Gamification as an e-learning tool: A Literature Review

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Abstract: The purpose of the article is to highlight the status of gamification of the educational process as an element of e-learning. The use of the game space in the educational process requires compliance with a number of specific conditions, so the task of the study is to determine the organisational and functional characteristics of gamification. The methodology involves the use of the principles of qualitative research, which analyses scientific views (53 sources were analysed) on the use of gamification in the educational process. The systematic literature review is conducted using the PRISMA 2020 flowchart, which allowed for a variable selection of sources relevant to the study of the current problem. The results of the study indicate the following trends in the positioning of gamification tools in the e-learning cluster: auxiliary status of gamification (42%), reinforcing status of the game factor (39%), alternative status of game-based learning (15%), negative feedback on the actualisation of gamification (4%). The literature review confirms the trend of involving a game case in the educational paradigm. At the same time, the role and format of gamification does not have a clear algorithm for implementation

and functioning in learning activities, which indicates the need to streamline this cluster of e-learning. The scientific and pedagogical discourse today does not have a clear answer to the general positioning of gamification in the educational system. Institutionally, gamification is enshrined in educational strategies due to global trends in the digitalisation of society, but at the organisational and functional level, there are contradictions about the status of the game space in the structure of e-learning. The study identified two cases of game-based learning platforms in the innovative educational space: an autonomous online game-based learning format (54%) and a game tool as an element of the digital learning environment (46%). The scientific novelty of the study is focused on the correlation of indicators of quantitative increase in the level of gamification and qualitative indicators of the effectiveness of this e-learning case. Prospects for scientific research are focused on developing a strategy for the development of gamification in the educational sphere in general and in the context of e-learning in particular. Conclusion. Thus, gamification has gained positions in the e-learning system and is forming its own niche in the educational paradigm. The rapid digitalisation of the socio-cultural space causes the diversity and disorder of the organisation of the e-learning game case (especially in the context of the educational and pedagogical status), which is expressed in the scientific discourse of the last five years.

Keywords: educational process, digitalisation, educational innovations, game-based learning space, game factor.

Introduction

Any educational tool that is rapidly gaining ground in learning activity requires a thorough study of its characteristics to determine the level of effectiveness. It is worth noting that the problem with gamification is that education is not essentially a game environment due to the dogmatic nature of functional and goal dimensions (Saleem, Noori & Ozdamli, 2022). However, in the dichotomy of expediency-demand in the current dynamic conditions of social development, preference is still given to trendy requests.

The modern educational space actively involves innovative formats, creating an environment close to the everyday practical level of society's development. Conservatism of education in today's dynamic society is a wrong strategy, as education should be correlated with the socio-cultural level of development. Gamification is one of the key tools of the global trend of digitalisation of education. The use of gaming potential was also typical for the traditional format of the educational process, but with the transition of this model to the digital space, the possibilities for its actualisation have significantly expanded.

In fact, the modern world is entering an information technology era that will shape the principles of education development (Li, Chu & Yang, 2022). The key indicators of online game-based learning platforms are user interface (UI) and user experience (UX) (Handayani et al., 2020).

Online gaming platforms create the conditions for ensuring fundamental educational activities: continuity, accessibility and mobility of learning (Suresh Babu & Dhakshina Moorthy, 2023). The literature review allows us to differentiate between fundamental and flexible dimensions of gamification in education. The diversity of views on the specifics of the use of gaming potential and its correlation with the value-based nature of the educational paradigm creates a pluralistic vector for the development of digital learning. Among the most popular online gaming platforms for education are Kahoot (Al Ghawail & Ben Yahia, 2022), EdApp, WizIQ, Qstream, AhaSlides, and others. Each of the platforms has its own design and educational and methodological features. Examples of synchronous and asynchronous digital educational and gaming spaces are given: WebEx and e-Class (Antonopoulou et al., 2022). Important aspects of online game platforms are the level of involvement of the subjects of the educational process.

Research Problem

The problem of gamification in education has become more relevant over the past decade, when the processes of total digitalisation of society have been implemented globally. Given that digital resources are used to the maximum extent possible in everyday life, their use in the educational system is an expected process. At the same time, a feature of the digital world is the variety of forms that are offered as an alternative to traditional models of social activity. Therefore, gamification, along with other elements of e-learning, should acquire an appropriate status that will determine the role and place of this tool in the educational process.

In general, the verification of e-learning in the socio-cultural dimension has already been carried out, so the question of streamlining its elements in the general education paradigm remains open. Systematisation of the experience gained in using gamification in the educational cycle allows us to develop a strategy for the development of education in the context of innovative transformations. The literature review on gamification in education provides a comprehensive understanding of the specifics of e-learning.

For the scientific discourse, the analysis based on the study of gamification in e-learning is valuable in the context of determining the educational characteristics of the game space. Thanks to the results obtained, it is possible to make a comparative analysis of innovative and traditional educational clusters. At the same time, it becomes possible to predict promising areas of gamification application.

The study of the problem of gamification in the quantitative dimension is presented by a significant number of works. At the same time, since gamification belongs to the cluster of innovative educational tools, the lion's share of studies is narrative in nature. It is clear that the initial interpretation of the gamification of education in the scientific discourse is adequate, as this is how the socio-cultural effect of innovative influence is reproduced. Instead, with the introduction of the educational and gaming space in the structure of learning activity, there is a need for a fundamental characterisation of its content and format.

The literature review is not intended to state the popularity and demand for gamification in e-learning, but to identify its strengths and weaknesses in the educational process. The rapidity with which gamification and digital learning in general have broken into the educational system is gradually transforming into a sustainable process that needs to be streamlined. Therefore, the experience gained and represented in scientific research should be structured and systematised in accordance with the realities and needs of educational development.

Research Focus

The focus of the study is on the rapid demand for innovative learning tools and the relevance of gamification to these needs of modern education. The review of works on the gamification of the educational process only confirms the trend towards the growing popularity of this e-learning tool. At the same time, there is a need for a qualitative distinction between the entire flow of educational and gaming elements to update educational and pedagogical goals.

Research Aim and Research Questions

The purpose of the study is to highlight the theoretical, methodological and practice-oriented dimensions of gamification in the scientific and pedagogical achievements of the last five years. The integration of the game segment into the educational space requires streamlining the algorithms of application in the educational cycle. Therefore, the tasks of scientific research are focused on the organisational and functional dimensions of gamification in the educational paradigm.

The research question is expressed in the context of generalising trends in the use of innovative educational and gaming space in scientific concepts of educational development. A literature review of the gamification of education allows us to trace the dynamics of the spread of this element of e-learning and the problems associated with this process.

Literature Review

The problem of gamification of the educational process is widely covered in the scientific and pedagogical discourse. The number of studies has been rapidly increasing in unison with the active development of the digitalisation of society (Oliveira et al., 2023). In this context, it is worth noting that a separate cluster of scientific research focuses on the coverage of the gamification of the learning process in the context of general trends in the digitalisation of education (Pathak, Singh & Aggarwal, 2022). Gamification is considered in more detail in the e-learning paradigm:

- gamification as a means of increasing interest in learning on the part of students (Candel, de-la-Peña & Yuste, 2023);
- the impact of the game format on academic performance (Palaniappan & Md Noor, 2022);
- educational and gaming space in the context of a clear and safe environment for obtaining a level of education (Navarro-Espinosa et al., 2022);

- the use of gamification elements in a traditional learning format (Thirakulwanich, Dragolea & Fekete-Farkas, 2020);
- information and technological vectors of the game case of education development (Senthil Kumaran, Nithiya Shri & Harini, 2023);
- strengthening the resilience of learning management systems (LMS) (Alzahrani & Alhalafawy, 2023) and institutional coherence of the educational paradigm disrupted by the COVID-19 pandemic (Rahayu et al., 2022);
- focus on personalisation of game activity during learning (Pakinee & Puritat, 2021);
- alignment of game-based learning dimensions with other technological advances such as Artificial Intelligence (Bachiri, Mouncif & Bouikhalene, 2023);
- the ratio of the effectiveness of the game-based learning format in the traditional and digital educational environment (Donath, Mircea & Rozman, 2020).

An important place in the literature review is occupied by the issue of the status of gamification in the e-learning system, the educational process and the educational paradigm in general. In particular, several concepts of positioning the game format of learning activity can be traced. A game case is defined as an element of stimulus to learning activity (Alzahrani & Salim Alhalafawy, 2022).

The factor that has somewhat divided the views of scholars on the use of game elements in the learning process is the role and place of this cluster in the strategies for the development of future education. Some researchers believe that the existing balance between traditional and innovative dimensions of learning should be maintained (Pradana et al., 2023). Another group of scholars argue that digital learning will strengthen its position to a dominant level in the educational system.

The scientific literature identifies both positive (Panagiotarou et al., 2020) and negative manifestations of the use of gamification in the educational process, which indicate low rates of successful completion of an online game training course (about 48% did not complete the chosen course (Eliyas & Ranjana, 2024)). The socio-psychological characteristics of gamification in the educational process are provided in the study Jayawardena (2021).

Despite the large number of studies on gamification in education, there are still many unexplored aspects of the value and content nature of the game-based learning format. Oliveira et al. (2021) emphasise the dispersion of literature on this topic, pointing to the isolation and fragmentation of behavioural guidelines for learning activity. Alshammari (2020) notes the lack of experimental evaluation of the effect of gamification.

Materials and Methods

The methodological arsenal of scientific research is based on the principles of qualitative research, which is based on the analysis of scientific works of the last five years devoted to the problem of gamification of the educational process. The research methodology is focused on the

analytical cluster, which is updated on the basis of scientific papers that highlight the problem of gamification of learning.

Standard search algorithms were used for the study sample. In particular, Google Scholar was the main scientometric platform used to select the literature. A similar literature review on the Google Scholar platform was conducted by Behl et al. (2022), but its results were limited by the homogeneity of the sample. The selection of literature is limited to publications of the last five years (2019-2024) due to a significant increase in the dynamics of the introduction of gamification tools in education and an attempt to concentrate the key trends in this process and avoid quantitative blurring of the problem. Key words used in the search: gamification of learning, educational and gaming space, innovative education. Given the global nature of the gamification of the educational process, no regional restrictions were applied to the study sample.

The PRISMA 2020 flowchart was used as an additional methodological tool to ensure the concentration of the selection of scientific papers for further analysis, thanks to which the sample acquired a variable character and lost its homogeneity. Similar studies on this topic and using PRISMA have already been conducted in the scientific discourse. In particular, Burlacu, Coman & Bularca (2023) identified scientific articles on e-learning humanisation in the Web of Science and Scopus databases. The key characteristics of the PRISMA 2020 approach in the literature selection process are highlighted in the flowchart, which defines the key parameters for selecting the scientific papers analysed in the current study.

Table 1

Selection of literature on the topic of gamification of digital education for the period from 2019 to 2024 on the GoogleScholar platform using the PRISMA 2020 flowchart

Identification of studies via databases		
Identification	Records identified from Databases (n = 4110)	Records removed before screening: Duplicate records removed (n = 950) Records marked as ineligible by automation tools (n = 2529) Records removed for other reasons (n = 369)
Screening	Records screened (n = 262)	Records excluded** (n =209)
	Reports sought for retrieval	Reports not retrieved

	(n = 262)	(n = 209)
	Reports assessed for eligibility (n =53)	Reports excluded: Reason 1 Not relevant to the purpose of the study (n = 78) Reason 2 Lack of value of materials for analysing the current problem (n = 121) Reason 3 Unconfirmed research data (n = 10)
Included	Studies included in review (n = 53)	

Source: compiled by the authors based on Page et al. (2021).

Thus, as a result of the identification of sources necessary for the analysis conducted in the current study, 53 works were selected for consideration (one source in the general list of references refers to the methodological case of the study and is not included in the specified sample).

Results

The analysis of the literature selected for the study revealed several natural trends in the use of gamification in the educational process. These processes relate to the specificity of the status of gamification in the education system. The key dimensions that characterise the electronic educational and gaming space are:

- compliance of the internal functionality of the digital game case with the quality of learning;
- correlation of value and goal aspects of gamification and educational development strategy.

The specificity of the organisational and functional potential of the electronic educational and gaming space indicates the formation of intra-educational features of the use of online gaming platforms. Gamification is gradually occupying its niche in the educational process, which necessitates a clear positioning of this element of educational activity. In the initial period of e-learning and digital gaming platforms implementation, they were almost unanimously defined as an innovative alternative tool in the education system.

Over time, it has become clear that the same type of alternative status no longer captures the full impact of gamification on the learning process. In the current study, the analysis of scientific achievements (for 2019-2024) on the topic of educational gamification demonstrated the diversity of the status granted to the digital learning and gaming tool (see Fig. 1).

Figure 1

The status of the digital game case in the educational system in the scientific discourse of 2019-2024 (based on the analysis of 53 papers).
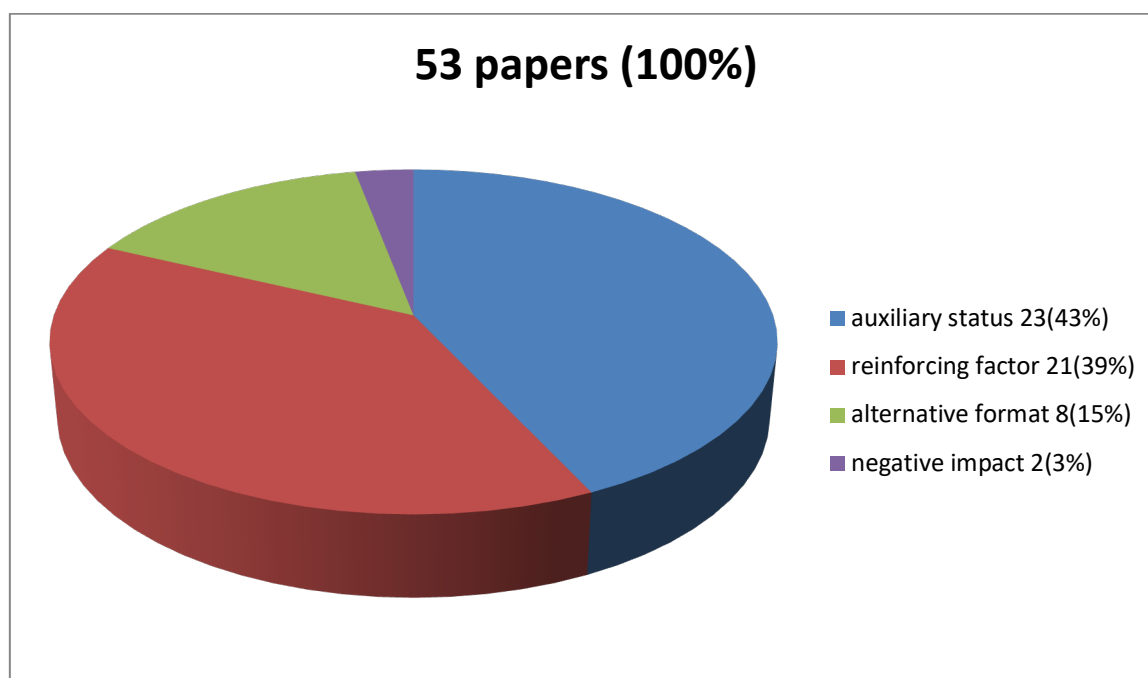
According to the results obtained, the electronic format of game-based learning is no longer considered as a temporary substitute for the traditional learning format, which was relevant during periods of socio-cultural crisis (related to the COVID-19 pandemic and the dominance of distance learning). The authors also note the total advantage of the positive impact of e-game learning in gamification research. The organisational and functional distribution indicates three key roles of the game case in e-learning:

- the auxiliary status of a game format that complements existing models of learning activity in a practical environment;
- amplifying effect, which emphasises the use of the game cluster as a driver of educational and pedagogical innovations that summarise the traditional educational potential;
- an alternative format that is an autonomous model of organising the learning process with a full cycle of learning activities.
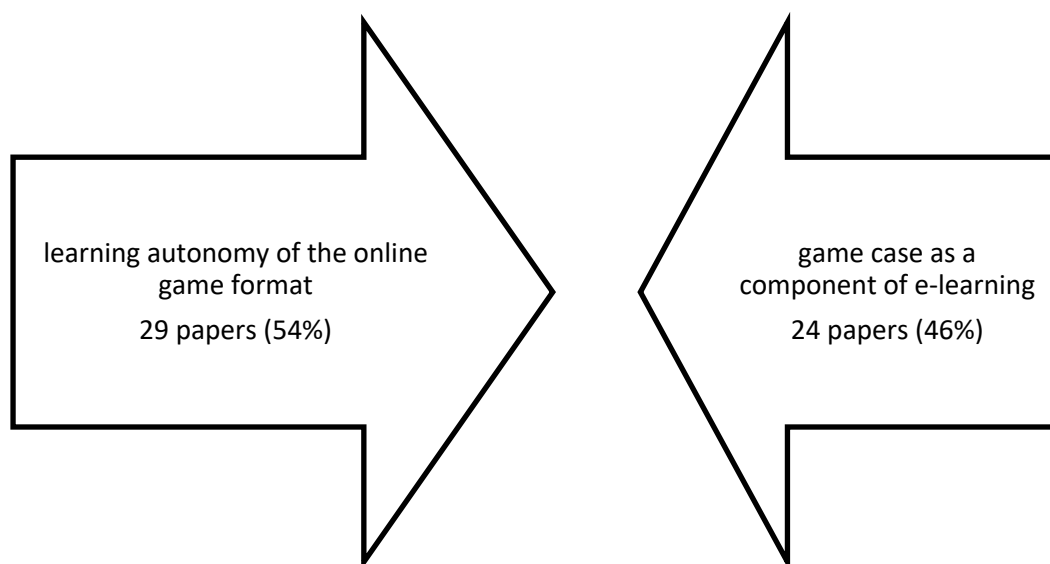
The auxiliary status of an online gaming platform may not be directly related to teaching and learning guidelines at all. In particular, Khaldi, Bouzidi & Nader (2023) note that the game model can serve solely as an element of attracting or encouraging students to study a subject, positioning itself as a kind of propaganda introduction to the speciality.

Another aspect that was investigated in the literature review was the content context of gamification in the learning environment. The results indicated that the intra-educational status of the digital game case is virtually equal (see Fig. 2).

Figure 2

The status of online gaming space in the educational and digital paradigm

learning autonomy of the online game format

29 papers (54%)

game case as a component of e-learning

24 papers (46%)

Source: Author's development.

This balance allows us to trace the contradiction of using the game format in the e-learning paradigm. On the one hand, gamification is positioned as a tool of the digital educational space with an inextricable link to information technology systems. That is, the game format is just a case of the general trend of digitalisation of education. On the other hand, scholars note the potential of the online game format, which is capable of forming exclusive and self-sufficient educational spaces. The presence of various online learning platforms confirms this thesis by providing statistics on the audience of users of such resources.

Discussion

The number of works presenting the educational and gaming space has been increasing dynamically over the past decade, due to the rapid development of digital technologies and their global integration into everyday life. Therefore, in the scientific discourse, there is a need not only to state the concepts of gamification as an e-learning format, but also to analyse the content dimension of this element of the educational cycle.

The auxiliary role of game-based learning, highlighted in the results of the current study as the most demanded, is highlighted in the context of integrating a game case into learning activities. Game elements, in particular the terminology and information case "TERMINator" (Seidlein et al., 2020), are actively used in the Moodle learning environment (Poondej & Lerdpornkulrat, 2020). Such guidelines determine that the game format is an element of digital learning, performing special functions, but not forming an autonomous educational paradigm.

Bennani, Maalel & Ben Ghezala (2022) focus on the adaptive function of the game case in the e-learning system, which correlates with the auxiliary model of online game-based learning. Online game-based learning platforms allow to maintain a kind of comfort zone (Ekici, 2021) for learners, as they involve activity in a familiar environment (Suppan et al., 2020).

According to the study, students' motivation increases by 25% after using the game format. At the same time, it is worth focusing on the superficiality of such indicators, as further studies have shown approximately the same rates of loss of interest in learning (Acosta-Medina, Torres-Barreto & Cárdenas-Parga, 2021) with a decrease in the level of interest in game design (Hassan et al., 2019). Therefore, despite the role of gamification in "counteracting attrition and dropout in e-learning" (Alsubhi et al., 2021), this motivational problem in modern education is far from being solved.

The compensatory dimension of the game cluster is designed to provide relevant experience for participants in the educational process, which, due to certain circumstances, is not available in the classroom format (Watini & Setyowati, 2023). This position is consistent with the mediating mission of game-based learning as outlined in the study by Gupta & Priyanka (2022). At the same time, the generalising role of the game cluster in educational activity is becoming more relevant. The effect of "gluing" the experience of acquired knowledge and skills prevailed in students' responses to their perception of the role of game-based learning (Oe, Takemoto & Ridwan, 2020).

The results of the study point to the reinforcing role of online game-based learning, which is consistent with the position of Rebelo & Isaias (2020), who argue that this format is a factor in increasing motivation for educational activity on the part of young people. In the worldview priorities of a young person, change and transformation are a determining factor in their interest in any process. Therefore, creating an alternative environment in the classical educational paradigm has a positive effect on achieving the loyalty of students.

Another marker of the development of digitalisation and gamification in education is the modelling of an environment (Dæhli et al., 2021), in which the effectiveness of the learning process is high (not necessarily higher than in the traditional learning format, but corresponding to the required level of knowledge acquisition). A key condition for the development of the game-based learning model is the continuous improvement of this format. In this case, innovation (de la Peña, Lizcano & Martínez-Álvarez, 2021) is easily fuelled by information intensity and technological progress. At the same time, the global process of digitalisation and the emergence of Information Society 5.0 is an important driver for the e-learning game case (Leung et al., 2021).

Kashive & Mohite (2023) emphasise the inseparability of the gaming space from the digital potential, noting that e-learning through technological solutions enables the game case to be implemented in education. The design of the online gaming space is understandable and interesting for learners, so the game format is accepted by them. If only the game model is left without the support of information and digital support, the educational and methodological

quality will be significantly reduced. These views correlate with almost half of the works reviewed in the current study, which indicate that the game case is positioned as an e-learning tool.

The balance of simplifying and complicating the learning process with game tools remains a controversial issue in scientific discourse (Sabri, Fakhri & Moumen, 2022). On the one hand, the game format enhances general capabilities in terms of updating and searching for information (Abdulaziz Alsubhi, Sahari & Tengku Wook, 2020). At the same time, the learning process requires ensuring an appropriate level of quality, which inevitably leads to the need to complicate the game format to finalise educational goals (Chelawat & Sant, 2022).

According to Ghai & Tandon (2023), "gamification is a multidimensional construct with a dynamic developmental component". Such concepts correlate with the principles of the current study, which emphasises the pluralistic nature of gamification in education. At the same time, the synergistic dimensions of the educational and gaming space, in which educational, methodological and information technology guidelines are combined and interact, are becoming more relevant. Special attention should be paid to the interdisciplinarity that accompanies the game case of learning activity.

Conclusions and Implications

Gamification of e-learning is becoming a real trend in the modern educational space. Online gaming platforms are gaining popularity among students due to their clear design and the demand for the digital cluster in the worldview paradigm of modern society. The results of the literature review indicate the need to systematise the existing gamification potential. Therefore, the study examined the organisational and functional characteristics of a game case in e-learning. The data obtained indicate the predominant positioning of game-based learning as an element of support for educational development in general and digital learning in particular (the aggregate indicator of the status of game case support in e-learning is 82%, while the alternative format is 15%, with 2% of negative characteristics of the game space). Another indicator relevant to the study was the internal educational status of the game case. According to the data analysis, the online game format can function in the educational process both autonomously (54%) and inextricably linked to the information and technological resources of the digital space.

In general, the results indicate the transformation of the educational game cluster from the status of an alternative to a full-fledged element of learning activity. At the same time, the main problem is still focused not on the format, but on the content of the digital game case in the educational process. The lack of intrinsic motivation among students creates the illusion of its presence due to the activation of brightness and accessibility of digitalisation and gamification design by external factors.

Suggestions for Future Research

Promising areas of research into the problem of gamification in e-learning are the formation of the organisational and functional structure of this educational case and the clarity of the value

and content guidelines of this format. At present, two trends in the development of gamification principles in the digital education paradigm are outlined:

- personalisation of the gaming space (Bennani, Maalel & Ben Ghezala, 2020), taking into account the individual needs and potential of the student;
- unification of online gaming platforms (Yamani, 2021), which focus on the educational and methodological planning of learning activities.

The flexibility of game-based and digital learning actualises the potential for self-directed learning (Aguilos & Fuchs, 2022), in which students, in addition to traditional fundamental skills, acquire a set of soft skills, digital skills, and creative skills. At the same time, a kind of game thinking is formed (Kučak, Biuk, & Mršić, 2022), which helps to master complex elements of the curriculum. After all, in a study comparing the effectiveness of game-based learning, personalised online courses had almost twice the success rate of their centralised counterparts on game-based learning platforms (Abbasi et al., 2021).

In general, the results of the introduction of gamification into the structure of digital learning allow us to understand the scale and intensity of the introduction of the game case into the education system. It is clear that the educational and gaming space should be properly presented in short-term educational plans and programmes and long-term strategies for the development of education. Having received the first results of the implementation, it is worth systematising the data obtained, taking into account the scale of the introduction of the game format in digital learning. The experience gained should be transformed into qualitative characteristics of the game case of education, which will focus on both organisational and functional, as well as value and content dimensions of game-based learning.

References

Abbasi, M., Montazer, G., Ghrobani, F., & Alipour, Z. (2021). Personalised Gamification in E-Learning with a Focus on Learners' Motivation and Personality. *Interdisciplinary Journal of Virtual Learning in Medical Sciences, 12*(3), 201-212. https://doi.org/10.30476/ijvlms.2021.89333.1070

Abdulaziz Alsubhi, M., Sahari, N., & Tengku Wook, T. (2020). A Conceptual Engagement Framework for Gamified E-Learning Platform Activities. *International Journal of Emerging Technologies in Learning (iJET), 15*(22), 4-23. Retrieved from: https://www.learntechlib.org/p/218420/

Acosta-Medina, J. K., Torres-Barreto, M. L., & Cárdenas-Parga, A. F. (2021). Students' preference for the use of gamification in virtual learning environments. *Australasian Journal of Educational Technology, 37*(4), 145-158. https://doi.org/10.14742/ajet.6512

Al Ghawail, E. A., & Ben Yahia, S. (2022). Using the E-Learning Gamification Tool Kahoot! to Learn Chemistry Principles in the Classroom. *Procedia Computer Science, 207*, 2667-2676. https://doi.org/10.1016/j.procs.2022.09.325

Alshammari, M. T. (2020). Evaluation of Gamification in E-Learning Systems for Elementary School Students. *TEM Journal, 2*, 806-813. https://doi.org/10.18421/TEM92-51

Alsubhi, M., Ashaari, N., Tengku, W., & Tengku Siti Meriam Tengku, W. (2021). Design and Evaluation of an Engagement Framework for e-Learning Gamification. *International Journal of Advanced Computer Science and Applications, 12*, 411-417. https://doi.org/10.14569/IJACSA.2021.0120947

Alzahrani, F. K., & Alhalafawy, W. S. (2023). Gamification for Learning Sustainability in the Blackboard System: Motivators and Obstacles from Faculty Members' Perspectives. *Sustainability, 15*(5), 4613. https://doi.org/10.3390/su15054613

Alzahrani, F., & Salim Alhalafawy, W. (2022). Benefits and challenges of using gamification across distance learning platforms in higher education: A systematic review of research studies published during the COVID-19 pandemic. *Journal of Positive School Psychology, 6*(10), 1948-1977. Retrieved from: https://mail.journalppw.com/index.php/jpsp/article/view/13543/8776

Antonopoulou, H., Halkiopoulos, C., Gkintoniand, E., & Katsimpelis, A. (2022). Application of gamification tools for identification of neurocognitive and social function in distance learning education. *International Journal of Learning, Teaching and Educational Research, 21*(5), 367-400. https://doi.org/10.26803/ijlter.21.5.19

Aguilos, V., & Fuchs, K. (2022). The perceived usefulness of gamified e-learning: A study of undergraduate students with implications for higher education. *Frontiers Education, 7*, 945536. https://doi.org/10.3389/feduc.2022.945536

Bachiri, Y.-A., Mouncif, H., & Bouikhalene, B. (2023). Artificial Intelligence Empowers Gamification: Optimising Student Engagement and Learning Outcomes in E-learning and MOOCs. *International Journal of Engineering Pedagogy (iJEP), 13*, 4-19. https://doi.org/10.3991/ijep.v13i8.40853

Behl, A., Jayawardena, N., Pereira, V., Islam, N., Del Giudice, M., & Choudrie, J. (2022). Gamification and e-learning for young learners: A systematic literature review, bibliometric analysis, and future research agenda. *Technological Forecasting and Social Change, 176*, 121445. https://doi.org/10.1016/j.techfore.2021.121445

Bennani, S., Maalel, A., & Ben Ghezala, H. (2022). Adaptive gamification in E-learning: A literature review and future challenges. *Computer Applications in Engineering Education, 30*, 628-642. https://doi.org/10.1002/cae.22477

Bennani, S., Ben Ghezala, H., & Maalel, A. (2020). AGE-Learn: An Ontology-Based Representation of Personalised Gamification in E-learning. *Procedia Computer Science, 176*, 1005-1014. https://doi.org/10.1016/j.procs.2020.09.096

Burlacu, M., Coman, C., Bularca, M. C. (2023). Blogged into the system: A systematic review of the gamification in e-learning before and during the COVID-19 Pandemic. *Sustainability, 15*(8), 6476. https://doi.org/10.3390/su15086476

Candel, E. C., de-la-Peña, C., & Yuste, B. C. (2023). Pre-service teachers' perception of active learning methodologies in history: Flipped classroom and gamification in an e-learning environment. *Education and Information Technologies, 29*, 3365-3387. https://doi.org/10.1007/s10639-023-11924-0

Chelawat, A., & Sant, S. (2022). Learner Motivation Through Gamification in E-Learning: A Study on Game-Based Formative Assessment in E-Learning. In C. Lane (Ed.), *Handbook of Research on Acquiring 21st Century Literacy Skills Through Game-Based Learning* (pp. 810-831). https://doi.org/10.4018/978-1-7998-7271-9.ch041

Dæhli, O., Kristoffersen, B., Lauvås, P., & Sandnes, T. (2021). Exploring feedback and gamification in a data modelling learning tool. *The Electronic Journal of e-Learning, 19*(6), 559-574. Retrieved from: https://files.eric.ed.gov/fulltext/EJ1330682.pdf

De la Peña, D., Lizcano, D., & Martínez-Álvarez, I. (2021). Learning through play: A gamification model in university-level distance learning. *Entertainment Computing, 39*, 100430. https://doi.org/10.1016/j.entcom.2021.100430

Donath, L., Mircea, G., & Rozman, T. (2020). E-Learning Platforms as Leverage for Education for Sustainable Development. *European Journal of Sustainable Development, 9*(2), 1. https://doi.org/10.14207/ejsd.2020.v9n2p1.

Ekici, M. (2021). A systematic review of the use of gamification in flipped learning. *Education and Information Technologies, 26*, 3327-3346. https://doi.org/10.1007/s10639-020-10394-y

Eliyas, S., & Ranjana, P. (2024). A Potent View on the Effects of E-Learning. *International Journal of Grid and High-Performance Computing (IJGHPC), 16*(1), 1-10. http://doi.org/10.4018/IJGHPC.335035

Ghai, A., & Tandon, U. (2023). Integrating gamification and instructional design to enhance usability of online learning. *Education and Information Technologies, 28*, 2187-2206. https://doi.org/10.1007/s10639-022-11202-5

Gupta, S., & Priyanka. (2022). Gamification and e-learning adoption: a sequential mediation analysis of flow and engagement. *VINE Journal of Information and Knowledge Management Systems*. https://doi.org/10.1108/VJIKMS-04-2022-0131

Handayani, V., Lukman Budiono, F., Rosyada, D., Nisa Sofia Amriza, R., Zulkifli, A., & Ummi Masruroh, S. (2020). Gamified Learning Platform Analysis for Designing a Gamification-Based UI/UX of E-learning Applications: A Systematic Literature Review. *8th International Conference on Cyber and IT Service Management (CITSM),* 1-5. https://doi.org/10.1109/CITSM50537.2020.9268791

Hassan, M. A., Habiba, U., Majeed, F., & Shoaib, M. (2019). Adaptive gamification in e-learning based on students' learning styles. *Interactive Learning Environments, 29*(4), 545-565. https://doi.org/10.1080/10494820.2019.1588745

Jayawardena, N. S. (2021). The e-learning persuasion through gamification: an elaboration of the likelihood model perspective. *Young Consumers, 22*(3), 480-502. https://doi.org/10.1108/YC-08-2020-1201

Kashive, N., & Mohite, S. (2023). Use of gamification to enhance e-learning experience. *Interactive Technology and Smart Education, 20*(4), 554-575. https://doi.org/10.1108/ITSE-05-2022-0058

Khaldi, A., Bouzidi, R., & Nader, F. (2023). Gamification of e-learning in higher education: a systematic literature review. *Smart Learning Environments, 10*(10). https://doi.org/10.1186/s40561-023-00227-z

Kučak, D., Biuk, A., & Mršić, L. (2022). Enhancing Student Learning Productivity with Gamification-Based E-learning Platform: Empirical Study and Best Practices. In Vasant, P., Zelinka, I., Weber, G. W. (Eds.), *Intelligent Computing & Optimisation*. Cham: Springer. https://doi.org/10.1007/978-3-030-93247-3_81

Leung, F., Lau, M., Wan, K., Law, L., Kwong, T., & Wong, E. (2021). Promoting Students' Global Perspectives Through a Gamified e-Learning Platform. *Frontiers in Education, 6*, 617680. https://doi.org/10.3389/feduc.2021.617680

Li, X., Xia, Q., Chu, S., & Yang, Y. (2022). Using Gamification to Facilitate Students' Self-Regulation in E-Learning: A Case Study on Students' L2 English Learning. *Sustainability, 14*(12), 7008. https://doi.org/10.3390/su14127008

Navarro-Espinosa, J. A., Vaquero-Abellán, M., Perea-Moreno, A.-J., Pedrós-Pérez, G., Martínez-Jiménez, M. P., & Aparicio-Martínez, P. (2022). Gamification as a Promoting Tool of Motivation for Creating Sustainable Higher Education Institutions. *International Journal of*

Environmental Research and Public Health, 19(5), 2599. https://doi.org/10.3390/ijerph19052599

Oe, H., Takemoto, T., & Ridwan, M. (2020). Is Gamification a Magic Tool? Illusion, Remedy, and Future Opportunities in Enhancing Learning Outcomes during and beyond the COVID-19. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal, 3*(3), 1401-1414. https://doi.org/10.33258/birle.v3i3

Oliveira, R. P., Santos, I. L., de Souza, C. G., Reis, A. d. C., & de Souza, W. M. (2023). A study on the relationship between industry 4.0 technologies and gamification in e-learning. *Interactive Technology and Smart Education, 20*(4), 449-474. https://doi.org/10.1108/ITSE-02-2022-0020

Oliveira, R. P., Souza, C., Reis, A., & Souza, W. (2021). Gamification in E-Learning and Sustainability: A Theoretical Framework. *Sustainability, 13*(21), 11945. https://doi.org/10.3390/su132111945

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D. et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 71*. https://doi.org/10.1136/bmj.n71.

Pakinee, A., & Puritat, K. (2021). Designing a gamified e-learning environment for teaching undergraduate ERP course based on big five personality traits. *Education and Information Technologies, 26*, 4049-4067. https://doi.org/10.1007/s10639-021-10456-9

Palaniappan, K., & Md Noor, N. (2022). Gamification Strategy to Support Self-Directed Learning in an Online Learning Environment. *International Journal of Emerging Technologies in Learning (iJET), 17*(3), 104-116. Retrieved from: https://www.learntechlib.org/p/220515/.

Panagiotarou, A., Stamatiouand, Y., Pierrakeas, C., & Kameas, A. (2020). Gamification acceptance for learners with differente-skills. International Journal of Learning. *Teaching and Educational Research, 19*(2), 263-278. https://doi.org/10.26803/ijlter.19.2.16

Pathak, S., Singh, N., & Aggarwal, S. (2022). Demystifying Effective E-learning Through Gamification. In Mallick, P. K., Bhoi, A. K., González-Briones, A., Pattnaik, P. K. (Eds.), *Electronic Systems and Intelligent Computing. Lecture Notes in Electrical Engineering.* Springer, Singapore. https://doi.org/10.1007/978-981-16-9488-2_11

Poondej, C., & Lerdpornkulrat, T. (2020). Gamification in e-learning: A Moodle implementation and its effect on student engagement and performance. *Interactive Technology and Smart Education, 17*(1), 56-66. https://doi.org/10.1108/ITSE-06-2019-0030

Pradana, F., Setyosari, P., Ulfa, S., & Hirashima, T. (2023). Development of Gamification-Based E-Learning on Web Design Topic. *International Journal of Interactive Mobile Technologies (iJIM), 17*(03), 21-38. https://doi.org/10.3991/ijim.v17i03.36957

Rahayu, F. S., Nugroho, L. E., Ferdiana, R., & Setyohadi, D. B. (2022). Motivation and Engagement of Final-Year Students When Using E-learning: A Qualitative Study of Gamification in Pandemic Situation. *Sustainability, 14*(14), 8906. https://doi.org/10.3390/su14148906

Rebelo, S., & Isaias, P. (2020). Gamification as an Engagement Tool in E-Learning Websites. *Journal of Information Technology Education: Research, 19*, 833-854. https://doi.org/10.28945/4653

Sabri, Z., Fakhri, Y., & Moumen, A. (2022). The Effects of Gamification on E-learning Education: A Systematic Literature Review and Conceptual Model. *Statistics, Optimisation & Information Computing, 10*(1), 75-92. https://doi.org/10.19139/soic-2310-5070-1115

Saleem, A. N., Noori, N. M., & Ozdamli, F. (2022). Gamification Applications in E-learning: A Literature Review. *Technology, Knowledge and Learning, 27*, 139-159. https://doi.org/10.1007/s10758-020-09487-x

Seidlein, A. H., Bettin, H., Franikowski, P., & Salloch, S. (2020). Gamified E-learning in medical terminology: the TERMInator tool. *BMC Medical Education, 20.* https://doi.org/10.1186/s12909-020-02204-3

Senthil Kumaran, V., Nithiya Shri, M., & Harini, A. (2023). A Review on Gamification in e-learning: Effects and Challenges. *Jurnal Pendidikan, 24*(1), 29-42. https://doi.org/10.33830/jp.v24i1.3673.2023

Suppan, M., Gartner, B., Golay, E., Stuby, L., White, M., Cottet, P., Abbas, M., Iten, A., Harbarth, S., & Suppan, L. (2020). Teaching Adequate Prehospital Use of Personal Protective Equipment During the COVID-19 Pandemic: Development of a Gamified e-Learning Module. *JMIR Serious Games, 8*(2), e20173. https://doi.org/10.2196/20173

Suresh Babu, S., & Dhakshina Moorthy, A. (2023). Application of artificial intelligence in adaptation of gamification in education: A literature review. *Computer Applications in Engineering Education, 32*, e22683. https://doi.org/10.1002/cae.22683

Thirakulwanich, A., Dragolea, L., & Fekete-Farkas M. 2020. Gamification and Learning: Enhancing and Engaging E-learning Experience. *Global Journal of Entrepreneurship and Management, 1*(1), 16-29. https://doi.org/10.57585/GJEM.020.002

Watini, S., & Setyowati, W. (2023). Using Gamification to Increase E-Learning Engagement. *International Transactions on Education Technology (ITEE), 1*(2), 84-94. https://doi.org/10.33050/itee.v1i2.234

Yamani, H. (2021). A Conceptual Framework for Integrating Gamification in eLearning Systems Based on Instructional Design Model. *IJET, 16*, 14-33. https://doi.org/10.3991/ijet.v16i04.15693