
Metaverse	gometa.io
ROAR	theroar.io
Total Immersion	t-immersion.com

2.1. Description of Several Games

Sea Chess [10] (Figure 1): The class is divided into 8 teams of 4 students. The teams play against each other in 4 duels. A duel is played as follows: Each pupil from both teams has a cone of the same colour per team. At a certain distance in front of both teams a Sea-Chess is drawn.

At a signal, the first of the two teams start and runs to the drawn chessboard and whoever is faster places the first cone in the square of their choice. They then go back and pass the baton to the next two teams by clapping their hands. They do the same and so on until one of the teams has placed three cones of the same colour in a line or diagonal. Two games can be played at the same time. If a team wins, it scores three points; if the game is tied, both teams score one point. Each team plays against the others and the number of points determines first, second and third place. The game has an impact on speed, reaction time and concentration. The motor element in the content of the game: Simple running is embedded in the curriculum of the first year. A flow method of organisation is used.

Figure 1. Students playing the game "Sea Chess"

Jump with a Hug (Figure 2): The class is divided into two lines facing each other at a distance. The pupils in the rows are separated by an arm's length, and pairs of pupils are formed from each row. At the teacher's signal, they all start at the same time and, with repeated two-legged jumps, each pair tries to be the first to reach each other and embrace. The game develops the explosive strength of the lower limbs. The motor element in the content of the game: Repeated bipedal jumping is embedded in the second year curriculum. A frontal method of organisation is used.

Figure 2. Students playing the game "Jump with a Hug"

Instant Shooting (Figure 3): The class is divided into two teams and set up in two lines facing each other behind the two end lines. Large, light balls are placed one metre on either side of the centre line. On a signal from the teacher, everyone runs to the balls at the same time and tries to hit some of the opposing players first with a snap shot. The game influences the explosiveness of the upper limbs and the speed of reaction. The motor elements in the content of the game: running and throwing a large, light ball with one or two hands, are covered in the curriculum for year one. A play-based method of organisation is used.

Figure 3. Students playing the game "Instant Shooting"

Exceed the Pass (Figure 4): The class is divided into three teams, which stand in columns along the length of the pitch. The distance between the pupils in the columns is four metres. One pupil from each column is chosen to start low behind one end line. The teacher hands a handball to the first of the teams. On the teacher's signal, the ball must be passed between the pupils in the teams and cross the opposite end line without being overtaken by the running pupil. The game is about the speed and accuracy. The motor elements in the content of the game: Catching, passing and running in a straight line are covered in the second year curriculum. A flow method of organisation is used.

Figure 4. Students playing the game "Exceed the Pass"

Play with the Middle One (Figure 5): The class is divided into two teams that spread out freely on the pitch. The pupils in each team wear different coloured T-shirts. One pupil is placed in the center of the field in a circle, three metres in diameter. One of the teams is given a handball to start the game. The aim is to pass the ball between the two teams, with the pupils from the other team trying to intercept it. A point is scored when one of the teams passes to the pupil in the circle and the pupil passes the ball back to them. The game develops skill, agility, accuracy, finding open spaces and placement. The motor elements in the content of the game: Catching, passing and holding the handball, are covered in the third year curriculum. A playful method of organisation is used.

Figure 5. Students playing the game "Play with the Middle One"

Challenge me to Chase (Figure 6): The class is placed freely in the playing field. One chaser and one chased are chosen and start chasing each other. In order to save himself the chased one needs to touch some of the students on the back. Then he starts chasing the chaser because he has been challenged. The game has an impact on reaction speed and agility.

The motor elements in the content of the game: running with change of direction, tempo and rhythm are set in the curriculum for the first grade. A frontal method of organization is used.

Figure 6. Students playing the game "Challenge me to Chase"

2.2. The Software Product Overly

A (https://overlyapp.com/) was selected for the study. Registration is required for use. It can be done by using a Google Account or by creating an account that only requires a first name, last name, email address and password. Then there are a few steps to specify the purpose of using the programme – There is a need to specify for what purpose the augmented reality will be used (for business, education or as a hobby), etc. After confirmation by e-mail, you can start working with the programme. There is a separate workspace for each project. By simply selecting the "Create" button, you can define the type of experience and its name. For the purpose of the study, the application-based image recognition was chosen. After creating the project, it is necessary to upload a tag in the form of an image, which is then scanned and used as a trigger to start the corresponding video. If the attachment is successful, the scene is rendered (Figure 7).

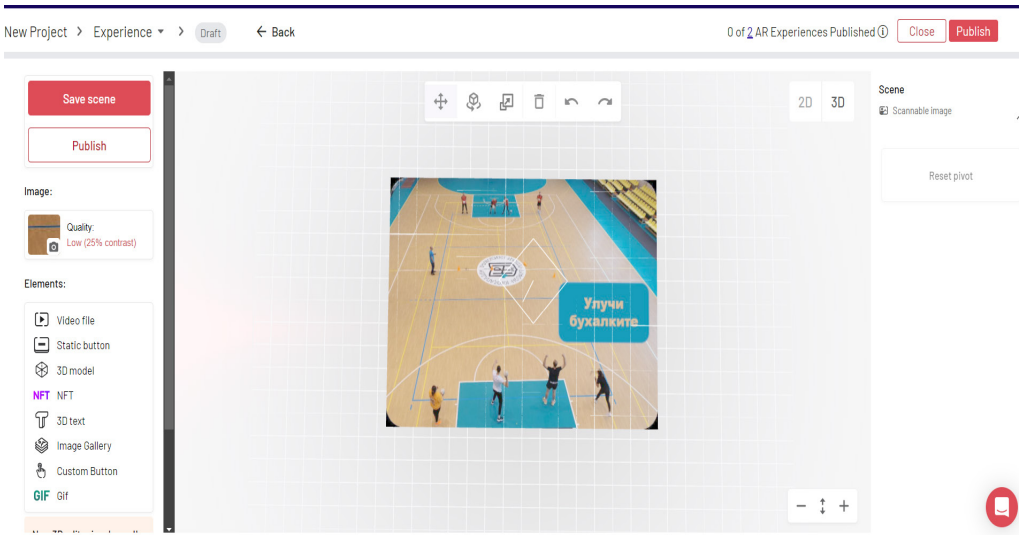

Figure 7. Home screen of the scene

The different elements are listed on the right of the screen (you can use video file, static button, 3D model, NFT, 3D text, etc.). For the needs of our example, we select the option to attach a video file and specify its location. Once it has been attached and converted, you can check that it is correct, replace it if necessary or add another. Once the video has been positioned in the scene, you can use the settings panel on the right of the screen to change its position, as well as its transparency, scale, the way it is displayed on the screen and the way the video starts.

Once the augmented reality has been successfully created, a welcome screen (Figure 8) will appear, displaying a QR code that can be used to download and install the Overlyapp, either from Google Play or the App Store. To preview the augmented reality created, it is necessary to install the application and scan the image previously uploaded and positioned on the right side of the screen.

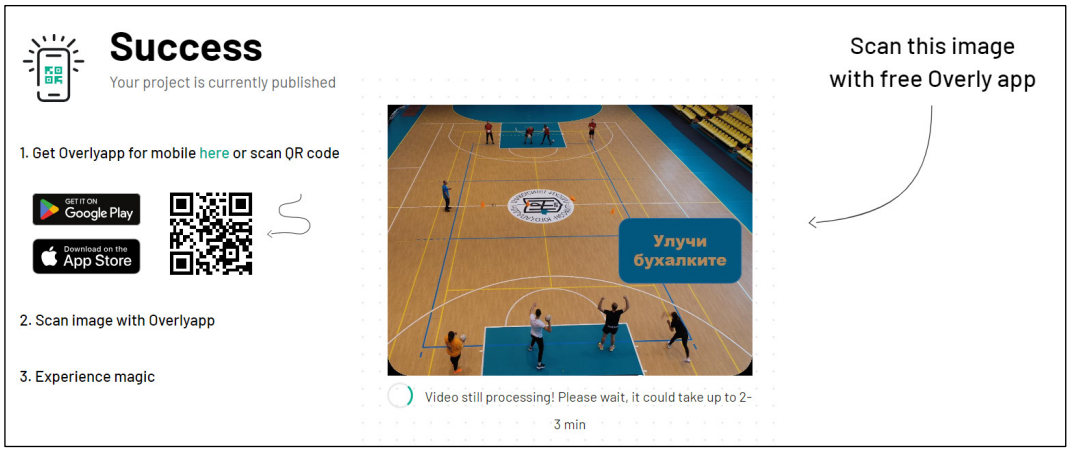

Figure 8. Final screen enabling the launch of augmented reality

Once the app is installed a "Tap to scan" button appears on the device screen to start the scan.

When it is complete can enjoy the augmented reality experience (Figure 9 and Figure 10).

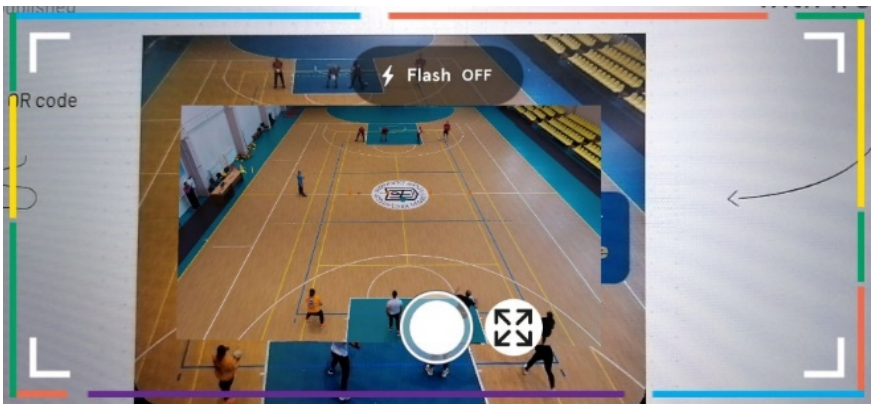

Figure 9. Augmented reality game "Hit the Bats"

Figure 10. Augmented reality game "Ivan, Where Are You?

3. Conclusion

Augmented reality facilitates the teaching of moving games by providing an effective means of presenting game rules and techniques through video demonstrations, thereby reducing the risk of errors and improving students' understanding of game instructions.

The interactive nature of augmented reality enhances student motivation and engagement by fostering interest and encouraging active participation, contributing to a positive learning environment and promoting teamwork.

The selected software demonstrates high efficiency in creating interactive augmented reality scenes due to its easy access via QR codes and adaptability to various learning conditions.

The implementation of augmented reality optimises the learning process by reducing the time needed for explaining game rules and supporting teachers in presenting complex activities. The study confirms that augmented reality can be successfully integrated as a modern educational tool, making physical education classes more accessible and effective, while promoting the digitalisation of the learning process and proves our hypothesis.

Visualisation in physical education plays a key role in the learning of sports games, as it offers several benefits that improve understanding and performance of exercises. One of the main reasons for the need for visualisation is that it provides a clear and accurate picture of the rules and techniques of sports games, preventing misunderstandings and errors. When students see the correct execution of movements, they can more easily reproduce them correctly. In addition, visualisation greatly improves student engagement. The use of video and augmented reality makes lessons more fun and interesting, which encourages active student participation. This is particularly useful when learning complex movements and coordination exercises that are difficult to explain in words alone. This creates a positive classroom atmosphere and encourages students to work hard to achieve better results. Visual materials also allow students to learn at their own pace. They can watch the videos and use augmented reality as many times as necessary to fully understand the exercise or game. In conclusion, augmented reality visualisation is a powerful tool in physical education that helps students understand, perform and remember the rules and movements of sports games more effectively and motivates them. It provides a clear and attractive way of presenting information, which facilitates the learning process and makes physical education more fun and effective.

The study highlights the benefits of augmented reality by demonstrating how it enhances the visualisation of moving games in physical education classes, facilitates the learning process by reducing the time needed to explain rules and demonstrate movements, and shows the potential for augmented reality to be more widely used in educational practice.

Suggestions for future research include developing augmented reality content for other academic disciplines, conducting longitudinal studies to assess the sustainable impact of augmented reality on students' motor skill development, motivation, and academic achievement, exploring the potential adaptation of augmented reality for students with special educational needs, and investigating the effects of 3D models, videos, and interactive scenes on students' cognitive processes, such as memorisation and concentration.

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