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Review

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Development of a Mobile Game for Teaching Traffic Rules

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Abstract. The use of mobile games in the educational process has gained increasing attention in recent years, as they provide a unique opportunity to combine situational and active learning with elements of entertainment. By incorporating interactive features, mobile games can transform traditional learning into an engaging and memorable experience. The findings demonstrate that mobile games incorporating AR features, animated instructors, and real-life simulations have the potential to significantly enhance learner motivation, interest, and retention of knowledge. These elements encourage active participation and provide learners with realistic scenarios that mimic everyday traffic situations, thereby reinforcing the acquired knowledge in practice. Preliminary analysis suggests that the integration of game-based mechanics, such as rewards, progress tracking, and immersive storytelling, further contributes to sustaining long-term engagement. The use of AR specifically allows learners to interact with their physical environment in meaningful ways, making the learning experience more authentic and effective. In conclusion, this study emphasizes the potential of AR-enhanced mobile games as powerful educational tools in the domain of road safety. Recommendations for future research include the optimization of mobile applications through adaptive learning systems, the inclusion of personalized feedback mechanisms, and the exploration of emerging technologies such as virtual reality (VR). It is expected that this work will serve as a foundation for further innovations in mobile learning and contribute to improving traffic safety education.

Keywords: gamification, Augmented Reality, game-based learning, traffic rules, studying road rules.

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Introduction

In the development timeline of humanity, teaching and learning have consistently been crucial components of societal progress. As we navigate through an era dominated by technological advancements, leveraging these innovations for educational purposes has become increasingly vital. Today, while technology has transformed how we access information and learn, there is a concerning trend of diminishing engagement in traditional study methods. Many individuals now feel less inclined to invest time in learning, believing that machines can perform basic tasks, which may lead to a lack of essential skills and knowledge, in the vital fields of teaching tragic rules. This field such road rules and discipline are crucial to be solved due to the serious problems and challenges caused by this field.

The aim of this study is to introduce innovative methods for teaching traffic rules, transforming the learning process into an engaging and interactive experience that motivates learners to actively participate. It is widely acknowledged that traditional methods of teaching traffic regulations and safe driving techniques often become boring and fail to engage students effectively. Consequently, drivers, especially beginners, the young generation, may not fully understand or apply the knowledge they have acquired in practice, leading to an increase in violations and accidents on the roads. The mobile game will use cutting-edge technology, such as gamification and augmented reality (AR), to create an effectiveб enjoyable learning experience. The app will have different difficulty levels, and the gamified emergency training will involve scenarios where players can learn important emergency response skills. Players will practice actions such as calling for help, providing first aid, and avoiding accidents. They will receive rewards/points for completing tasks correctly, encouraging them to improve their skills. In addition, augmented reality will be used to simulate real-world scenarios, allowing users to practice checking oil levels, refueling a car, and understanding its internal systems. This will enhance their confidence and practical knowledge, helping them to engage with the game more effectively.

The literature review

The road is the most important element in our lives, it plays a key role in both daily life and routine affairs. Road safety is crucial, especially in the context of increasing accidents, which makes traffic safety education extremely important. The development of mobile games for traffic safety education has attracted the attention of researchers and practitioners due to its interactivity and ability to engage users. Research shows that gamification of learning can significantly increase student motivation, which is especially important for young people who actively use mobile technologies.One of the key aspects of gamification is the use of game elements to increase user engagement and interest in the learning process. According to Gee (2003), games contribute to creating a learning context by allowing users to master information through hands-on experience and problem solving in a game format. Mobile games focused on learning traffic rules can provide interactive scenarios that allow users to apply their knowledge in a safe and controlled environment. Regarding the specifics of traffic regulations training, works such as the study by J. A. V. Rojas and co-authors (2019) indicate the need to create adaptive systems that consider the level of knowledge and skills of users. A personalized approach in mobile games can help with targeted training, as well as increase the level of security, as users will be able to practice the rules in practice in conditions close to real ones. Considering new technologies, the use of mobile games for traffic regulations training can be effective in combination with other methods such as theoretical classes, tests and practical exercises. Research shows that a combined approach

increases the chances of successful learning of the material and the formation of skills necessary for safe driving. In conclusion, the use of mobile games as a tool for teaching traffic rules opens new horizons for educational technologies. This approach not only helps to increase motivation, but also makes the learning process more interactive and accessible, which is especially important today, where mobile devices are central to people's lives.

The methodology

The main goal of this systematic review is to evaluate the effectiveness of using gamification and augmented reality technologies in learning traffic and road rules, by collecting, analyzing existing literature relating to the topic of the study. Consequently, the methodology part is written by following PRISMA guidelines that guarantee the transparency and relevant of data. The research problem for this study is that traditional methods of teaching traffic rules and safe driving skills are often boring and do not engage users enough. As a result, drivers, especially beginners, may not learn or put their knowledge into practice. One of the main hypotheses of this study is that the combination of game-based and Augmented Reality (AR) techniques for teaching safe driving will enhance the quality of learning and better prepare users for practical application of traffic rules compared to more traditional teaching methods.

Information sources. The extensive search of these databases was carried out to identify relevant literature related to the development of mobile games, augmented reality (AR) technologies and gamification, as well as their application in teaching traffic rules and road safety. Moreover, according to the search strategy, there was used keywords including “gamification learning traffic rules”, “AR for study traffic rule”, while applying filters to limit results to publications from 2020 to 2024. These databases were chosen for their wide coverage in the fields of engineering, technology and social sciences, which are directly related to the mobile game development project and the use of AR to improve road safety. To ensure the relevance and timeliness of our review, we analyzed studies published between 2020 and 2024 years. Furthermore, the PRISMA flowchart diagram which highlights study selection process in accordance with the PRISMA guidelines [3].

Inclusion Criteria: Studies of application system:

- gamification and augmented reality (AR) in road safety education, driver training.
- Studies evaluating or discussing the effectiveness of AR and gamified approaches in teaching road safety.
- Articles on the effectiveness of gamification in learning.
- Articles on the effectiveness of AR in learning.

Exclusion Criteria: Research on -

- unrelated topics such as psychological or medical factors that are not related to the topic
- formats (mini-reviews, opinion articles) studies without relevant data or results by topic.
- topics unrelated to road safety or driver education

From the initial set of 731 studies, 435 were excluded due to non-compliance with these criteria. The remaining studies were carefully analyzed for their relevance and inclusion in the analysis. A mobile game effectively caters to three main audiences. Young drivers gain practical knowledge and confidence, driving school students reinforce their theoretical learning through simulations, and children/teens build foundational road safety skills in an engaging way. The game’s use of gamification and AR makes learning more interactive and effective for all groups. Data collection methods. In this study, we will use a combination of qualitative and quantitative

data to evaluate the effectiveness of our mobile game application. Quantitative data will be collected through pre- and post-tests on driving knowledge and skills to measure the effectiveness of the learning process and improvements in user scenarios. We will also collect data on users' interactions within the application, including the frequency of sessions, rates of performance in AR-based simulations, and other relevant metrics.

Data items. For this study, the following results were requested in order to evaluate the effectiveness of a mobile application with elements of gamification and augmented reality for teaching traffic rules in Table 1.

Table 1. Results and variables requested in the study of a mobile application for teaching traffic rules

Category	Results/Variables	Description	Compatibility with the field of results	Methods for selecting results
Main results	The level of knowledge	Measurement by pre- and post-tests, assessment of the correctness of answers	Compatible: knowledge of traffic rules	They were chosen because of their direct connection with the objectives of the study
	Reaction and accuracy of decisions	Average reaction time and percentage of correct decisions	Compatible: assessment of decision-making skills on the road	Selected to analyze the impact of gamification on practical skills
	The level of user engagement	Frequency and duration of application usage	Compatible: an indicator of interest in the gameplay	The basis for evaluating the success of gamification
	The effectiveness of training	Comparing the results of pre- and post-tests	compatible: the success rate of the methodology	key indicator of the effectiveness of the application
Additional results	User Experience Assessment	Satisfaction with the functionality and convenience of the interface	Shows a subjective assessment of the application	Selected to understand user preferences
	Behavioral changes	Changing awareness of traffic regulations and road behavior	Related to the purpose of improving road safety	Assessment through questionnaires and focus groups
Participant variables	Age	Grouping by age categories (9–17, 18-35, 35+)	Allows you to evaluate the effectiveness for different groups	They are used to stratify participants
	Gender	Distribution of participants by gender	Influences the analysis of engagement and preferences	It is analyzed as an additional factor
	Driving experience	Division into groups	It affects the perception of the	It is used to build a more

		with/without experience	material	accurate analysis
Game indicators	Points and rewards	The number of points for completing tasks	Shows the success of users in the gameplay	It is used as an indicator of engagement
	Level progress	Reaching new levels of difficulty	The success rate of learning	It is evaluated according to the application data
	Interaction with AR	The number of successful recognitions and simulations	Evaluates the use of augmented reality technology	It is directly related to the AR mechanics of the application
	Usage time	Total duration and number of gaming sessions	Indicates the degree of engagement	Reflects long-term interest

The Table 1, contains a list of the main and additional results, as well as the variables requested in the study. It reflects their relationship to the objectives of the study and the methods of analysis used.

The sampling methods for this study are a stratified sampling method. In stratified sampling, researchers divide subjects into subgroups called strata based on characteristics that they share (e.g., race, gender, educational attainment) [4]. This method ensures that each subgroup is represented, as shown in Table 1, there are 3 key audience groups. Participants can be recruited through driving schools, online platforms and social media for experiments and pre, post test. Moreover, in a beta-testing phase, there will be recruited individuals interested in new technology or gamified learning experiences.

Here are the key ethical considerations for this app

- User Privacy and Data Protection will be considered, by ensuring privacy policies and obtaining explicit user consent.
- The app will provide clear instructions and safety warnings, particularly for AR interactions involving real-world objects, users must be given consent and be aware of potential risks.
- AR scenarios and gamified content should encourage safe practices, avoid promoting risky behaviors, and provide guidance to prevent accidents or misuse.
- There will be ensured that all educational content is accurate and up to date, as misinformation could lead to unsafe driving practices.

The difficulty levels in the game are set to ensure a gradual learning experience based on the player's correct or incorrect answers. The accident scenarios, safe driving training, and emergency response in the game have been designed with the principles of augmented reality in mind. These features provide visual and audio feedback that simulate realistic driving situations, enhancing the learning experience. This is just the beginning of the development process for this mobile game. After it is released, a beta test will be conducted to identify any issues that users may encounter and prevent them. Following the launch, user feedback will continue to be collected for ongoing refinement and content updates. In addition, a study using both quantitative and qualitative data will not only measure how well the participants learned the information, but also find out how involved they were in the learning process, which is also important for us. This approach will help you understand how effective these innovative methods are in teaching traffic rules and how useful they can be for future drivers.

Findings/Discussion

For the systematic review of this topic, there were several academic databases used. Furthermore, for the significant and comprehensive account this study demonstrated the PRISMA flow diagram in Figure 1, with the template [3] from the official website.

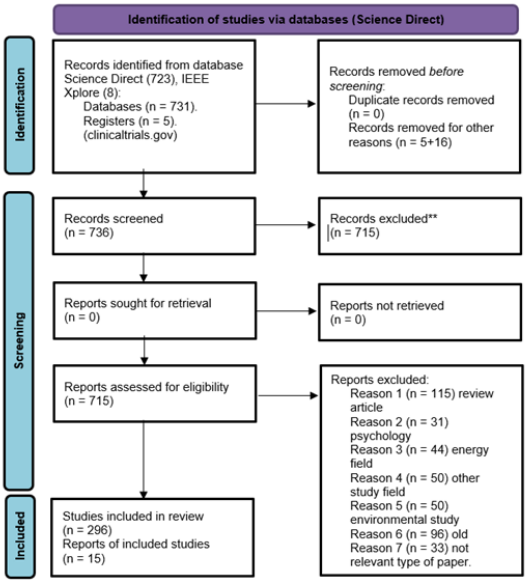

Figure 1. Prisma flow diagram for this topic

To illustrate, Science Direct, IEEE Xplore and clinicaltrials.gov was used for the identification of similar studies in the range of 2020-2024. Consequently, 435 studies from 731 are considered irrelevant to this study, due to the different reasons.

Including, the variety of study areas [5][6][7][8], like papers that focus on the psychological factors, medical factors, etc. In addition, some papers were not fit by the format as mini reviews [9]. Furthermore, some papers handle different key factors, areas like “Human–machine cooperative decision-making and planning for automated vehicles using spatial projection of hand gestures” [10], “A game-based deep reinforcement learning approach for energy-efficient computation in MEC systems”.

For instance, in the article “The Zebra Crossing Game – Using game theory to explain a discrepancy between road user behavior and traffic rules”, focusing on the Norway cyclists and pedestrians. To test this, they studied crossing behaviour at three zebra crossings, two crossings where cyclists approached from the pavement and one crossing where cyclists came from a combined cycle and walking path, and found that rather than aligning with traffic rules, the actual crossing behaviour aligned with the solution generated by game theory. The results of this research show that game theoretic modelling can be a valuable tool to understand road user interaction with the statement like, better understanding and ability to predict road user interactions could help to improve traffic safety.

Conclusion

The application is expected to have an impact on increasing users' confidence in knowing the rules of the road, which will serve as an important step for developing safe driving skills.

The analysis of statistical data, which will be carried out in the future, will probably confirm the high efficiency of mobile applications with elements of augmented reality and gamification for teaching traffic rules. It is expected that most users will note an improved understanding of traffic rules, which will indicate the significant potential of AR technologies in the field of educational applications.At the same time, subsequent research will identify possible technical difficulties that users may encounter, which will allow developers to improve the interface and adapt the application for various mobile platforms. In the future, work will focus on making the app more accessible to a wide audience.Thus, this research will become the basis for the development of future mobile educational applications aimed at improving road safety. In the future, the development of versions of the application for various operating systems will help reach more users. Further research will also focus on the impact of long-term use of the application on the sustainability of knowledge and practical skills.At the next stage of the project, it is planned to add complexity level adjustment functions, a progress monitoring system and adaptive learning elements that will allow the application to adapt to each user, increasing their interest and motivation to learn. Since the project is being carried out in Kazakhstan, its development will strengthen the patriotic component, which corresponds to the state program for the introduction of modern technologies and the development of human capital. The use of AR and gamification in teaching traffic rules will contribute to the formation of responsibility and a safety culture among the population, which is important for creating a responsible society. Overall, it is expected that further work on the project will confirm the effectiveness of combining augmented reality and gamification in educational applications, and that this approach will prove useful for improving road safety.

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Жол қозғалысы ережелерін үйретуге арналған мобильді ойын әзірлеу

Аңдатпа. Оқу процесінде мобильді ойындарды қолдану ситуациялық және белсенді оқытуды ойын-сауық элементтерімен тиімді үйлестіре алады. Бұл зерттеу кеңейтілген шындық (AR) және геймификация элементтерін пайдалана отырып, мобильді ойынды дамытуға, пайдаланушылардың белсенділігін арттыруға және олардың жол қозғалысы ережелерін түсінуін жақсартуға арналған. Әдебиеттерді жүйелі шолу аясында 2020-2024 жылдар аралығында мобильді ойындардың оқуға әсері туралы жарияланған 435 мақала талданып, қаралды. Әдебиеттерді алдын ала талдау AR және анимациялық нұсқаушылар сияқты ойын элементтерін біріктіру пайдаланушылардың қызығушылығын және ақпаратты сақтауды арттыруы мүмкін екенін көрсетеді. Бұл тәсіл жол қозғалысы қауіпсіздігі саласындағы білім сапасын арттырады деп күтілуде. Қорытындылай келе, білім берудің мобильді қосымшаларын оңтайландыруға және оқу процесіне инновациялық технологияларды енгізуге бағытталған болашақ зерттеулерге ұсыныстар енгізілген. Бұл жұмыс мобильді оқыту және жол қауіпсіздігін арттыру саласындағы одан әрі дамудың негізі болады деп күтілуде.

Түйін сөздер: геймификация, Толықтырылған Шындық, ойынға негізделген оқыту, жол қозғалысы ережелері, жол қозғалысы ережелерін үйрену.

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Разработка мобильной игры для обучения правилам дорожного движения

Аннотация. Использование мобильных игр в образовательном процессе позволяет эффективно сочетать ситуационное и активное обучение с элементами развлечения. Данное исследование посвящено разработке мобильной игры с использованием элементов

дополненной реальности (AR) и геймификации, чтобы повысить вовлеченность пользователей и улучшить их понимание правил дорожного движения. В рамках систематического обзора литературы были проанализированы и рецензированы 435 статей, опубликованных в период с 2020 по 2024 год о влиянии мобильных игр на обучение. Предварительный анализ литературы показывает, что интеграция игровых элементов, таких как дополненная реальность и анимированные инструкторы, потенциально может повысить интерес пользователей и сохранить информацию. Ожидается, что такой подход повысит качество образования в области безопасности дорожного движения. В заключение приводятся рекомендации для будущих исследований, направленных на оптимизацию образовательных мобильных приложений и внедрение инновационных технологий в учебный процесс. Ожидается, что эта работа станет основой для дальнейших разработок в области мобильного обучения и повышения безопасности дорожного движения.

Ключевые слова: геймификация, дополненная реальность, обучение на основе игр, правила дорожного движения, изучение правил дорожного движения.

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