GRID 2022
11 . INTERNATIONAL SYMPOSIUM
GRAPHIC ENGINEERING AND DESIGN
03-05. NOVEMBER 2022

11th GRID SYMPOSIUM

Video games as a learning tool - potential applications in the Graphic engineering and design studies

Bojan Banjanin, Neda Milić Keresteš, Rastko Milošević, Savka Adamović, Magdolna Pál
University of Novi Sad, Faculty of technical sciences, Department of graphic engineering and design, Novi Sad, Serbia

Introduction

Throughout history, games have been meant to enrich leisure time and provide a sense of advancement and fulfilment by following specific rules and overcoming obstacles. Play, on the other hand, is usually not bounded by externally imposed rules and is more casual, creative, and liberating. However, that does not mean participating in a game cannot be playful. Our educational system is, by analogy to games, also founded on a different set of rules meant to be obeyed. By following these rules and overcoming various obstacles throughout studies, students acquire specific achievements after which they should be prepared for the challenges of the real world. Suppose the educational system is looked at in this way. In that case, educators can be found to be in the position to tailor their "mini-systems" to be similar to games or even to incorporate different kinds of games for better understanding, engagement, and learning. Guided by this premise, over the last three decades, there have been discussions about the influence of gaming on learning in students of various ages. Games are also studied as a tool for adult professional education and training.
This paper aims to give insight into research done in the field of implementing games for educational purposes and what are some of the advantages and disadvantages of using games in education in the last decades. After this initial part of the study, suggestions about potential applications in Graphic engineering and design studies are discussed.

Literature review

Simulation can be defined as a “representation of reality or some known process/phenomenon“ (Deshpande & Huang, 2011). It is a mathematical or algorithmic model with an appropriate set of constraints that allows predictive system analysis (Ochoa, 1969).
A simulation game, on the other hand, is a simulation with elements such as score, performance rating, conflict, and payoff, but which still simulates an actual world situation for decision-making or alternate evaluation (Deshpande & Huang, 2011). Simulations and simulation games allow the player to experience some process and engage in it without the risk of expensive mistakes. If a simulation involves competition (players with themselves or other players), it can be considered a simulation game. However, if the focus of a simulation involves only the completion of an event, it cannot be considered a game (Ke, 2009).
A serious game is a term coined by Abt (1987) in his book “Serious Games”, and it can be defined as games whose primary purpose is education rather than entertainment. They are designed to teach academic content and skills to students playing them (Mayer, 2014).
Investigations of serious games have grown in the past 20 years, and today it represents an established academic field, as seen in Figure 1 (Gómez & Suárez, 2021).

Game-based learning

Simulation games and problem-based learning represent experiential learning, collaborative, active, and learner-centric approaches (Deshpande & Huang, 2011). Both approaches include some assessment. In problem-based learning, self-assessment is conducted at the end of the problem or the learning cycle. The simulation game has a scoring system that indicates one’s performance. In game-based learning, students can be motivated to maximize their scores by trying alternative strategies and learning something new from the literature. Games can also be offered online, where advanced graphics and multimedia may be used to capture students’ attention. In addition, help for the problems encountered in the game could be found online without waiting for the instructor to address the problem.

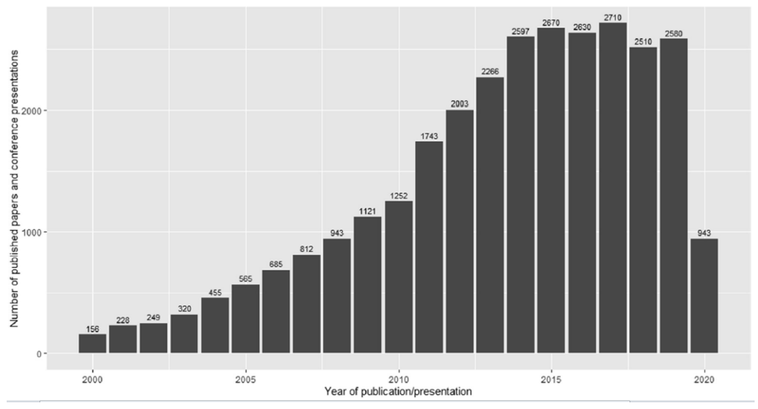

Figure 1

Number of research papers on serious games from year 2000 to 2020 according to Gómez & Suárez (2021)

Results

Using simulations in the field of Graphic engineering and design

Research papers and solutions regarding simulations and games in teaching graphic arts and printing are scarce. However, there are solutions for simulating some of the printing processes found during the research phase, such as Sinapse print simulators (Sinapseprint, 2017) and PrintSIM simulators (Printsim, 2022).
These examples can be categorized as simulations, but not as simulation games due to the lack of some of the essential elements of the games, such as rules, goals and objectives, conflict/competition, win/lose conditions, representation, or story. One can argue that in these simulations, there are specific “rules” for running a printing press or that there are objectives, such as successfully running the machines. However, conflicts/competition or win/lose conditions are vaguely defined. Concerning representation, usually in these simulations, there are only some kind of user interface and rarely the exact 3D model of the observed printing machine, which can be observed in real-time, rotate around and interact with it. Moreover, there is no storyline besides strict theoretical explanations of the machines and systems.

Discussion

Possible solutions for using simulation games in the field of Graphic engineering and design curriculum

Using real printing machines in learning and training for special situations is very expensive (material and labour costs as well as the operating expenses of the press) and often impossible due to the risk of causing damage to the press. Purchasing a printing machine for training is a significant investment for most companies and schools. Even if resources are allocated for buying a printing machine, problems with available space for its installation can arise. Instead of using real machines, simulations can be used to train professional people in occupations where a human error would cost considerably or even be dangerous for their lives. Simulations provide risk-free education and practical knowledge for the trainee. It is possible to construct expert systems for complicated processes with many variables, such as in the printing industry. The purchasing costs of the simulation system are much lower than the costs of the corresponding printing press line, and usually, one system can serve several purposes or printing presses (Launonen, 1998). Technologies such as modern game engines (Unreal Engine, Unity, etc.), virtual reality, and augmented reality can help develop new simulations and interactions with otherwise expensive printing machines often unavailable to students. To acquire practical skills in the graphic arts industry, students need to have a chance to see and interact with printing systems and get familiar with the processes. Besides company visits which are very useful for getting a glimpse into the industry workflow, they cannot see all of the machines and systems that the curriculum includes, and they do not have the opportunity to try and work on the ones they saw. With the simulations, this can be overcome.

Conclusion

Throughout reviewed literature, evidence has been accumulating on the positive impact of educational games (serious games) on students' learning and achievement and the impact of non-educational games on different psycho-physical traits. Today's dynamic way of life and almost innate familiarity with technology opens many new possibilities for teaching and can facilitate a better understanding of specific topics.
From the statements mentioned above, it can be seen that to incorporate simulation gaming into the curriculum of Graphic engineering and design studies, knowledge and expertise from different disciplines should be combined. Artistic as well as technical skills are needed to accomplish this goal. Artistic skills include concept art, 3D modelling (in Autodesk 3D Max, Inventor, CATIA, etc.), and building virtual environments such as print shops where virtual machines would be located (Unreal Engine, Unity, etc.). Technical skills are also needed to get precise animations of the system and printing parameters which can be modified during the pre-printing, printing, and post-printing processes to get a representative simulation game. Industry experts should also be involved in this process to ensure that the functionality of the simulation game provides realistic feedback to the students. Finally, educators and game designers should ensure that all the necessary information is provided and delivered during the game. That simulation has game elements that provide a fun experience, realistic immersion in the game world, and challenges that students need to overcome to finish the game. Developers could provide a proper system for evaluating and assessing student progression.

REFERENCES

Abt, C. C. (1987) Serious Games. University Press of America.
Deshpande, A. A., & Huang, S. H. (2011) Simulation games in engineering education: A state-of-the-art review. Computer applications in engineering education. 19 (3), 399-410.
Gómez, R. L., & Suárez, A. M. (2021) Gaming to succeed in college: Protocol for a scoping review of quantitative studies on the design and use of serious games for enhancing teaching and learning in higher education. International Journal of Educational Research Open. 2, 100021. Available from: doi: https://doi.org/10.1016/j.ijedro.2020.100021
Ke, F. (2009) A qualitative meta-analysis of computer games as learning tools. Handbook of research on effective electronic gaming in education. 1-32.
Launonen, R., Kinnunen, T., Kuusisto, M., & Vainikainen, I. (1996) Simulation and Hypermedia-The Key to Education. In: Technical Association of the Graphic Arts, TAGA, pp. 666-676.
Mayer, R. (2014) Computer games for learning. Cambridge, MA: MIT Press.
Ochoa, A. (1969) Simulation and gaming: Simile or synonym? Peabody Journal of Education. 47 (2), 104-107.
PrintSIM. (2022) PrintSIM Standard. Available from: https://printsim.com/product/ [Accessed 9th august 2022]
Sinapseprint. (2017) Print simulators. Available from: http://www.sinapse-print.com/-Simulators-11- [Accessed 9th august 2022]

ACKNOWLEDGMENTS

This research (paper) has been supported by the Ministry of Education, Science and Technological Development through the project no. 451-03-68/2020-14/200156: “Innovative scientific and artistic research from the FTS (activity) domain”.