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PAPER

Effectiveness of Gamification in Mobile and Interactive Learning: Analysis of Approaches and Outcome

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ABSTRACT

The use of new approaches in pedagogy, which is partly due to the digitalisation of this process, creates the language for the further evolution of the field. The purpose of the paper is to study the effectiveness of using gamification in the educational process and to investigate different research approaches and their results. The proposed study is based on a systematic review of scientific literature. Certain scientific methods were used: content analysis of professional literature. The results of the study indicate that today the possibilities of combining the traditional use of gamification and the digital environment are actively used. The study findings indicate positive effects of gamification include improved motivation for learning activities, the benefits of developing skills and abilities, the development of communication and teamwork skills, and psychological relief. The difficulty in using gamification is price. It is shown that the importance of implementing various gamification models – role-playing games, story-based learning, quests, simulations, virtual reality, etc. gamification plays a positive role primarily in the motivational component of learning. The conclusions emphasise the further prospect of studying gamification through the prism of its potential evolution. The contribution of the study lies in its systematic review of various gamification approaches in education.

KEYWORDS

gamification, educational process, learning strategies, digital tools, engagement of students, performance assessment

1 INTRODUCTION

Over 90% of students today own a smartphone, and almost 75% of them keenly engage with educational apps and platforms [1]. The rapid pace of digitalisation is changing the process of education, introducing advanced technologies. The current development of digitalisation has a powerful impact on the use of the latest educational technologies. It is shaping new methodologies for organising the educational process, which often apply not only to higher education but also to school education. This versatility attracts more and more teachers who are ready to use such

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technological solutions. Students are also interested, as the latest technologies are able to offer not only huge amounts of useful information but also opportunities for original learning and further use.

Against this background, gamification of the educational process is an important element that can be applied at all levels of education. Due to the convenient combination of educational material and game learning technologies, it is possible to increase the motivation of students in learning, which can directly affect the quality of education [2, 3]. Interactive mobile technologies and platforms that support the use of mobile devices have become important tools in the modern educational process, especially when it comes to using gamification capabilities. Gamification allows you to use game elements like completed levels, rewards, ratings, and individual quests to increase user motivation. Mobile learning environments are conducive to gamification models and can be integrated through apps. These applications can be easily adapted to the individual needs of learners, providing interactive, personalised learning. This approach promotes the development of skills, increases the efficiency of learning, and makes education a fun experience.

Despite the various positive claims about the effectiveness of gamification in education, its real impact on the learning process remains a subject of active scientific debate. In addition, approaches to implementing gamification vary depending on participants' discipline and age category. At the same time, a problematic aspect is the correlation between the information and game aspects. Determining the boundary when the game ceases to be educational and turns into entertainment will not contribute to the further development of the educational process. The main research problem is the lack of a unified approach to assessing the effectiveness of gamification in the educational process. Moreover, insufficient systematisation of the results of different approaches and the lack of clear criteria for assessing effectiveness limit the possibility of widespread use of this powerful tool in education. Therefore, it is important to understand which approaches to gamification are the most effective for achieving certain educational goals in different contexts.

In such circumstances, considering the existing experience of gamification becomes an important scientific issue. Hence, given these challenges, understanding existing experiences with gamification has become an important scientific concern. With the growing body of literature on the subject, there is a need for a detailed analysis to distinguish between key elements and less relevant details of gamification usage. Given the volume of scientific literature, there is a need to understand in detail the existing experiences to identify important and unimportant details of the use of gamification.

The purpose of the paper is to analyse the effectiveness of gamification in the educational process and to study different research approaches and their results. The realisation of this goal primarily involves analysing the current scientific literature, considering existing models of gamification and determining their effectiveness (or possible problems). Accordingly, the main research questions are as follows:

- 1. What gamification models are used to increase the effectiveness of learning?
- 2. What results have been achieved through gamification in the educational process?
- 3. What problems arise when implementing gamification?

For this purpose, two hypotheses have also been proposed in advance, requiring further confirmation or refutation:

1. Using gamification in the educational process increases student engagement and improves academic performance.

2. The effectiveness of gamification depends on adapting models to the specifics of the academic discipline, the individual characteristics of applicants, and the technical support capabilities for the educational process.

2 LITERATURE REVIEW

The purpose of this literature review is to demonstrate the theoretical foundations of the study of gamification in education and to systematise the knowledge of scientists about this trend. Accordingly, this literature review refers to systematic reviews. The criteria for inclusion of the literature in this review were based on strict criteria:

- 1. All works must relate to innovative educational technologies.
- **2.** All works should reflect the specifics of the implementation and use of gamification in the educational process.
- **3.** Date range: from 2019–2024.

Thus, this review concerns only current works of the last five years.

Gamification in modern education has its own history of research, as it is popular at the intersection of modern pedagogy and digital technologies. The use of game elements began much earlier, even before the dominance of digital technologies [4], and consisted of the active use of game elements and tools in a non-game educational context, in particular, to increase the existing level of motivation of students and their involvement in the educational process [5]. Such approaches make it possible to create much more interactive and cognitive educational experiences that better form theoretical knowledge and practical skills [6]. Many modern researchers agree with the conclusion that the use of game technologies directly depends on the availability of an appropriate level of motivation in students, in particular, an appropriate level of self-esteem and the search for intrinsic motivation [7].

The use of elements of game technologies creates a sense of educational progress, which gives impetus to further learning and intensifies the cognitive activity of students. Some researchers have concluded that gamification is an important factor in ensuring the necessary levels of social interaction of students and appropriate social cooperation, which is also important in forming appropriate motivation [8], [9]. Scientists have assessed the practical aspects of introducing gamification into the educational process, which also involves the use of integrated gaming tools in relevant learning platforms and courses [10]. Modern digital learning tools like location-based learning games, are important. They require GPS, but applications can create additional interactive tasks that depend on the spatial location of users. In particular, quests or historical tours that require students to stay in certain locations have all the capabilities to provide instant progress assessments, provide the necessary advice, or encourage further action. For this purpose, separate notifications are used; interactive elements that support constant user engagement can generate virtual awards (virtual badges), etc.

It is important to analyse the experience of individual digital platforms that have integrated such tools into digital education and stimulate heuristic activity [11]. Certain aspects of artificial intelligence technologies, simulations, virtual reality, and role-playing games have also been studied, which has allowed us to summarise existing experiences of their integration into the educational process. However, these studies focus on local features and do not consider general trends in the implementation of gamification. Researchers have focused on students' enthusiasm for learning as an important advantage of gamification [12]. Some scholars have concluded that students who actively use gamification in their studies are significantly more motivated during learning activities, indicating a much higher level of motivation [13]. Other researchers have emphasised the role of digitalisation of learning in the development of creativity and critical thinking [14], [15].

N. Vidakis et al. investigated the peculiarities of creating educational data in the game based on the analysis of a serious game of the ancient theatre [16]. Also, the limitation of this study is the predominantly narrow focus of the study and the characterisation of local features. N. Bizami et al. characterised various innovative pedagogical principles used in modern distance education [17]. However, the author mainly paid attention to the possibilities of modern digital tools and did not characterise the full potential of gamification forms. Gamification is a promising approach to modernising modern education, which has the potential to increase student motivation and engagement.

Obviously, further attention of researchers can be drawn to problematic aspects, in particular, to take into account and analyse both the advantages and disadvantages of gamification and to ensure a balance between game elements and learning objectives [15], [18]. In the future, researchers in this important field will be able to more effectively assess the role of innovative technologies in education, including through the prism of games and game-based methods. Therefore, the above gaps will be addressed in this study and a comprehensive approach to the problem. In particular, to characterise both the broad possibilities of gamification and individual problematic issues.

3 METHODOLOGY

3.1 Research design

The study is qualitative work, according to which the appropriate methodology was chosen. The proposed study is based on a systematic review of scientific literature. Data from leading scientometric databases were used to search for sources: PubMed, Scopus, Web of Science journals, Ebsco and Sherpa Romeo. The selection of scientific sources was based on clear criteria for the inclusion of scientific literature. In particular, such indicators as scientific novelty and relevance were taken into account. The date range was 2019–2024.

Therefore, the inclusion criteria were based on the following aspects:

- **1.** Research concerns the main mechanisms of introducing gamification into the educational process.
- **2.** The inclusion of scientific literature from different authors representing different geographies is allowed.
- 3. Publications from peer-reviewed journals.
- 4. Time range of writing: 2019–2024.
- **5.** Various types of research are subject to inclusion: both quantitative and qualitative. The main emphasis is on mixed studies.
- 6. Writen language English, Ukrainian.

Exclusion criteria:

1. Research concerns only innovative educational tools and does not concern gamification.

- 2. The work partially describes game methods of work.
- 3. Publications in non-peer-reviewed journals, duplicates.
- 4. Articles without full text.
- 5. Articles written in other languages if there is no possibility of translation.

3.2 Sample and data collection

Scientific sources were selected to conduct the review and analytical study, including articles from scientific journals, chapters from collective monographs, and conference materials. The sources were selected on the basis of relevance to the research topic and relevance (primarily, the relevant scientific literature of the last six years was taken into account). The process of data selection consisted of the following steps: creating a search query, selecting professional literature, selecting sources, and analysing their full texts.

For example, to find relevant sources, separate search queries were formed with the following keywords: gamification, learning process, learning strategies, digital tools, engagement of students, performance assessment.

The main search databases were the scientific and metric databases of PubMed, Scopus, and Web of Science journals. These keywords became a guideline for the search. First of all, 925 results were found. This selection was based on the analysis of the article's topic and abstract, which should relate to the use of gamification in the educational process of today. As a result of the annotation study, 145 sources were selected.

After that, other databases like Ebsco and Sherpa Romeo, were added, where another 45 relevant sources were identified. After that, all the results were analysed to determine their relevance to the topic of our study. As a result, 139 sources were pre-selected. Information about them was transferred to an Excel spreadsheet. In particular, the year of publication, methodological basis and main results were recorded. Further, certain exclusion criteria were applied. First, all materials that did not directly address gamification were rejected. Secondly, we excluded works without a detailed methodology. The chronology of the selected literature is limited to 2019. It is important that one article has no more than 6 authors. Another important aspect was the practical significance of the study results. As a result of these restrictions, 94 references were selected. After analysing the text of these studies, 45 items of scientific literature were selected.

3.3 Data analysis

The next step was a detailed analysis of the full texts of the selected scientific sources, which contained key topics and recommendations related to the use of gamification. Separately, a critical thematic analysis of the content was carried out, which made it possible to identify the main successful practices related to these processes. Particular attention was paid to identifying innovative approaches that contributed to the effective implementation of gamification in digital education. Additionally, a comparative analysis of international knowledge was made. This involved comparing findings from separate countries to identify common trends in education. For example, the study explored how cultural and infrastructural factors influenced the adoption of gamification tools and their effectiveness in various educational settings.

Ethical considerations were an integral part of the data analysis. Transparency and copyright protection were strictly observed. Correct citations and references were ensured to avoid data distortion. The use of texts, graphs, or tables adhered to licensing requirements, ensuring the integrity of the systematic review.

This systematic review is also based on general ethical principles of data management. Transparency and copyright protection are observed. Although the systematic review is based on published sources, the work guarantees correct citations and avoids data distortion. The use of texts, graphs or tables strictly complies with licensing requirements and includes appropriate references. However, some limitations are also worth noting. The main limitation of this paper is the emphasis on English-language literature. In addition, emphasis is placed on the inclusion of literature for the last 5 years. Accordingly, older studies were ignored. In addition, the work includes only scientific sources; however, other types of sources like reports and analytical reports, are not included. These points should be taken into account when interpreting the data. The practical significance of the paper is that it provides educators, curriculum and mobile application developers with a clear understanding of the effectiveness of gamification as an educational phenomenon. It is about the possibilities of optimising educational applications in the future, developing inclusive adaptation of various gamification approaches, and facilitating the adaptation of inclusive needs of students.

4 RESULTS

Modern researchers understand gamification as the application or use of game mechanisms for educational purposes, which is increasingly used for the effective operation of educational environments [16]. The importance of gamification processes depends on many factors that need to be considered when planning their use. At the same time, the scientific literature presents some scenarios for its effective application and work with digital environments. It is worth noting that in modern conditions, traditional and digital forms of games are used in the educational process. In the traditional learning environment, it is possible to further use wellknown game elements that encourage better learning and understanding of new educational material.

For example, among the usual game elements that complement face-to-face learning is the receipt of relevant badges or other visual rewards (see Figure 1). As a result of successful completion of tasks or solving problems, students can receive badges that certify their status as successful learners [17].



Source: Author's development.

Fig. 1. Ways of using gamification

Visual rewards increase interest in learning and encourage others to receive the same rewards for their educational achievements. Some educational institutions practice the strategy of using leader boards – special tables (ratings or other visual materials) demonstrating or recording the academic success of certain students [18]. They also use a tool for dividing educational material into separate levels, which, once mastered, allow for visualisation in different ways. It is worth noting that such technologies for integrating gamification into the educational process, although inherent in traditional learning, are undergoing digital evolution in the modern world [19]. Students are actively using various digital awards on social media, local university networks, etc., to demonstrate their success, which turns the educational process into a kind of game in which everyone can join the leadership.

Specialised games are often used in digital environments to improve the learning of new material [20]. First, we are talking about specialised game platforms (stimulators) that open up opportunities for teachers to integrate educational material and game elements [21]. In particular, the use of specialised educational games is implemented through the inclusion of various aspects of game material in game scenarios. To implement this plan, various platforms are used that can effectively visualise the game component and combine it with educational content. Virtual reality and augmented reality technologies are also very popular today, and specific opportunities for learning in a game form are being formed [22].

For example, medical students can learn surgery or other operations using virtual reality simulators in a playful way and without harming the life and health of patients. Some researchers do not consider virtual reality to be a gaming technology. However, its ability to create an imitation of the environment allows it to be classified as a game, which, however, is quite demanding in terms of system requirements.

In general, in secondary education institutions, quests for learning are used as a game [23]. It is about forming a system of tasks or missions, by solving which students will acquire new knowledge or repeat already known material. The completion of quests is visualised, which also makes this method like badges. Modern digital technologies also make it possible to deploy quests in virtual reality. From this point of view, it is important to point out the possibilities of virtual reality. Thanks to VR, scientific events can be comprehended through interactive storytelling. Special applications for smartphones are quite accessible and growing in number. For example, thanks to the educational VR apps Titans of Space or Google Expeditions, learning is accessible to the masses.

Some elements of the game are used in existing STEM practices and activities. Research shows that gamified STEM activities positively increase student interest and motivation and significantly improve students' critical thinking [24]. Digital platforms like TryEngineering empower educators to nurture the next generation of technology innovators using gamified resources, lesson plans and activities that engage and inspire [25].

Another game technology that is equally popular in secondary and higher education is the formation of collective games [26]. It is about creating or simulating game situations in which students have to work together in a team in order to achieve their goals and move to the next level. Games in such circumstances undoubtedly develop teamwork, communication and social skills. Table 1 presents the main conditions for the successful implementation of various gamification models, their main elements and limitations.

Models	Effect	Conditions	Limitations
Reward system	Increases motivation level, Student engagement	Clear rules Fair game play A fair reward system	May create unnecessary competition Less effective for older students
VR	Effective for hands-on learning	High technical requirements, availability of equipment	High cost of equipment Not all teachers know how to use the tools correctly
Role playing games	Develops critical thinking and teamwork skills Increases motivation level	A clear scenario, appropriate to the level of knowledge of students	Requires significant resources to develop scenarios
Quests	Increases motivation level, Student engagement	Visualization of progress Use of modern technologies	Difficult to adapt to all disciplines
STEM activities with game elements	Student engagement Increases interest in STEM, improves critical thinking	Integration of gamified resources into the curriculum	Requires additional training for teachers
Storyline (narrative)	Stimulates interest and creativity	Learning through an interesting plot	Requires time to develop Less effective in disciplines with a clear knowledge structure

Table 1. Comparative characteristics of various gamification models

Source: Authors' development.

The use of gamification in the organisation of the learning process has numerous advantages and positive results (refer to Table 2). Games help to motivate students' learning activities, master the learning material and develop key skills that will be needed in later life. For example, in a study conducted in a secondary school in Poland, the use of gamified quizzes and leader boards significantly increased student participation and improved test scores in mathematics by 20% over one semester. Similarly, in Ukraine, a university-level biology course successfully integrated virtual reality simulations to teach anatomy, allowing students to explore complex structures interactively. These gamified approaches not only enhanced knowledge retention but also fostered collaboration and problem-solving skills among participants. Such practical cases demonstrate the transformative potential of gamification in real educational settings, reinforcing its theoretical advantages.

Table 2. Positive changes due to gamification

Factor	Characteristic	Researches
Help in learning new material and revision of what has already been learnt	Digital teaching methods and the use of gamification make it possible to learn new material in an optimal way. Similarly, certain games can enhance and concentrate attention, and restore knowledge, which helps to consolidate and update the information received. Undoubtedly, this feature makes learning much more effective.	[11], [13], [27], [28], [29], [30]
Increased motivation and interest in learning	Games attract students' interest and increase their motivation for further study. The use of computer games makes learning more interesting and interactive, which, in turn, motivates students to participate more actively in classes and demonstrate their knowledge.	[3], [4], [7], [10], [24], [31], [32], [33], [34].
Formation and development of modern skills	The close integration of digital tools not only in education but also in other aspects of everyday life or professional training makes the acquisition of digital competences extremely important. Gamification also allows for the development of key skills for working with the digital environment. At the same time, certain levels of communication and critical thinking are also developed. Such skills are essential for building a successful career in today's digitally connected world.	[5], [15], [18], [35], [36], [37]

(Continued)

Table 2. Positive changes due to gamification (Continued)

Factor	Characteristic	Researches
Psychological relief	The use of game elements helps to create a relaxed atmosphere during classes, knowledge tests, practical work, etc. This approach significantly reduces stress and anxiety among students. It is worth highlighting the Ukrainian experience of using gamification. In the context of martial law and Russian aggression, the use of gaming technologies has demonstrated positive results that could reduce stress levels. Obviously, this use of gamification will require further consideration	[3], [9], [10], [32], [38], [39]

Source: Authors' development.

However, researchers note some difficulties in the use of gamification. It is emphasised that its use requires specific circumstances, deliberate implementation, adaptation of the proposed teaching methods to the objective conditions of the educational institution, the needs of students, and their ability to work with digital environments (the latter is also relevant for teachers) [37]. Integration of game elements requires careful planning, availability of adequate material and technical resources, and planning by teachers.

5 DISCUSSION

In accordance with the purpose of the paper, the results demonstrate the effectiveness of using gamification in the educational process and analyse the positive experiences of using the relevant tools.

It is strong-minded that traditional forms of organising the educational process also have a game component. Other researchers highlight this, arguing that the gamification of education as a phenomenon is not an invention of the modern world but rather the result of the gradual evolution of education, which in recent decades has clearly changed its direction to student-centeredness [38], [40].

The results demonstrated the importance of implementing various gamification models: role-playing games, story-based learning, quests, simulations, virtual reality, etc. However, although the work presents that these tools play an important role, other works suggest that gamification is an additional tool that qualitatively affects learning motivation. However, today, this mechanism cannot be used independently [41], [42]. This requires additional conditions, i.e., the formation of qualitatively new learning environments. From this point of view, the use of gamification in secondary education is worth noting. According to researchers, its evolution into an independent educational element has more excellent prospects for development since younger and middle-aged students are more prone to development. Respond to games and their integration with learning [43], [44], [45]. This issue will also require additional analysis since the proposed literature poorly represents the features of gamification in school and higher education institutions.

The proposed results demonstrate that gamification plays a positive role primarily in the motivational component of learning. Learning new and repeating old material increases interest in learning and forms and develops additional skills and active communication. Studies by other authors also indicate that the use of gamification is a separate industry with its own platforms and software capabilities that contribute to effective learning [45], [46], [47]. For example, in Eastern Europe, where education systems often undergo modernisation, gamification is increasingly used as part of digital transformation projects to enhance student engagement and adapt to new teaching methodologies. Platforms tailored to regional needs, like localised content and multilingual support, have shown great promise in countries like Poland.

The results also indicate that more outstanding student engagement is a positive consequence of introducing game forms. These results are generally confirmed by other researchers who have tried to synthesise the existing experience of using gamification [48], [49], [50]. It is important to note that the trends in the use of gamification are global in the modern market of educational services. This trend will only develop in the future. At the same time, researchers rightly emphasise the factors that do not contribute to the further spread of gamification and reduce its effectiveness. Even considering the tangible benefits, the use of gaming tools (real and virtual) also has specific challenges [50], [51]. In the context of Eastern Europe, these challenges include the need for teacher training, the adaptation of international platforms to local educational standards, and overcoming resistance to change within traditional educational systems.

In particular, the need to use powerful resources for the development and implementation of appropriate software, which, in addition, will require serious system gadgets for continuous operation, is rightly noted as a serious challenge [21], [13], [52], [53]. There are also significant risks that students will be more interested in the game process than in the necessary knowledge or theoretical skills. This can create serious obstacles to knowledge acquisition. Besides, this study contributes to the growing body of study on the effectiveness of gamification in education by systematically analysing various approaches and their outcomes. One of the contributions of this study is the integration of traditional gamification methods with modern digital technologies. From a theoretical basis, this study contributed to a deeper understanding of how game mechanics can be successfully incorporated into educational frameworks. It highlighted the intersection of motivational theories and digital learning environments. Also, the study demonstrated how gamification can align with cognitive and behavioural learning principles to enhance student engagement. In addition, this study (based on an analysis of modern literature) offered a theoretical model for how gamification can serve as an auxiliary yet increasingly essential component of the educational process. From a practical basis, the findings of this study underscored the importance of using gamification as a tool to foster motivation and enhance retention. These outcomes are not only relevant in educational settings but also carry over into students' future professional lives. Separately, researchers have drawn attention to the financial challenge [13], [20]. Resource constraints as a challenge to the introduction of mobile digital technologies can be overcome by using free or low-cost tools: combining Google Classroom and Google Forms (using gamification by creating mini-quests, questionnaires, or rating tables), Kahoot! We are also talking about lightweight frameworks for mobile gamification, like the Storyline-Based Framework (creating individual learning scenarios in which students consistently complete tasks), or using mobile applications for gamification (Quizizz, Seppo.io, Padlet, etc.). Low-resource solutions also include the use of messengers, QR codes, artificial intelligence technologies, etc. for gamification. Such solutions allow to effectively realize gamification opportunities even in conditions of limited funding.

The methodology used also has certain limitations. First of all, we are talking about a sample of scientific literature that, on the one hand, is relevant to today's needs and, on the other hand, is focused on English-language publications. Undoubtedly, there is a need to get acquainted with other studies that demonstrate national experiences and are written in other languages. This will, to some extent, allow us to update the study and make it more international in the future. At the same time, referring to the experience of English-language research does not diminish the relevance of the paper, as it accumulates sufficient scientific resources to understand the general trends and effectiveness of gamification of the educational process.

6 CONCLUSION

This study underscores the growing importance of incorporating game mechanisms into educational environments to enhance the effectiveness of the learning process. Gamification demonstrates several advantages, like its ability to motivate students, improve learning outcomes, and facilitate the acquisition and retention of knowledge.

The paper also deals with such aspects as benefiting from the development of new skills and abilities that are useful for learning and in further professional life, increasing motivation (interest in learning activities), developing communication skills and teamwork, and psychological relief. Some difficulties in the further development of gamification of education and, accordingly, its effectiveness have also been identified. Also, the factors related to the fact that gamification is an auxiliary process in education, the importance of which, however, will grow, may negatively affect the effectiveness.

Mobile technology through cloud storage and data synchronization allows students and teachers to access educational materials at any time. It also opens opportunities for personalized learning with adaptive algorithms. Availability in remote regions makes gamification more accessible to a wider audience. For educators, gamification allows them to motivate learning. Developers use gamification to form a new customer base and introduce innovative solutions that can be equally integrated not only into education but also into other areas of activity. Policymakers and civil servants should take advantage of gamification when developing regulatory tools, scaling innovative solutions, and taking other steps to foster a regulatory environment that supports mobile learning. The main limitations of this paper are the emphasis on English-language literature and the inclusion of literature from the last five years. Accordingly, older studies were ignored. In the future, this opens new directions; in particular, it is worth demonstrating a comprehensive study of this topic over the last 10 years.

Moreover, future research should explore more cost-effective, scalable solutions and the long-term effects of gamification on learning outcomes. Empirical studies that test the theoretical models proposed in this study are needed to examine how gamification functions in different educational contexts. These contexts are especially relevant to the Ukrainian experience, which will require further modernization using games.

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