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ADVANTAGES OF USING MOBILE APPS IN PHYSICS LESSONS AT SCHOOL

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Abstract. The development of mobile applications increases educational aspects, including the ability to perform the laboratory work. Mobile AR tools offer a simple and cost-effective solution to help students to overcome the limitations of online education. However, the number of articles exploring the benefits of using AR mobile applications in physics lessons in schools is limited and absent in the Kazakh context. In addition, most experiments use static or 2D images that reproduce limited. The article presents the results and process of an experiment using the AR mobile application in physics lessons at the Lyceum school No. 85 in Astana. The use of interactive and dynamic 3D models improves student results in teaching physics and positively influence the attitude of students to the introduction of mobile applications in the courses. The results show significant improvements in the maintenance and understanding of physical concepts compared to traditional teaching methods. The experiment is not entirely intended to encourage the abandonment of laboratory devices, but shows that mobile applications can be an effective alternative to a dangerous and expensive laboratory environment and that such tools can be used to improve teaching in the natural sciences. 58 students were selected from the 8th grade, divided into 2 groups according to the test results. 2 days of experiments were conducted using traditional and mobile applications, the results were analyzed and it was shown that the mobile application helped to increase the level of learning.

Keywords: mobile application, AR, EdLab, education, school, physics

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МЕКТЕПТЕ ФИЗИКА САБАҚТАРЫНДА МОБИЛЬДІ ҚОСЫМШАЛАРДЫ ҚОЛДАНУДЫҢ АРТЫҚШЫЛЫҚТАРЫ

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Аннотация. Мобильді қосымшалардың дамуы білім беру аспектілерін, соның ішінде зертханалық жұмыстарды орындау мүмкіндіктерін арттыруда. Мобильді AR құралдары оқушыларға онлайн білім беру шектеулерін жеңуге көмектесетін қарапайым және үнемді шешім ұсынады. Алайда, мектептерде физика сабақтарында AR мобильді қосымшаларын пайдаланудың артықшылықтарын зерттейтін мақалалар саны шектеулі және Қазақстандық контексте жоқ. Сонымен қатар, эксперименттердің көпшілігі статикалық немесе 2D кескіндерді пайдаланады, олар қосымша ақпаратты қоспай-ақ бірдей ақпаратты қайталайды. Мақалада Астана қаласы №85 мектеп-лицейінде физика сабақтарында AR мобильді қосымшасын қолдану арқылы жүргізілген эксперимент нәтижелері мен процессі көрсетілген. Интерактивті және динамикалық 3D үлгілерді пайдалану оқушылардың физика бойынша оқу нәтижелерін жақсартатынын және оқушылардың мобильді қосымшаларды сабақ барысына енгізуге деген көзқарасына оң әсер ететінін көрсетеді. Нәтижелер дәстүрлі оқыту әдістерімен салыстырғанда физикалық тұжырымдамаларды сақтау мен түсінудегі айтарлықтай жақсартуларды көрсетеді. Эксперимент толығымен зертханалық құрылғылардан бас тартуға үгітту үшін арналмаған, бірақ мобильді қосымшалар қауіпті және қымбат зертханалық ортаға тиімді балама бола алатынын және мұндай құралдарды жаратылыстану пәндерінде оқытуды жақсартға және мотивацияларын арттыруға пайдалануға болатынын көрсетеді. 8-сыныптан 58 оқушы алынып, тесттілеу нәтижелері бойынша 2 топқа бөлініп, дәстүрлі форматта және мобильді қосымша көмегімен оқушылармен 2 күн көлемінде эксперимент жүргізілді, нәтижелер талданып, мобильді қосымшаның оқу деңгейін көтеруге қаншалықты әсер еткендігі анықталды.

Түйін сөздер: мобильді қосымша, AR, EdLab, білім беру, мектеп, физика

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ПРЕИМУЩЕСТВА ИСПОЛЬЗОВАНИЯ МОБИЛЬНЫХ ПРИЛОЖЕНИЙ НА УРОКАХ ФИЗИКИ В ШКОЛЕ

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Аннотация. Развитие мобильных приложений повышает образовательные аспекты, в том числе возможности выполнения лабораторных работ. Мобильные инструменты AR предлагают простое и экономичное решение, которое поможет учащимся преодолеть ограничения онлайн-образования. Однако количество статей, изучающих преимущества использования мобильных приложений AR на уроках физики в школах, ограничено и отсутствует в казахстанском контексте. Кроме того, в большинстве экспериментов используются статические или 2D-изображения, которые воспроизводят одну и ту же информацию без дополнительной информации. В статье представлены результаты и процесс эксперимента с использованием мобильного приложения AR на уроках физики в школе-лицее №85 г.Астаны. Использование динамических и интерактивных 3D-моделей показывает, что учащиеся улучшают результаты обучения физики и положительно влияют на отношение учащихся к внедрению мобильных приложений в ход занятий. Результаты показывают значительные улучшения в поддержании и понимании физических концепций по сравнению с традиционными методами обучения. Эксперимент полностью не предназначен для отказа от лабораторных устройств, но показывает, что мобильные приложения могут быть эффективной альтернативой опасной и дорогостоящей лабораторной среде и что такие инструменты можно использовать для улучшения преподавания в естественных науках. Из 8 класса было отобрано 58 учащихся, по результатам тестирования разделено на 2 группы. Через 2 дня эксперимента над участниками с использованием традиционного и мобильного приложения, проанализированы результаты и показано, что мобильное приложение помогло повысить уровень обучения.

Ключевые слова: мобильное приложение, AR, EdLab, образование, школа, физика

Introduction

Augmented Reality (AR) is a technology that enhances our perception of the real world by superimposing digital information and media onto it. This technology is used in various fields, including education, entertainment, and advertising. AR enables users to interact with virtual objects in a real-world environment, providing an immersive and

interactive experience (Kukulska-Hulme, 2009). In the context of education, AR technology can be used to create virtual learning environments and simulations that allow students to explore and experiment with concepts in a more engaging and interactive way. AR can also be used to provide real-world examples of abstract concepts and theories, making it easier for students to understand and retain the information (Cobcroft et al., 2008).

The integration of technology into education has been a growing trend in recent years, and for good reason. Technology has the potential to greatly enhance the quality of education, making it more effective and enjoyable for students of all ages. It provides new and innovative ways for teachers to engage students and for students to access information and resources. One of the main benefits of technology in education is increased student engagement and motivation. By incorporating technology into lessons, teachers can create interactive and engaging learning experiences that keep students interested and motivated. This can be especially important for subjects such as physics, which can be perceived as abstract and difficult. Another benefit of technology in education is improved access to information and resources. With the internet and mobile devices, students can access a wealth of information and resources at any time and from anywhere. This can be especially beneficial for students who may struggle to understand concepts in the traditional classroom setting. Finally, technology has the potential to revolutionize the way teachers design and deliver lessons. With the use of educational apps, simulations, and virtual environments, teachers can create lessons that are interactive, immersive, and tailored to the needs and learning styles of their students (Birt et al., 2018).

The use of mobile applications based on augmented reality in physics lessons at school has numerous advantages for both teachers and students. AR technology provides an immersive and interactive learning experience, improves student engagement and motivation, and enhances the understanding and retention of abstract concepts. By incorporating AR technology into physics lessons, teachers can create lessons that are engaging, interactive, and tailored to the needs and learning styles of their students (Abidin et al., 2017).

One of the main advantages of using mobile applications based on augmented reality in physics lessons is improved engagement and interactivity. AR technology enables teachers to create virtual learning environments and simulations that allow students to explore and experiment with physics concepts in a more engaging and interactive way. By providing a hands-on and immersive experience, students are more likely to be interested and motivated in the subject, leading to greater engagement in the lesson. For example, a teacher could use an AR app to create a virtual physics lab where students can perform experiments and simulations, helping them to understand and retain the information in a more meaningful way. This type of interactive experience can also help to make physics more accessible to students who may struggle with abstract concepts in a traditional classroom setting (Motiwalla, 2007).

Another advantage of using AR in physics lessons is enhanced assessment and evaluation. With AR technology, teachers can create gamified quizzes and assessments that make learning more enjoyable for students and provide a more accurate evaluation of their understanding of the subject. These types of assessments can also provide immediate feedback to students, allowing them to see where they need to improve and making it easier for teachers to identify areas where they need to provide additional support. For example, a teacher could use an AR app to create a physics quiz that allows students to answer questions by pointing their mobile device at objects in the real world. This type of gamified assessment can help to engage students and make learning more enjoyable, leading to greater motivation and understanding of the subject (Ozdamli & Cavus, 2011).

The use of AR in physics lessons can also lead to increased student understanding

and retention. By providing real-world examples and simulations, students are more likely to understand and retain the information. Additionally, the hands-on and interactive nature of AR technology helps to make abstract concepts more accessible and understandable, leading to greater retention of the information. For example, a teacher could use an AR app to create a virtual 3D model of a physics concept, such as the laws of motion. This type of interactive and immersive experience can help students to understand and retain the information in a more meaningful way, leading to improved performance on assessments and a deeper understanding of the subject.

Finally, the use of AR in physics lessons is easy to integrate into lesson planning. With the availability of AR apps and software, teachers can easily incorporate AR technology into their lessons without having to make significant changes to their teaching style or lesson plans. Additionally, the use of AR technology does not require any special training or technical expertise, making it accessible and user-friendly for teachers of all experience levels. For example, a teacher could use an AR textbook app to enhance a lesson on the laws of motion. The teacher could easily integrate the app into the lesson by having students use the app to interact with the textbook and perform simulations related to the subject. This type of integration allows teachers to enhance their lessons with AR technology without having to make significant changes to their teaching style or lesson plans. The use of mobile applications based on augmented reality in physics lessons has numerous advantages for teachers. By improving engagement and interactivity, enhancing assessment and evaluation, increasing student understanding and retention, and making it easy to integrate into lesson planning, AR technology provides an effective and accessible tool for teachers to enhance their lessons and improve student performance in physics (El-Hussein, 2010).

One of the major advantages of using mobile applications based on augmented reality in physics lessons is the immersive and interactive learning experience it provides. AR technology allows students to experience physics concepts in a more engaging and interactive way, providing them with a hands-on and immersive learning experience. This type of experience helps students to understand and retain the information in a more meaningful way and can also help to make physics more accessible to students who may struggle with abstract concepts in a traditional classroom setting. For example, a student could use an AR app to explore the laws of motion through simulations and virtual experiments, helping them to understand and retain the information in a more engaging and interactive way. This type of immersive learning experience can also help students to develop critical thinking skills as they explore and experiment with physics concepts (Bressler et al., 2019).

Another advantage of using AR in physics lessons is improved understanding of abstract concepts. By providing real-world examples and simulations, students are more likely to understand and retain the information. Additionally, the hands-on and interactive nature of AR technology helps to make abstract concepts more accessible and understandable, leading to a deeper understanding of the subject. For example, a student could use an AR app to create a virtual 3D model of a physics concept, such as the laws of gravity. This type of interactive and immersive experience can help students to understand and retain the information in a more meaningful way, leading to improved performance on assessments and a deeper understanding of the subject (Chiang et al., 2014).

The use of AR in physics lessons can also lead to enhanced engagement and motivation. By providing a more interactive and engaging learning experience, students are more likely to be interested and motivated in the subject, leading to greater engagement in the lesson. Additionally, the gamified and interactive nature of AR technology can make learning more enjoyable for students, leading to greater motivation and a more positive attitude

towards learning. For example, a student could use an AR app to answer physics questions by pointing their mobile device at objects in the real world. This type of gamified and interactive experience can help to engage students and make learning more enjoyable, leading to greater motivation and understanding of the subject (Fombona et al., 2017).

Finally, the use of AR in physics lessons provides students with real-world application of physics principles. By providing virtual simulations and real-world examples, students are able to see the practical applications of physics in their daily lives, leading to a deeper understanding and appreciation of the subject. For example, a student could use an AR app to explore the real-world applications of the laws of motion, such as how they apply to sports and physical activities. This type of real-world application can help students to see the relevance of physics in their daily lives, leading to a deeper understanding and appreciation of the subject. Thus, the use of mobile applications based on augmented reality in physics lessons has numerous advantages for students. By providing an immersive and interactive learning experience, improving understanding of abstract concepts, enhancing engagement and motivation, and providing real-world application of physics principles, AR technology provides an effective and accessible tool for students to improve their understanding and performance in physics. With its hands-on and interactive approach, AR technology can help to make physics more accessible and enjoyable for students of all levels, leading to greater success and a deeper appreciation of the subject (Aydin, 2021).

One of the most effective ways to use augmented reality in physics lessons is through virtual reality labs and experiments. These applications allow students to experience physics concepts in a hands-on and interactive way, providing them with a real-world simulation of a laboratory experiment. By using VR technology, students can perform experiments that would be too dangerous or too expensive to perform in a traditional classroom setting, leading to a deeper understanding of the subject. For example, a student could use an AR app to explore the behavior of waves in a virtual physics lab. This type of hands-on and interactive experience allows students to see the behavior of waves in real-time, leading to a deeper understanding of the subject. Additionally, virtual reality labs and experiments can provide a fun and engaging learning experience, helping to increase student motivation and engagement (Sharma et al., 2018).

Interactive 3D models and simulations are another effective way to use augmented reality in physics lessons. By providing students with a 3D representation of a physics concept, they can better understand the subject and retain the information in a more meaningful way. Additionally, the interactive nature of these simulations can help to make abstract concepts more accessible, leading to a deeper understanding of the subject. For example, a student could use an AR app to create a virtual 3D model of a physics concept, such as the behavior of light. This type of interactive and immersive experience can help students to understand and retain the information in a more meaningful way, leading to improved performance on assessments and a deeper understanding of the subject.

Augmented reality textbooks and study guides are another effective way to use AR in physics lessons. By providing students with a hands-on and interactive experience, these types of applications can help to improve student understanding and retention of the information. Additionally, AR technology can provide a more engaging and interactive experience than traditional textbooks, leading to greater motivation and engagement. For example, a student could use an AR app to study the behavior of light and waves. This type of interactive study guide can provide a more engaging and interactive learning experience, helping students to understand and retain the information in a more meaningful way.

Gamified physics quizzes and assessments are another effective way to use AR in

physics lessons. By incorporating gamification elements, such as points, rewards, and leaderboards, these types of applications can help to engage students and increase motivation. Additionally, gamified assessments can help to evaluate student understanding in a more meaningful and interactive way, leading to greater student success. For example, a student could use an AR app to answer physics questions by pointing their mobile device at objects in the real world. This type of gamified and interactive experience can help to engage students and make learning more enjoyable, leading to greater motivation and understanding of the subject. Additionally, this type of gamified assessment can help teachers to evaluate student understanding in a more meaningful way, leading to improved performance and deeper understanding of the subject. In conclusion, there are numerous effective mobile applications based on augmented reality for physics lessons. From virtual reality labs and experiments, to interactive 3D models and simulations, to augmented reality textbooks and study guides, to gamified physics quizzes and assessments, AR technology provides an effective and accessible tool for students to improve their understanding and performance in physics. With its hands-on and interactive approach, AR technology can help to make physics more accessible and enjoyable for students of all levels, leading to greater success and a deeper appreciation of the subject.

One of the main challenges of using augmented reality in physics lessons is the cost and availability of AR technology. While AR technology is becoming more widespread, it can still be difficult and expensive to obtain the necessary hardware and software to use it effectively in a classroom setting. In some cases, schools may not have the budget to purchase or maintain the necessary AR technology, making it difficult for teachers to use it in their lessons. Additionally, some students may not have access to the necessary technology outside of the classroom, limiting the benefits of using AR in physics lessons.

Another challenge of using AR technology in physics lessons is the technical difficulties and requirements that come with using it. AR technology can be complex and difficult to set up, requiring specialized skills and knowledge to use it effectively. Additionally, AR technology often requires a stable internet connection, which can be difficult to maintain in a classroom setting. This can limit the use of AR technology in physics lessons and make it difficult for teachers to use it effectively.

While AR technology can be an effective tool for improving student engagement and motivation, it also has the potential to be distracting. For example, students may be more interested in exploring the AR environment than paying attention to the lesson. Additionally, some AR apps may be designed more for entertainment than education, leading to a lack of focus and decreased student performance. This can make it difficult for teachers to use AR technology effectively in the classroom and limit its benefits.

Finally, the limited availability of AR physics apps is another challenge of using AR technology in physics lessons. While there are many AR apps available for general educational purposes, there is a limited number of apps specifically designed for physics lessons. This can make it difficult for teachers to find AR apps that are relevant and effective for their students. Additionally, some AR apps may not be of high quality or may not be up-to-date with the latest physics knowledge, limiting their effectiveness in the classroom. While the use of mobile applications based on augmented reality in physics lessons has numerous advantages, it also presents several challenges and limitations. From the cost and availability of AR technology, to the technical difficulties and requirements, to the potential for distraction, to the limited availability of AR physics apps, these challenges can limit the effectiveness of AR technology in the classroom and make it difficult for teachers to use it effectively. Despite these challenges, however, AR technology remains a promising tool for

improving student engagement and motivation, and for helping students to understand and retain complex physics concepts. By overcoming these limitations and challenges, teachers and students can benefit from the many advantages of using AR technology in physics lessons.

This study evaluates the impact of mobile technology on the learning outcomes of 8th grade students from №85 school-lyceum in Astana. The study compares the performance of two groups of students - one using mobile technology (EdLab app) for learning physics, and the other taught through traditional methods. The results show that the use of the mobile app EdLab leads to improved learning outcomes in terms of understanding the concepts of electricity. The app provides students with a range of information on theories and practical aspects of electricity, and allows them to conduct experiments without physical apparatus. The study highlights the potential of mobile technology in enhancing the quality of education and increasing accessibility, while also acknowledging the need to address issues such as excessive screen time and privacy concerns.

Research methods

In our technological era, everyone has their own portable mobile devices. By accessing the internet easily through these devices, people can carry out their activities anywhere in the world. Time and space are no longer obstacles and people can communicate and exchange information with each other. The term "mobile" refers to the ability to move freely or to be in a different place easily and conveniently. Mobile learning emphasizes the importance of using mobile devices for education in any place and at any time. The convenience and accessibility of information are the main advantages of mobile technology, which greatly contributes to education. The limitations of traditional education are being increasingly overcome. Devices such as the iPad greatly enhance the learning experience for students by improving their engagement, enriching their mobile experiences, and encouraging them to use modern technologies for learning.

Mobile learning has many advantages, such as improving digital and technological skills, allowing for individual and collaborative learning, providing support and customization for learners, reducing digital divide, improving the quality of education, and promoting self-evaluation and self-awareness. The widespread use of mobile technology can enhance communication and knowledge transfer between learners and teachers, and increase the efficiency of education. This study highlights the positive aspects of mobile learning, and suggests that mobile technology can be effectively utilized in education to improve the quality of education and increase accessibility. However, it also acknowledges the need to address issues related to technology use, such as excessive screen time, privacy concerns, and the need for proper regulation (Sembayev et al., 2021).

This study uses a mobile technology-based experimental method to evaluate the effect of the technology on the learning outcomes of students. The study was conducted with 56 8th grade students from N85 school-lyceum in Astana. The students were divided into two groups, an experimental group and a control group, each consisting of 28 students. The experimental group used mobile technology for their learning, while the control group was taught through traditional methods. The study was conducted over two days, focusing on the topic of «Electricity». The results of the pre- and post-test were analyzed and compared between the two groups.

EdLab mobile application is used for conducting physics experiments. Its main goal is to allow students to perform experiments on «Electricity» in physics class, without the need for physical apparatus. The app allows students to measure electrical parameters like amperage, voltage, resistance, and current through experiments. The results can then be recorded and analyzed.

The mobile app EdLab provides information about the theories of physics, as well as practical information that is useful for students and teachers alike in conducting experiments related to the «Electricity». The app is equipped with an ammeter, voltmeter, resistor, and current sensor, and allows users to record experimental results in real-time. The app is well-designed and contains a wealth of information, making it a valuable resource for students who are studying physics and need to better understand the concepts of the «Electricity».

Results and discussion

Students «Electricity» are encouraged to carry out experimental activities in order to deepen their understanding. After testing the students, their knowledge level is divided into two groups based on their test results. Group I has a knowledge level of 68.2 % and Group II has a knowledge level of 69.1 %. Group I students used EdLab mobile application during their experimental activities, while Group II students performed experiments in a traditional manner. Figure 1 represents the flowchart of the experiment procedure. The test results show that students who used the EdLab mobile application had a slightly lower score compared to those who performed experiments in a traditional manner. The experiment (questionnaire) was carried out as described.

In the educational process, it is important to observe the high level of interest in the use of mobile applications by top students, who are eager to acquire new information, learn new things, and use modern technologies. They are curious and actively experiment in the educational process. With the help of new technologies, students are able to acquire knowledge on their own and the teacher's role is limited to the role of a guide. The implementation of educational activities with the use of mobile applications contributes to an increase in students' level of involvement, as well as their level of motivation. Students themselves take the initiative in checking the results of their educational activities, and with the help of mobile applications, the first group of students use the acquired knowledge effectively. However, in the second group of students, who have not fully grasped the format of learning, there are still difficulties in performing tasks on time. We should note the possibility of using mobile technologies in the future for conducting educational activities. The use of mobile applications can also have a positive effect on students' psycho-emotional state and reduce stress. Mobile learning with the help of apps can significantly improve the learning outcomes and motivation of students. The study showed that students using mobile learning with apps had a 7.4 % increase in their learning outcomes compared to students who used traditional learning methods, while students who used mobile learning with apps had a 1 % higher motivation level compared to students who used traditional learning methods. The use of mobile devices allows students to study at any time and place, thus increasing their flexibility and accessibility to learning materials. Mobile learning can also help students focus and avoid distractions during their studies. However, it is important to note that excessive use of mobile devices can negatively affect students' health and well-being. Therefore, it is essential to balance the use of mobile learning with other activities and ensure students have a healthy study-life balance.

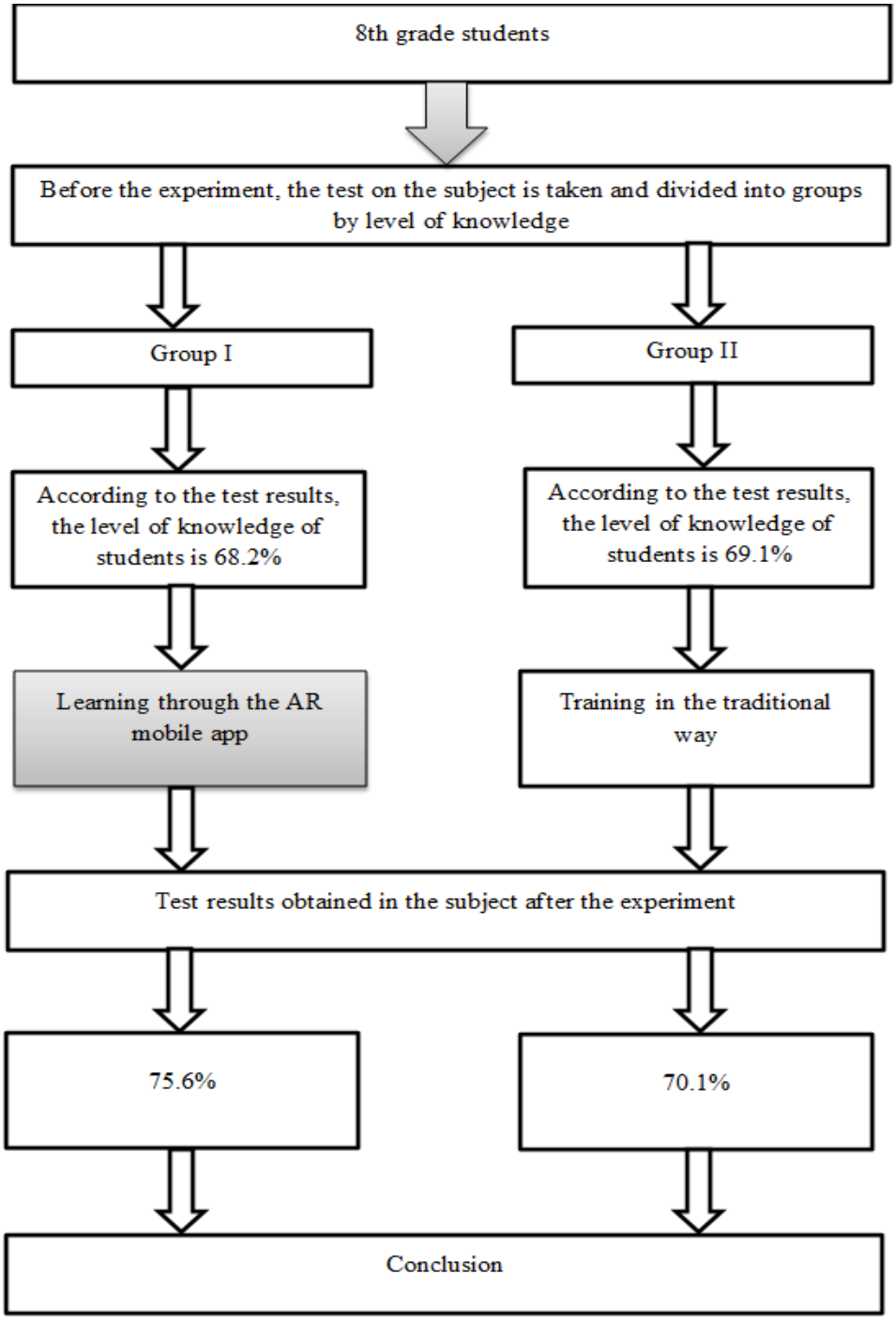

Figure 1 – The flowchart of the conducted experiment

Education is becoming increasingly mobile and technology-based, with students

being able to access information and materials from their own devices. This presents new opportunities for effective learning, but also requires teachers to have a thorough understanding of educational technologies. The main goal of education remains to provide students with practical knowledge, and it's important for teachers to implement technological tools effectively (Serik et al., 2022). However, the use of these tools is often not well-researched and implemented without proper testing. The use of mobile devices in education has allowed many students to improve their theoretical and practical knowledge in various subjects. By aligning with the SAMR model, we can ensure that teachers use mobile devices in a way that enhances learning and creates more meaningful educational experiences. The use of mobile devices in education has been shown to increase student engagement and the ability to understand complex concepts. It is therefore important for teachers to make full use of these devices in their teaching practices to improve the quality of education.

1. To enhance the competence of teachers, transformation-oriented training sessions could be held, where models of innovative teaching methods can be demonstrated, practical examples given, and teachers encouraged to apply new or improved teaching methods. Teachers can also exchange ideas and information in an open and collaborative environment and apply best practices in their teaching to achieve better results.

2. Teachers should provide students with learning opportunities and resources. They should teach students how to effectively use internet resources, stressing the importance of ethical behavior. The goal is to equip every student with the necessary digital literacy skills. Additionally, teachers can encourage the use of technology in the classroom to enhance the learning experience for all students.

Conclusion

The use of mobile applications based on augmented reality in physics lessons at school has numerous advantages for both teachers and students. From improved engagement and interactivity for teachers, to immersive and interactive learning experiences for students, AR technology has the potential to enhance the effectiveness and enjoyment of physics lessons.

The advantages of using AR technology in physics lessons include improved engagement and interactivity for teachers, enhanced assessment and evaluation, increased student understanding and retention, and easy integration into lesson planning. For students, AR technology offers an immersive and interactive learning experience, improved understanding of abstract concepts, enhanced engagement and motivation, and real-world application of physics principles. Despite these advantages, however, there are also several limitations and challenges of using AR technology in physics lessons, including the cost and availability of AR technology, technical difficulties and requirements, potential for distraction, and limited availability of AR physics apps.

In conclusion, the use of AR technology in physics lessons has the potential to greatly enhance the effectiveness and enjoyment of these lessons for both teachers and students. However, it is important for teachers to carefully consider the limitations and challenges of AR technology and to work to overcome these challenges in order to fully realize its potential benefits.

Future research on the use of AR technology in physics lessons should focus on exploring new and innovative ways to overcome the limitations and challenges of AR technology, such as developing more affordable and accessible AR hardware and software, improving the technical ease of use, reducing the potential for distraction, and increasing the availability of high-quality AR physics apps. Additionally, research should also focus on the effectiveness of AR technology in improving student learning outcomes and teacher

effectiveness, and on developing best practices for using AR technology in physics lessons. By exploring these areas, we can better understand the full potential of AR technology in enhancing the education of our students and preparing them for a successful future in physics and beyond.

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