Siirt Journal of Education

Research Article | Application Date: 30.07.2024 | Acceptance Date: 28.12.2024

Examination of Educational Digital Video Games on the STEAM Game Distribution Platform

Şehmus FİDAN[1]
Ömer Ali KARAMAN[2]
Abdullah YILDIRMAZ[3]

Abstract

STEM education is an interdisciplinary approach that integrates science, technology, engineering, and mathematics, aiming to enhance students' problem-solving and critical thinking skills. Digital games are considered effective tools for STEM education due to the interactive and engaging environments they provide. Specifically, simulation and problem-solving-focused digital games enable students to combine theoretical knowledge with practical applications. The purpose of this study is to evaluate the educational potential of digital game distribution platforms in the context of STEM education and to provide recommendations for integrating educational games into teaching processes. The research focuses on popular digital game distribution platforms such as STEAM, EPIC Games, and GOG, and analyzes the educational games available on these platforms using content analysis. The analysis includes details about the developers of the educational games, age ratings, prices, number of reviews, and percentage of positive reviews. The findings indicate that digital games can be effectively utilized as educational tools to support problem-solving and critical thinking skills. Furthermore, the affordability and accessibility of the games available on these platforms present significant opportunities for equitable access to education. This study highlights the potential of digital games to support interdisciplinary learning within STEM education and aims to provide practical recommendations for their effective use in educational contexts

Keywords: Digital Video Games, Science Technology Engineering Math (STEM), Game Distributions Platforms

[1] Asst. Prof., Batman University, Vocational School of Technical Sciences, Electronic and Automation Department, Batman, sehmus.fidan@batman.edu.tr, https://orcid.org/0000-0002-5249-7245
[2] Assoc. Prof., Batman University, Vocational School of Technical Sciences, Electronic and Automation Department, Batman, omeralikaraman@batman.edu.tr, https://orcid.org/0000-0003-1640-861X
[3] Asst. Prof., Batman University, Vocational School of Social Sciences, Department of Marketing and Advertising, Batman, abdullah.yildirmaz@batman.edu.tr, https://orcid.org/0000-0003-0712-7816

For citation: Fidan, Ş., Karaman, Ö. A., & Yıldırmaz, A. (2024). Examination of educational digital video games on the steam game distribution platform. *Siirt Journal of Education, 4*(2), 78-104. DOI: 10.58667/sedder.1525059

Siirt Eğitim Dergisi

Araştırma Makalesi Başvuru Tarihi:30.07.2024 Kabul Tarihi:28.12.2024

STEAM Oyun Tasarım Platformunda Bulunan Eğitsel Video Oyunlarının İncelenmesi

Şehmus FİDAN[1]
Ömer Ali KARAMAN[2]
Abdullah YILDIRMAZ[3]

Özet

STEM eğitimi, bilim, teknoloji, mühendislik ve matematik disiplinlerini birleştiren, öğrencilerin problem çözme ve eleştirel düşünme becerilerini geliştirmeyi hedefleyen disiplinler arası bir yaklaşımdır. Dijital oyunlar, sundukları etkileşimli ve motive edici ortamlar sayesinde STEM eğitimi için etkili bir araç olarak görülmektedir. Özellikle simülasyon ve problem çözme odaklı dijital oyunlar, öğrencilerin teorik olarak edindikleri bilgileri pratikle birleştirmelerine olanak sağlamaktadır. Bu çalışmanın amacı, dijital oyun dağıtım platformlarının STEM eğitimi açısından eğitsel potansiyelini değerlendirmek ve bu platformlardaki eğitici oyunların öğretim süreçlerine entegrasyonuna dair öneriler sunmaktır. Araştırma, STEAM, EPIC Games ve GOG gibi popüler dijital oyun dağıtım platformlarına odaklanmış; bu platformlardaki eğitsel oyunlar, içerik analizi yöntemiyle incelenmiştir. İncelemeler sonucunda eğitsel içeriğe sahip oyunların üretici firmaları, yaş sınırları, fiyatları, yorum sayıları ve olumlu yorum yüzdeleri gibi bilgiler analiz edilmiştir. Bulgular, dijital oyunların problem çözme ve eleştirel düşünme becerilerini destekleyen eğitsel bir araç olarak kullanılabileceğini göstermektedir. Ayrıca, bu platformlardaki oyunların uygun maliyetli ve erişilebilir olması, eğitime eşit erişim sağlama açısından önemli fırsatlar sunmaktadır. Çalışma, dijital oyunların STEM eğitimi bağlamında disiplinler arası öğrenmeyi destekleme potansiyelini vurgulamakta ve bu oyunların etkili kullanımına yönelik pratik öneriler sunmayı amaçlamaktadır.

Anahtar Kelimeler: Dijital Video Oyunları, Bilim Teknoloji Mühendislik Matematik (STEM), Oyun Dağıtım Platformları

[1] Dr. Öğr. Üyesi., Batman Universitesi, Teknik Bilimler Meslek Yüksek Okulu, Elektronik ve Otomasyon Bölümü, Batman, sehmus.fidan@batman.edu.tr, https://orcid.org/0000-0002-5249-7245
[2] Dr. Öğr. Üyesi., Batman Universitesi, Teknik Bilimler Meslek Yüksek Okulu, Elektronik ve Otomasyon Bölümü, Batman, Batman, omeralikaraman@batman.edu.tr, https://orcid.org/0000-0003-1640-861X
[3] Dr. Öğr. Üyesi., Batman Universitesi, Sosyal Bilimler Meslek Yüksek Okulu, Pazarlama ve Reklamcılık Bölümü, Batman, abdullah.yildirmaz@batman.edu.tr, https://orcid.org/0000-0003-0712-7816

Atıf için: Fidan, Ş., Karaman, Ö. A., & Yıldırmaz, A. (2024). STEAM oyun tasarım platformunda bulunan eğitsel video oyunlarının incelenmesi. *Siirt Journal of Education, 4*(2), 78-104. DOI: 10.58667/sedder.1525059

Introduction

In order to improve global education, modern educational approaches are essential for training a workforce with strong problem-solving skills, critical thinking abilities, and the ability to work effectively as a team (Çınar & Çiftçi, 2016). At this point, as an innovative educational approach, it has been studied on the STEM (Science, Technology, Engineering, Mathematics) approach since the 2000s. This educational approach is seen as important since it contributes to sustainable growth as well as scientific and technological development. STEM education adopts a holistic approach that focuses on skills such as research, problem-solving, effective communication, and design, rather than treating related disciplines separately. In STEM education, games with both educational and entertaining content play a very important place. Educators note that STEM develops the creativity and thinking skills of students (Perignat, 2019). Digital video games with educational content developed by independent producers offered on gaming platforms stand as a great opportunity for the adoption and popularization of the STEM education approach.

The STEAM platform, a leading distributor, has reported that the number of its active users has exceeded 20 million since its initial release in 2003. Similarly, access to YouTube and Twitch, which are the video publishing platforms, has also increased by 10% during the pandemic (Stephen, 2020). According to global market data, the gaming industry was valued at $162.32 billion in 2020, with projections estimating it will reach $295.63 billion by 2026 (Lynkova, 2021). Based on these data, it can be concluded that games have become an essential component of daily life, particularly for Generation Z. Although the standards for digital games remain inadequate, the rise of independent games has garnered interest from discerning players. Furthermore, certain games, such as the Blue Whale, have been identified as harmful, posing significant risks to the well-being of young individuals on a global scale (Mukhra et al., 2019). Therefore, it is very important to make choices according to age criteria in the selection of games (Bozkurt, 2014). Beyond making better use of the time, educational digital video games are both entertaining and offer important opportunities in raising individuals in accordance with the STEM philosophy in a highly creative way.

There is a limited number of articles that evaluate digital games with educational content available on the STEAM platform. Lin et al. (2018) examined the impact of positive and negative reviews during the early access phase on the development of games. Lin et al. (2019) conducted game reviews for 6,224 games available on the Steam platform, collecting and evaluating data such as positive/negative comments and playing times; however, they did not perform an educational analysis. Arnedo and Solórzano (2020) conducted a review of games available on Steam that are designed to develop basic programming skills. These games were evaluated as educational tools, focusing on their effectiveness in teaching computational thinking and enhancing coding abilities. The study concluded that the reviewed digital video games are highly suitable for educational purposes. Miljanovic and Bradbury (2018) conducted a review of 49 games based on programming skills, evaluating their educational content offerings using criteria such as accessibility, contribution to learning, and participation.

Barr (2017) demonstrated that commercial digital video games enhance students' communication and adaptability skills in higher education. Similarly, Mozelius et al. (2017) highlighted that digital video games with educational content are highly effective at balancing entertainment and educational value. Mallory (2019) explored the influence of well-designed games on cognitive learning, using Kerbal Space Program as a case study to illustrate the characteristics and impact of effective game design. Ranalli and Ritzko (2013) discussed the Kerbal Space Program game, a digital video game focused on rocket building, in the basic engineering design course for first-year engineering students. In this context, they conducted pre- and post-tests for the game they analyzed and compared the results with those from an in-class, toy-based activity. Fidan et al. (2022) reviewed educational digital games, assessing their integration into electrical engineering education and suggested curriculum enhancements.

The STEAM digital game distribution platform offers the largest selection of games with educational content. Studies conducted on STEAM distribution platform have identified various games suitable for classroom use, all aligned with the principles of STEM philosophy (Boytchev & Boytcheva, 2020; Bayas et al., 2022). The selected games possess qualities that can enhance students' creativity and deepen their subject-related knowledge. The games discussed in this article, as outlined in the subparts, are highly educational in content. Reviews collected from the STEAM platform regarding the games in question have been analyzed. Educational value of the games, their accessibility in terms of price has been examined. Additionally, information about these games, including the producer, release date, content age rating (PEGI), price, number of reviews, and percentage of positive reviews, is presented. The PEGI (Pan European Game Information) system, referenced in the previous sentence, is a video game content rating system designed to categorize games based on age restrictions and provide guidance for gamers and their parents.

Although the use of digital games in education is gaining increasing importance, the educational potential of digital game distribution platforms has not been sufficiently explored. The primary research problem of this study is to evaluate the suitability of popular digital game platforms for STEM education and provide guidance on integrating educational games into learning processes. In this context, the study aims to assess the potential of digital game platforms within the framework of STEM education. Specifically, the services offered by popular platforms such as Steam, GOG Galaxy, and Epic Games Store, along with their user engagement features, are analyzed to examine how educational games can be integrated into educational processes. STEM education is an approach aimed at fostering students' problem-solving, critical thinking, and interdisciplinary learning skills. Therefore, this research focuses on understanding whether educational digital games can contribute to the development of these skills. The significance of this study lies in shedding light on the relationship between digital game platforms and education, offering valuable guidance for educators and policymakers in selecting STEM-focused digital tools.

Literature Review and Stem Approach

Advances in science and technology have led to the development of innovative tools and methods that enhance educational experience. These advancements have not only made learning more accessible but also introduced new ways of engaging students, such as through digital platforms and interactive technologies. In addition, there is a need for new educational approaches that can foster the development of individuals with strong problem-solving skills, critical thinking abilities, and the capacity to work effectively in teams, in order to train the workforce necessary for advancing the country's economy (Çınar and Çiftçi, 2016). To cultivate qualified individuals, there has always been a need for approaches that incorporate modern educational methodologies. STEM (Science, Technology, Engineering, Mathematics), illustrated by the keywords in Figure 1, is one such contemporary approach. It is regarded as significant not only for fostering scientific and technological advancements but also for contributing to sustainable growth. STEM education emphasizes a holistic methodology, focusing on essential skills such as research, problem-solving, effective communication, and design, rather than treating these disciplines in isolation. STEM education aims to develop students' knowledge and problem-solving skills by providing them with an interdisciplinary perspective on various problems.

It is predicted that the STEM education system, supported by four different fields in both academic and professional terms, will gain momentum and become more widespread. STEM was initially developed with a non-educational focus. However, its growing integration into the field of education has necessitated significant reforms in this area. The increasing number of students choosing STEM subjects in high school and higher education has further emphasized the need to provide STEM-related education (Office of the Chief Scientist, 2013).

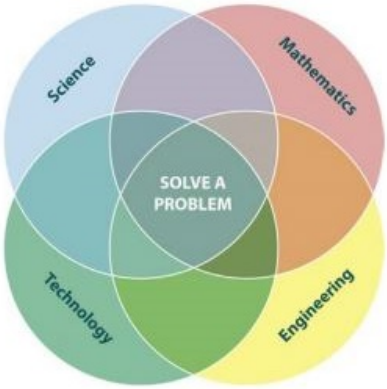


Figure 1. STEM keywords

Globally, education and training systems are continuously adapting to ever-changing political, social, and economic conditions. Over the past decade, these efforts have increasingly focused on STEM. The concept of STEM was first introduced by the National Science Foundation in the United States in the late 1990s. Initially, it was referred to as SMET; however, due to negative feedback, the term was rebranded as STEM (Sanders, 2009; Williams, 2011).

STEM's agenda primarily focuses on professional and economic priorities, aiming to equip individuals with the skills needed for a rapidly changing workforce and to drive innovation in key industries. (Williams, 2011). These goals have been funded by governments and heavily supported by politicians. The most effective way for England to remain competitive in the era of globalization is by focusing on high-value goods, services, and industries (Sainsbury, 2007, p.3). The European Commission has been focusing on STEM-centered policies since the 1990s. Similarly, several Asian countries with significant potential in education systems and economic performance—such as Korea, Japan, China, and Taiwan—have developed comprehensive national policies centered on science and technology. These countries have also undertaken university and industry-focused research and development initiatives to further their advancements in these areas.

Several international organizations place significant emphasis on STEM-related issues, establishing a global focal point for collaboration and development. Notable organizations such as the Organization for Economic Cooperation and Development (OECD), the World Bank, UNESCO, the European Union, and the International Association for the Evaluation of Educational Achievement (IEA) play a significant role in advancing STEM education (Marginson et al., 2013). Efforts by both the private and public sectors to drive societal progress have heightened the demand for individuals with STEM skills and competencies (Rothwell, 2013). However, despite these positive developments, many countries face challenges in achieving the desired success in STEM education. Research on this topic identifies two primary reasons for the lack of success in STEM education:

1) Structure of the curriculum in schools

2) Skill levels or training of educators who will provide STEM-related training or education.

However, some countries are taking significant steps to address challenges related to the lack of success in STEM education. For instance, Australia is shifting from state-based and outcomes-focused curricula to a unified national curriculum. Regarding the second factor influencing success, it is essential to focus on educators by developing subject-specific preparation programs for those who will receive STEM education. Creating an educational environment integrated with STEM seems valuable in terms of the potential gains of education. First, this education prioritizes a constructivist pedagogy, original learning, and the student-centered approach. Secondly this education enhances individuals' creativity through an interdisciplinary approach that encourages both educators and students to expand beyond their specific fields (Pitt, 2009). Moreover, this approach provides opportunities to students to adapt to the 21st century by giving them some abilities such as the ability to adapt, complex communication,

social skills, problem-solving, self-government, self-development, and the ability to develop systems (Bellanca and Brandt, 2010).

Performing extracurricular activities for students is now becoming an integral part of informal educational environments. Studies show that creating informal activity environments offers engineering students a fun way to engage with all aspects of engineering. Reviewing the literature on extracurricular activities, one often encounters the terms 'game' and 'entertainment' (Martin et al., 2018). Educational games have long been centered on fostering the development of children (Piaget, 1945; Vygotsky, 1978). Research suggests that educational computer games can enhance students' interest in learning (Ebner & Holzinger, 2007; Malone, 1980) while also providing significant learning motivation (Burguillo, 2010; Dickey, 2011). Furthermore, these games contribute meaningfully to the development of both cognitive and social skills among students (Harris & Reid, 2005).

With the rapid advancement and widespread adoption of computer and communication technologies, it is expected that technology-based learning approaches will continue to evolve. Educational computer games are anticipated to play a pivotal role in shaping future educational practices. Integrating computer games—widely popular among today's youth—into educational processes offers a promising way to create engaging learning environments that not only capture students' attention but also enhance their success through active learning. For this reason, this study assumes that the use of educational digital games, which are believed to enhance students' knowledge, skills, and motivation to learn in educational environments, will be beneficial. It is believed that as technology becomes more integrated into STEM education, the educational functions of games in the fields of science, technology, engineering, and mathematics should be emphasized alongside their entertainment value.

Method And Platform Analysis

In this study, the characteristics of digital game distribution platforms were analyzed using descriptive content analysis and case study methods. Prominent platforms, including Steam, GOG Galaxy, and Epic Games Store, were selected based on criteria such as popularity, user base size, and the inclusion of educational games in their libraries. These platforms were examined by comparing their service offerings and user engagement metrics. Specifically, the Steam platform was analyzed in detail through a case study approach, focusing on its extensive game library and the integration of educational games into teaching practices. Educational games were selected based on criteria such as user feedback, PEGI age ratings, content features, and game genres. Data collection tools were employed to investigate the characteristics of digital game distribution platforms and the use of educational games. Data were gathered from official platform websites and literature reviews, then analyzed using thematic content analysis. Validity was ensured by utilizing data from reliable sources, while reliability was maintained through systematic cross-checking and iterative verifications. These methodological approaches provided valuable insights into the potential of digital game platforms for STEM education and contributed to the development of recommendations for integrating educational games into classroom settings.

Platforms History and Analysis

Digital game platforms are significant because they offer a variety of advantages to their users. In this context, an effective platform should also include features such as creating an infrastructure for users' comments and feedback and allowing them to add/remove other players as friends. Additionally, platforms should include essential game-related information, such as release dates, language options, version updates, and current pricing details (Valve, 2021b). Furthermore, from a research perspective, the availability of statistical information and game-related performance indicators on digital distribution platforms is expected to facilitate the integration of these games into educational contexts, particularly within the framework of STEM education. To achieve this, platforms should present statistical data, including player age demographics, gameplay durations, player leveling systems, and detailed information about game types and content (Lin, 2019).

Steam is a digital game distribution platform developed by Valve Corporation in 2003. Steam is important since it is the first platform in order to access PC gaming software and to purchase games digitally. After the first release of Counter-Strike Version 1.4 on the platform, Steam has turned into a huge platform, where more than a hundred new games are added per month today. Compared to its competitors, no platform matches the scale of Steam. Its extensive library, which includes approximately 30,000 games, including independent titles, underscores its immense size and influence (Valve, 2021a). Figure 2 provides a screenshot of the Steam game distribution platform.

Figure 2. A screenshot of the STEAM platform

GOG Galaxy was first designed to present old computer games that were hard to find and purchase and was published by CD Project in 2008. The Platform offers an environment for playing especially older games. Nowadays, GOG is no longer limited to retro games; there are also a large number of modern and independent games in its showcase (Gog, 2008). The Epic Games Store was developed by Epic Games to compete with Steam and published in 2018. However, it remains a platform with a relatively limited selection of games. Despite its smaller library, Epic Games Store has experienced rapid growth due to the success of titles such as Unreal Engine and Fortnite (Epic Games, 2018). According to reviewers, the store has several problems in terms of usage since it does not have any filter options and a storage unit containing types.

Itch.io, launched in 2013, is a platform designed to facilitate the management of standalone game uploads. It aims to provide innovative and independent games for users seeking alternatives to mainstream offerings in the gaming industry. The platform allows users to search using popular tags, filter by price range, and engage with a vibrant discussion community. Itch.io is particularly well-suited for discovering small, independent games (Itch.io, 2013). Origin is an exclusive game client platform of Electronic Arts (EA). Those who want to play a modern EA Game must install this client (Origin, 2011). Another platform, Battle.net, offers a special interface for online distributions of globally large games (Blizzard, 2017). This platform has been presented as a necessity for the games of Blizzard Company. Regarding this necessity, players have stated that it is inconvenient to necessarily register to play games.

UPlay, developed by Ubisoft, serves as a platform for playing Ubisoft games. Acting as a social hub, UPlay features a reward system where players can earn benefits either by completing tasks or through paid options. Even if most games are purchased via Steam, an Uplay account must be created to play the games. The platform's special discounts, free play periods, and opportunities to try games have contributed to its rapidly growing user base (Ubisoft, 2009). The Humble Store, which is better known on the market as Humble Bundles, comes to the fore with collections of games that follow a specific theme and are usually offered with a high discount. The platform first started with the ‘pay as you like’ system, where a large number of games can be found, and revenues earned from games are donated to charities. E-books, royalty-free music and various software for creators, or stand-alone games

can also be purchased in the Humble Store. The Humble Store also offers different content than the games offered on the Steam platform (Humble, 2010). In addition to the platforms mentioned above, there are also platforms such as Bethesda Launcher, Green Man Gaming, and Fanatical. Fanatical in particular sells e-books and educational materials in addition to games (Hearn, 2020).

It has been observed that although digital game distribution platforms have introductions stating that games are educational, more detailed classification is not made. For educators who want to use the games examined in the later parts of the article as a supporting element in education, providing a solution to this situation by making the platforms suitable to STEM philosophy is seen as an important issue in the research. In this regard, the in-game leveling system can be designed to match a grading system in educational institutions, or the game platform can do a study related to this. In classroom gaming, entertainment is not the first goal, but the secondary goal. For this reason, it is important that game platforms and digital games are available in schools within certain standards. Regarding this, there is no clear standard for the use of independent digital video games in the classroom. The STEAM platform, which has the largest library, offers 22 of the specified 24 games with educational content. Therefore, in the following sections, comments were made by collecting data presented through the STEAM.

Content Analysis of Educational Games

When classifying games on platforms, categories such as puzzle, arcade, simulation, and role-playing are commonly used. In the game reviews conducted as part of this study, the classification(s) to which each game belonged were identified. Additionally, in line with the purpose of the study, it was important to establish a classification system specifically for educational purposes. Consequently, the games were categorized into seven groups: construction-based, electronic design-based, factory setup and optimization-based, software development-based, mechanical design-based, physics and chemistry-based, and management-based.

Construction-Based Games

Poly Bridge, developed by Dry Cactus, is a game centered on building durable bridges to facilitate vehicle passage. Players use various materials such as asphalt roads, steel beams, wooden support columns, ropes, and hydraulic systems to achieve specific objectives. The game can be thought of as a puzzle game aiming to develop individuals' building skills and imagination. The game, first released on July 12, 2016, Poly Bridge is particularly suitable for academic disciplines that include statics courses but has also attracted a wide audience due to its entertaining nature. The game has received 10,295 customer reviews, 92% of which are positive. Figure 4 provides a screenshot of the Poly Bridge game, while Figure 3 illustrates its content in greater detail (Steam, 2016a).

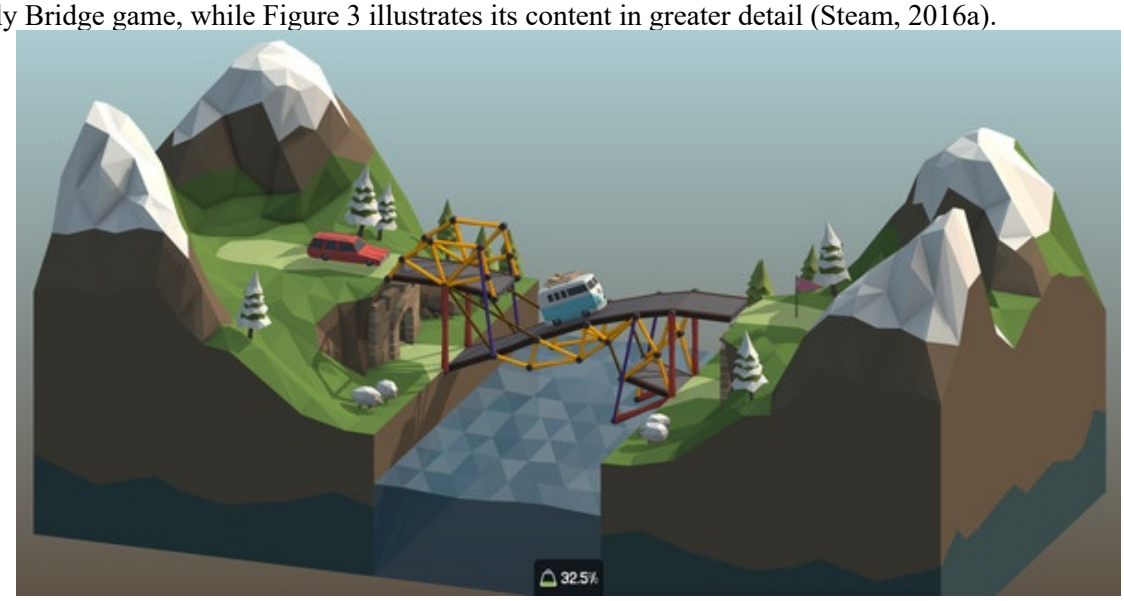


Figure 3. A screenshot of the Poly Bridge game

Electronic design-based games

In the Shenzhen-IO game, players can design circuits using various components, including microcontrollers, memory modules, logic gates, and LCD screens. The game features a compact and powerful assembly-like programming language, allowing players to write code with conditional execution for each command. Customer reviews indicate that the game requires a foundational understanding of circuit design, does not appeal to all types of players, and places significant emphasis on design and document interpretation (West, 2016).

The Hardware Engineering game is defined as a simplified digital circuit design game that could be used in departments related to electrical and electronics. In Hardware Engineering, which is defined in the open-ended game type, freedom is provided by leaving the progressing to people thanks to its non-linear design. This flexibility encourages the use of different methods to solve problems, making the game valuable for developing engineering skills. In this context, the game holds significance for its alignment with these qualities. Initially released on September 29, 2016, the game remains in its development phase. Data from the Steam store reveal that 55% of the 166 customer reviews are positive. However, some reviews highlight criticisms regarding the game's incompleteness and the presence of bugs (Steam, 2016b). However, despite the criticisms, as an idea, it seems appropriate to be used as additional material in the electrical-electronics and computer departments.

Silicon Zeroes is a game that has the potential to meet goals such as designing complex electronic circuits (e.g., basic components, doors, and collectors) included in the curriculum of a digital electronics course. Players begin the game as a start-up company in Silicon Valley during the 1960s and advance by completing various projects. At higher levels, the game introduces more advanced tasks, such as CPU design, providing opportunities for deeper engagement with circuit design principles. In an educational context, Silicon Zeroes can serve as supplementary material or an assignment in electrical, electronics, or computer engineering programs. Player reviews indicate that the game is both highly popular and regarded as educational. Notably, feedback suggests that even individuals without a professional background in the field gained valuable insights into digital design concepts through the game (Steam, 2017a). To provide further context, a screenshot of Silicon Zeroes is presented in Figure 4.

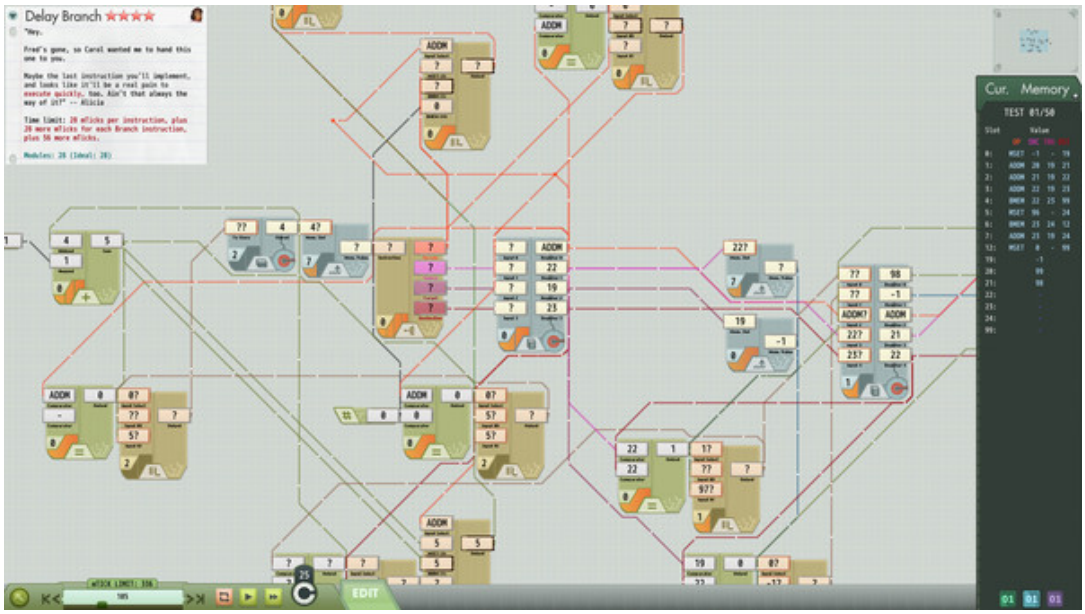


Figure 4. A screenshot of the Silicon Zeroes game

PC Building Simulator is a game developed on performing tasks such as repairing computers that have power supply failing, motherboard problems, and whose video card has burned in accordance with orders received via email. The data obtained through the Steam store showed that 94% of the 24912 customer reviews were positive. Reviews indicate that players can learn about many components and

concepts used in computer hardware through gameplay (Steam, 2019a). Released on January 29, 2019, the game is particularly suitable for students in electrical, electronics, and computer engineering programs. Given its educational content, PC Building Simulator aligns well with the philosophy outlined in this study. Figure 5 provides a view of the workspace interface in the PC Building Simulator game, as purchased through Steam.

Figure 5. A view of the working environment in the PC Building Simulator game

Factory Setup and Optimization-Based Games

Infinifactory is an open-ended puzzle game developed by Zachtronics, which has designed many games that can be used for educational purposes. The game is basically built to design factories that bring together products for alien overlords. Players could optimize their solutions and compare their designs with those of other players, allowing for further refinement and improvement. Reviews of the game indicate that it is particularly valuable for its focus on factory automation and puzzle-solving skills (Steam, 2020a). This combination of creative problem-solving and optimization makes Infinifactory a notable example of a game with potential applications in educational contexts.

Factorio is an elegantly designed game centered on factory layout and production-based survival, incorporating elements such as resource management and assembly. The game features a unique storyline in which the player, stranded on an alien planet due to a spaceship crash, must build and optimize factories to find a way to escape. There are reviewer comments indicating that the game is creative for planning and industrial engineers (Fitzgerald, 2016).

Software Development-Based Games

Hacknet can be described as a hacking simulation that is terminal-based, has an immersive story and enables the uncovering of mental abilities. The tasks within the game are described as enjoyable, logical, and engaging (Eş, 2015). While the game carries a 16+ age restriction and includes mission scenarios that could be considered sensitive, it holds potential as a training tool for "white hat hacker" education by simulating real-world challenges. Reviews about the game indicate that, beyond providing insights into hacking, the game is also regarded as intellectually stimulating and thought-provoking. TIS-100 is another game created by Zachtronics. It is an open-ended programming game in which corrupted code sections are rewritten to repair TIS-100 and to unravel its secrets. In the game, there are many tasks that are available in the content of digital electronics courses, from the logic collection operation to complex digital circuit design operation. In the customer reviews, the difficulty of the stages of a processor-designing and the need to read a significant amount of user documentation to overcome these stages have been mentioned (Steam, 2015a).

EXAPUNKS is another open-ended puzzle game developed by Zachtronics and based on the story of an old hacker. In the game, tools called EXA can be modified to break up networks, duplicate themselves, destroy files, terminate other EXAs, and leave without a trace. Banks, universities, factories, TV stations, highway signs, and many other places can be hacked in the game. In customer reviews related to the game, it has been noted that the game is a puzzle-solving game by writing code, is difficult, and is not suitable for everyone (Macgregor, 2018).

While True: Learn is a unique game for individuals interested in learning the fundamentals of machine learning and related technologies. According to its Steam description: "You're a machine learning specialist who makes neural networks, but your cat seems to be better at it. Now you must solve puzzles to build a cat-to-human translation system (who knows what else this cat is capable of!). Earn a fortune, buy kickass cat outfits, and learn how machine learning really works!" The game is based on real-life machine learning technologies, such as expert systems and recurrent neural networks (RNNs). While it does not comprehensively cover machine learning topics, reviews indicate that it provides a helpful introduction to understanding the overall concepts. The game has received highly positive reviews for its engaging and educational approach (Steam, 2019b). Figure 6 presents a screenshot of the While True: Learn game.

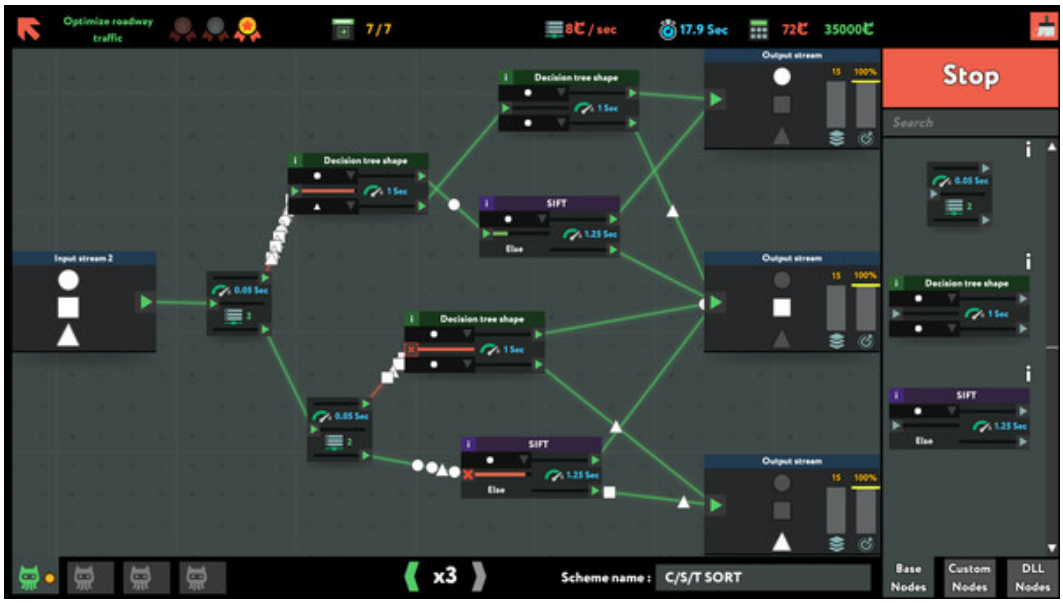


Figure 6. A screenshot of the While True Learn game

Comet64, released in 2021, is described as a puzzle game centered on programming. The positive feedback rate of the game, which has received 51 reviews yet, is 90%. Especially for students studying in departments where basic programming skills are required, it is possible to recommend the comet 64 game. Beyond just passing the course, solving mysteries in the in-game scenario and getting on the leaderboard can be shown as important factors for motivation (Steam, 2021a).

Mechanical design-based games

Car Mechanic Simulator, as illustrated in Figure 7, is a simulation game series that combines entertainment with teaching the fundamentals of vehicle mechanics. The game provides players with a wide range of tools and mechanisms for repairing vehicles. In the assigned tasks, some customers explicitly state which parts are problematic, while others only describe the general issue, leaving it up to the player to identify the faulty components. Customer demands and vehicle issues are highly variable, ranging from problems with tires, brakes, and suspension to engine-related issues, covering virtually every conceivable part of a vehicle. Reviews indicate that the game is widely appreciated, with many players finding it both enjoyable and highly educational. This game is particularly well-suited for use in fields such as mechanical engineering and automotive engineering. However, it is also accessible

to anyone with an interest in vehicles, offering an opportunity to enhance their knowledge and skills (Steam, 2017b).

Diesel Brothers-Truck Building Simulator is a game described as a truck/van-making simulator. As in the Car Mechanic Simulator game, it is possible to disassemble and assemble almost all parts of a truck. In general, those who played the game have noted that the game is quite instructive. However, as of May 10, 2019, the first release date, the positive feedback rate was 63% in 901 customer reviews since there was a lot of bugs initially, while in recent periods this rate has increased to 78% as optimization problems related to the game are solved (Steam, 2019c). The game has content that could even be a direct course as additional material in departments related to machinery and automotive.

Figure 7. A screenshot of the Car Mechanic Simulator game

LogicBots is a puzzle game in which robots are used/designed to complete challenges at various levels. The primary feature of the game is its focus on designing robots to solve complex logic puzzles. Once created, these robots can be controlled directly by the player or programmed to operate independently to complete tasks. Customer reviews suggest that the game resembles a simulation specifically designed for educational purposes rather than a highly imaginative or creative experience. While some players criticized its limited ability to stimulate creativity, the game still offers valuable content that can be effectively utilized in educational settings, particularly in courses related to robot design (Steam, 2017c).

Rover Mechanic Simulator is a game in which players, as a technician living in the Mars colony, undertake the repair and maintenance of the main mission reconnaissance vehicles. In the game, it is possible to disassemble the reconnaissance vehicles into the smallest parts and see the details, as well as to use many different devices such as a 3D printer, recycling machine, and soldering tool. The game received 224 reviews, with 91% positive feedback. In some of the reviews, it is stated that the game is quite educational even for machine manufacturers (Steam, 2020b).

Main Assembly is a game centered around building and testing robots on customizable platforms. In terms of fun, a wide range of robots are presented in the game. It is also possible to design test platforms in the game. In addition, the game also has educational content in terms of containing visual programming. When examining comments about the game, it was found that it has creative and entertaining content, and also forced players (Steam, 2021b).

Physics-Chemistry-Based Games

Opus Magnum is a game that invites players to master a complex alchemy engine to create a variety of products, such as vital solutions and precious stones. It allows players to design and build machines that perform alchemy operations by using a variety of components within the game, including

programmable arms, customizable pallets, and more esoteric devices such as Van Berlo's wheel and Animism Glyph. In the reviews, it is stated that all engineers should play this game and that the game is very informative about the field (Wiltshire, 2017).

Kerbal Space Program, as depicted in Figure 8, is a simulation game that brings the dream of becoming an astronaut closer to reality. NASA collaborated in the design of the game, and it is known that many astronauts and NASA employees actively play it. The game provides players with an engaging platform to explore the principles of space exploration and rocket science. Reviews highlight that some students preparing for university entrance exams reported significant improvements in their understanding of fundamental physics concepts after playing the game. Data from the Steam store reveals that 94% of the 70,344 customer reviews are positive, with recent reviews showing an even higher positive feedback rate of 96% (Steam, 2015b).

Figure 8. A screenshot of the Kerbal Space Program game

Management-Based Games

Human Resource Machine is a game designed for programming enthusiasts, particularly those intrigued by desk work and seeking an enjoyable way to learn programming. In this game, puzzles can be solved through visual programming, and logical flow and memory management can be realized. Reviews of the game highlight its ability to enhance skills in mathematics, critical thinking, and algorithm design (Steam, 2015c). 911 Operator is a simulation game where players assume the role of an emergency response officer. The game challenges players to handle calls covering a wide range of topics and to make decisions based on the nature of each situation. Beyond answering calls, players may need to coordinate emergency assistance or manage resources like the police, fire department, and healthcare professionals. More than 50 recordings have been made for this game, which is based on real calls; thus, the game contains many different scenarios (Steam, 2017d).

Hardware Engineers is a simulation game tailored towards the field of computer technology. In order to be successful in the game in areas such as economy, reputation, sales strategy and communication, you can work with a large number of components such as processors, graphics cards, and RAM with realistic and balanced features. When the customer reviews are examined, it is understood that not only collecting computers but also many works such as installing software and repairing operations can be done in the game (Steam, 2019d). Therefore, it can be said that the game has educational and entertaining content for Computer Science and management-based departments.

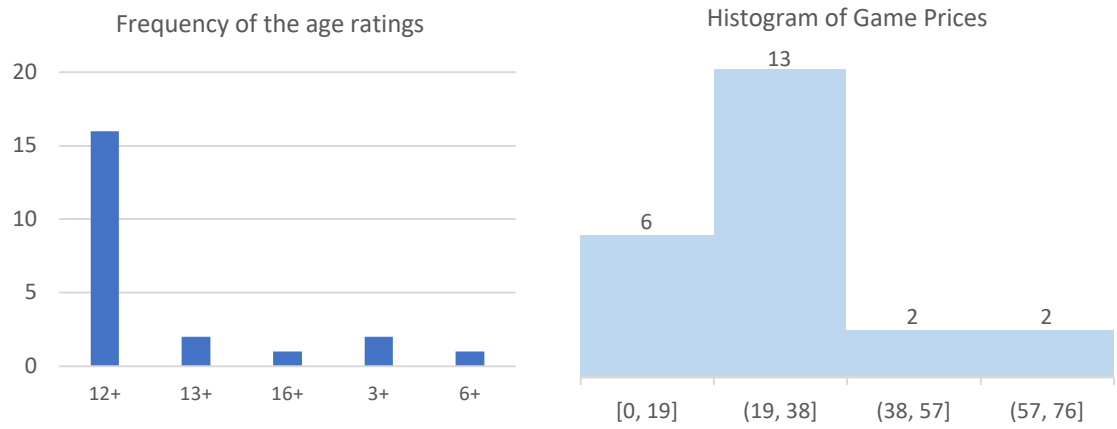
Findings And Results

Table 1 provides information on the producers, release dates, age ratings, and prices of games identified as aligned with the STEM philosophy. Among the producers, Zachtronics is the company that produces the most games among producers. The data reveal that most of the games were developed between 2015 and 2017. Specifically, 13 games were released during this period, 6 games between 2017 and 2019, and 4 games between 2019 and 2021. This trend indicates a decline in the production of educational games in recent years. It is suggested that the market for educational games could be revitalized if these games were actively incorporated into school curricula, emphasizing their alignment with educational objectives. This integration has the potential to reshape the market by demonstrating the value of these games as effective educational tools.

Table 1. Game name, producer, release date, age rating and price information

Game name	Producer	Release Date	Age Rating	Price ($)
Car Mechanic Simulator	PlayWay S.A.	28 Jul 2017	3+	3.87
Hacknet	Team Fractal Alligator	13 Aug 2015	16+	2.31
TIS-100	Zachtronics	20 Jul 2015	12+	1.62
Infinifactory	Zachtronics	30 Jun 2015	12+	4.87
Shenzen-IO	Zachtronics	17 Nov 2016	12+	3
EXAPUNKS	Zachtronics	22 Oct 2018	12+	4
Opus-Magnum	Zachtronics	7 Dec 2017	12+	4
Human Resource Machine	Tomorrow Corporation	15 Oct 2015	6+	3.12
While True Learn	Luden.io	17 Jan 2019	13+	6.28
Factorio	Wube Software	14 Aug 2020	13+	6.25
LogicBots	Incandescent Games	8 Feb 2017	3+	3.87
Hardware Engineers	Green127	8 Feb 2017	12+	3.12
911 Operator	Jutsu Games	24 Feb 2017	12+	3
Hardware Engineering	Pb Studios	29 Sept 2016	12+	1.31
Silicon Zeroes	PleasingFungus Games	29 Sept 2016	12+	3
PC Building Simulator	Claudiu Kiss	29 Jan 2019	12+	4
Kerbal Space Program	Squad	27 Apr 2015	12+	7.37
Poly Bridge	Dry Cactus	12 Jul 2016	3+	2.31
Diesel Brothers	Code Horizon	10 May 2019	12+	1
comet 64	What sorceress this	5 Feb 2021	12+	3.12
Rover Mechanic Simulator	Pyramid Games	12 Nov 2020	12+	2.56
Main Assembly	Bad Yolk Games	26 Jan 2021	12+	7.5

Figure 10a provides information on the age suitability of the games analyzed. According to the data, 69% of the games are rated suitable for ages 12+, 8% for ages 13+, and 4% for ages 16+. In addition, a child who is 13-year-old can play 96% of these games. Thus, it can be said that these games, which are stated to be educational, are suitable for children to play. Figure 10b gives information about the prices of the games. When these data are examined, it is observed that the games remain mainly below $5. Given that new games with high-end graphics are released at prices of $ 80-100, these prices can be said to be quite reasonable. The prices of these games indicate that educational games are particularly accessible and affordable for younger age groups. Moreover, the reasonable prices of educational games make it much easier for schools to access them.



(a) (b)

Figure 10. Age frequency (a) and price information (b) of the games

Table 2. Number of reviews, percentage of positive reviews, game classification, and education level

Game name	Number of reviews	% of positive reviews	Game Classification	Minimum Education Level
Car Mechanic Simulator	31164	%89	Mechanical design based	Middle School
Hacknet	10863	%93	Software development based	Middle School
TIS-100	2564	%97	Software development based	High School
Infinifactory	1459	%95	Factory setup and optimization based	High School
Shenzen-IO	2324	%96	Electronic design based	High School
EXAPUNKS	838	%96	Software development based	High School
Opus-Magnum	3154	%97	Physics-Chemistry based	High School
Human Resource Machine	2050	%94	Management-based	High School
While True Learn	4460	%92	Software development based	High School
Factorio	88822	%98	Factory setup and optimization based	High School
LogicBots	146	%82	Mechanical design based	High School
Hardware Engineers	267	%86	Management-based	High School
911 Operator	921	%88	Management-based	High School
Hardware Engineering	166	%55	Electronic design based	High School
Silicon Zeroes	185	%95	Electronic design based	High School
PC Building Simulator	24912	%94	Electronic design based	High School
Kerbal Space Program	70344	%96	Physics-Chemistry based	High School
Poly Bridge	10295	%92	Build-based	Middle School
Diesel Brothers- Truck Sim.	901	%78	Mechanical design based	Middle School
Comet 64	51	%90	Software development based	High School
Rover Mechanic Simulator	224	%91	Mechanical design based	Middle School
Main Assembly	397	%93	Mechanical design based	High School

Table 2 provides an overview of the game producers, the number of reviews, the percentage of positive reviews, game classifications, and the recommended education levels for each game. While some games can be categorized into multiple classifications due to their diverse features, they have been assigned to the most relevant class based on their primary gameplay mechanics and objectives. The recommended education levels listed in Table 2 were determined by assessing students' knowledge in areas such as mechanical, electronic, and software-related topics. These recommendations also take into account the courses students have completed in these fields, ensuring that the games align with their academic background and learning needs. This categorization helps identify the most suitable games for specific educational contexts. The terms 'Middle School' and 'High School' are used to provide a general categorization of the educational levels where the games can be effectively utilized. These categorizations are based on the expected cognitive and technical skills required to engage with the content of each game. While 'Middle School' corresponds to students typically aged 10-14, 'High School' refers to those aged 15-18, aligning with the general education system's grade levels and curriculum focus.

Games such as Car Mechanic and Rover Mechanic Simulator are accessible and can be effectively played at the middle school level, contingent upon students' interests. However, for these games, the often-assigned 12+ age rating primarily reflects the degree of violence in the game rather than the cognitive skills required to solve in-game challenges. Another critical aspect of age ratings is whether the mental abilities necessary for problem-solving in these games have developed. In Turkey, the age range for middle school education is defined as 10-14 years. Therefore, it can be inferred that the cognitive abilities required to engage with these games typically develop after the 3rd grade of middle school. Educational video games are generally more challenging than games designed purely for entertainment. For instance, electronic design-based games require not only problem-solving skills but also a foundational understanding of electronics. As such, students must be at least in the 2nd grade of high school to effectively engage with these games. Due to their complexity and reliance on specific technical knowledge, these games are particularly well-suited for students in the 3rd or 4th grades of vocational high schools or those pursuing associate degrees.

Although conducting a market survey to determine the number of games sold is crucial, many companies treat such information as a trade secret. As a result, while game reviews on STEAM can provide some insight into sales figures, it is not possible to make definitive interpretations. As shown in Figure 11, Factorio, Kerbal Space Program, and Car Mechanic Simulator have received 88,822, 70,344, and 31,164 customer reviews, respectively, indicating that these games are both widely played and preferred. However, when compared to the review counts of some of the best-selling games, such as GTA 5 with 939,113 reviews (Steam, 2015d) and PUBG with 1,404,394 reviews (Steam, 2017e), it becomes evident that games with educational content occupy a more niche position. These figures suggest that while educational games attract a considerable audience, they remain overshadowed by games featuring violent, war-related, or crime-based content, which are significantly more popular among the broader gaming community. This disparity highlights the challenge of promoting educational games to a wider audience.

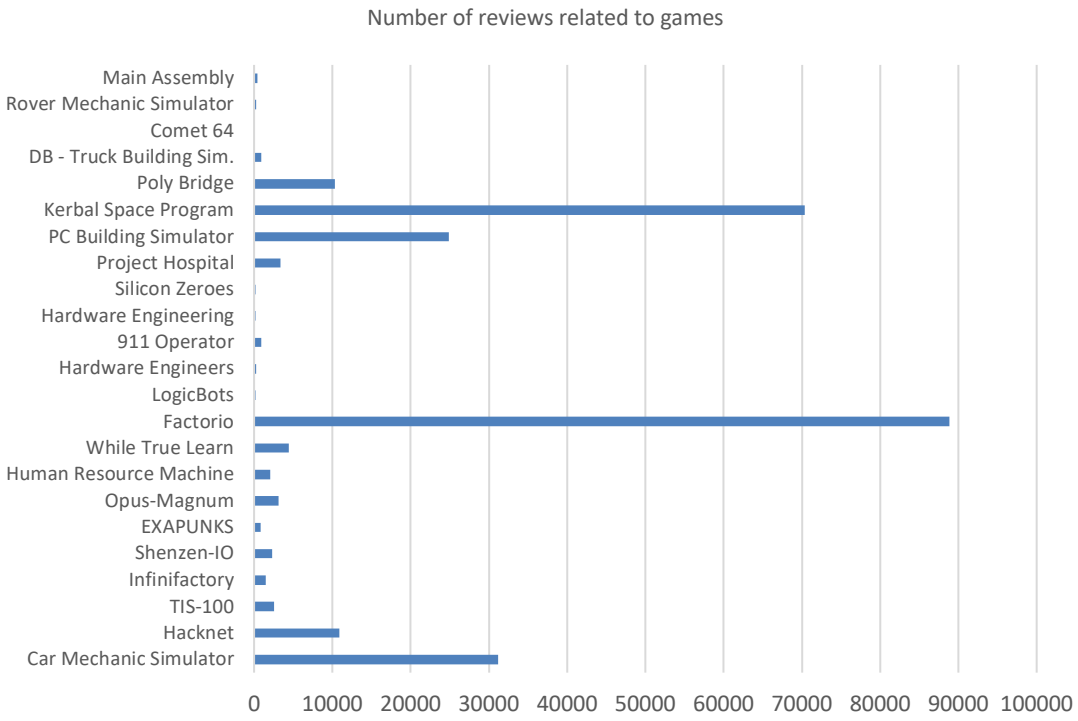


Figure 11. Number of customer reviews

Data obtained from the Steam gaming platform also provide insights into the positive feedback percentages for educational games, as shown in Figure 12. Players who prefer educational games generally intend to engage with them seriously, which explains the predominance of positive reviews. Negative feedback is typically limited to complaints about structural issues within the game, excessive difficulty, lack of accompanying educational materials, or optimization problems. Customer reviews cited in the section discussing the introduction of digital games are particularly valuable for understanding the educational impact of these games. The positive feedback percentages chart reveals a high level of satisfaction, with total satisfaction exceeding 90%, even when considering Hardware Engineering, which is included in the analysis. This trend underscores the strong reception and perceived value of educational games among their target audience.

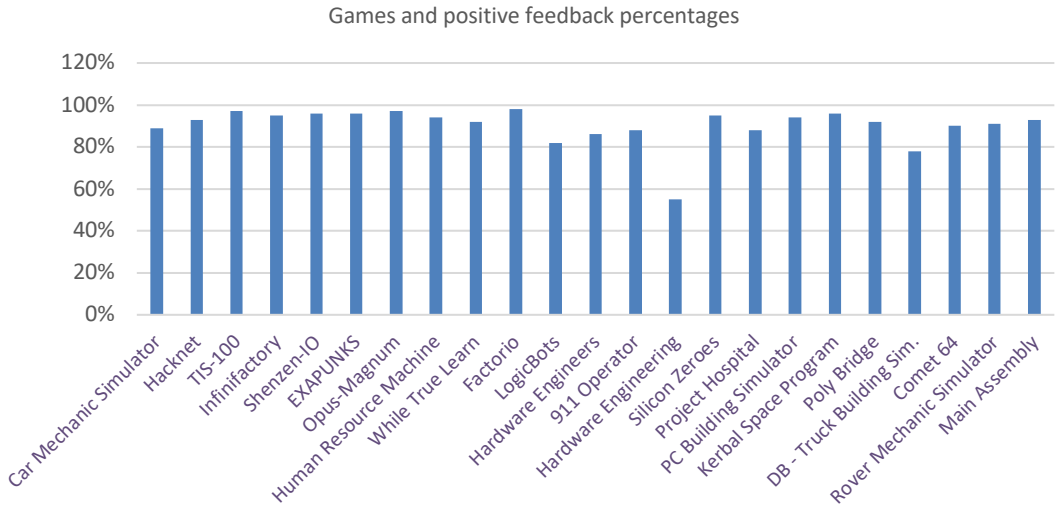


Figure 12: Games and positive feedback percentages

In conclusion, the data indicates that educational games are both affordable and highly regarded by players, as evidenced by their positive reception. However, a noticeable decline in their production in recent years highlights a growing need for revitalization in this genre. Integrating these games into school curricula could not only stimulate the market but also increase their adoption and effectiveness as educational tools, thereby leveraging their full potential in enhancing learning outcomes.

DISCUSSION

The findings of this study provide valuable insights into the educational potential of digital game distribution platforms within the context of STEM education. Specifically, the analysis of popular platforms such as STEAM, EPIC Games, and GOG demonstrates how these platforms can integrate educational games into teaching practices. The results align with previous research emphasizing the importance of digital games in enhancing problem-solving and critical thinking skills (Yang, 2012; Checa-Romero, 2016; Behnamnia et al., 2020; Mao et al., 2021; Xu et al., 2023; Akramova et al., 2024).

In addition to studies highlighting the effectiveness of digital games in education, critical perspectives can also be found in literature (Gros, 2003; Freitas, 2018; Hussein et al., 2019). These studies suggest that if digital games are not sufficiently aligned with curriculum objectives, they may become a source of distraction, thereby reducing learning effectiveness (Chen & Hwang, 2014). The results of this research emphasize the necessity of structured integration of digital games into curricula to maximize their educational impact.

This study underscores the potential of digital games to support interdisciplinary learning in STEM education. Educational games can create immersive and interactive learning environments that facilitate the practical application of scientific and mathematical concepts. For example, simulation-based games bridge the gap between theoretical knowledge and real-world applications, enabling students to gain experience in a risk-free environment.

Moreover, the educational games observed in this study are characterized by affordability and accessibility, providing opportunities for equitable access to quality education. This is particularly important for socioeconomically disadvantaged groups with limited access to traditional educational resources. Platforms like STEAM contribute to the democratization of STEM education tools by offering educational games at relatively low costs. However, several challenges exist regarding the integration of digital games into STEM education. First, the lack of standardized evaluation criteria for educational games complicates educators' efforts to identify high-quality resources. Additionally, this study focuses on three major platforms, which limits generalizability to smaller or less popular platforms. Furthermore, analyses based on user feedback and platform data may involve potential biases. For instance, user reviews often focus on the entertainment value of a game rather than its educational content.

Conclusion

Educational computer games hold significant potential in enhancing cognitive skills and serve as a dynamic and interactive alternative to traditional educational approaches. Their effectiveness has been demonstrated, particularly in improving learning outcomes in science, technology, engineering, and mathematics (STEM) fields (Nykle et al., 2008; Gredler, 2013; Mayer, 2016; Smaldone et al., 2017; Mayer, 2019; Videnovik et al., 2020).

In this study, educational games were evaluated across seven categories. This classification was developed based on expert opinions to comprehensively address the diverse educational features of these games. A total of 22 educational games were analyzed, and their statistical data are presented in Tables 2 and 3. The findings of the study suggest that educational digital games can be effectively integrated into STEM-focused curricula, contributing to the development of students' problem-solving and critical thinking skills. Furthermore, the cost-effectiveness and accessibility of these games present a significant

opportunity to ensure equitable access to education for students from diverse socioeconomic backgrounds.

This study goes beyond presenting only statistical data, focusing on how these games can be integrated into education. For instance, recommendations have been developed regarding the use of games in classroom settings. In this context, it is suggested that educational games be directly aligned with STEM education and systematically integrated into curricula. Developing teacher guides and adapting the content of these games to align with educational programs could significantly enhance their effectiveness as learning tools.

Future research could provide suggestions for game developers on how to update their games for classroom use. In addition to their educational aspects, these games can also be evaluated as visual and musical works of art, enabling a transformation that enhances learning within the STEM framework. Redesigning games to bridge the gap between art and education could lead to a more effective learning experience.

In conclusion, the findings of this study emphasize the potential of educational digital games to enhance student achievement and promote equitable access to education. Further studies on the integration of educational games into STEM education are expected to provide valuable contributions to both research and practice.

Etik Beyannamesi

Bu çalışmada "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında belirtilen kurallara uyulduğunu ve "Bilimsel Araştırma ve Yayın Etiğine Aykırı Eylemler" başlığı altında belirtilen eylemlerden hiçbirini gerçekleştirmediğimizi beyan ederiz. Aynı zamanda yazarlar arasında çıkar çatışmasının olmadığını, tüm yazarların çalışmaya katkı sağladığını ve her türlü etik ihlalinde sorumluluğun makale yazarlarına ait olduğunu bildiririz.

References

Abt, C. C. (1970). *Serious games*. The Viking Press.

Adams, E., & Rollings A. (2014). *Fundamentals of game design*. Prentice Hall.

Akramova, G., Ma'murov, B., Akramova, S., Qo'ldoshev, R., & Shodmonova, A. (2024). Methods of using STEAM technologies in the development of pupils' computational thinking. *E3S Web of Conferences*. https://doi.org/10.1051/e3sconf/202453805034.

Alkan, N. (2014). Tarihin çağlara ayrılmasında "üçlü sistem" ve Türk-İslâm tarihinin çağ taksimi meselesi. *Turkish History Education Journal, 3*(2), 43-64.

Arnedo-Moreno, J., & García-Solórzano, D. (2020, November). *Programming is fun! a survey of the Steam digital distribution platform.* In 2020 IEEE 32nd Conference on Software Engineering Education and Training (CSEE&T) (pp. 1-4). IEEE.

Ata, B. (2009). Sosyal bilgiler ünitesi kavramı üzerine bazı düşünceler. *Sosyal bilgiler öğretiminde yeni yaklaşımlar* (ss. 45-56). Pegem Akademi.

Aydoğdu K., İ. (2015). *Dijital oyunlar ve dijital şiddet farkındalığı: Ebeveyn ve çocuklar üzerinde yapılan karşılaştırmalı bir analiz*. Uluslararası Sosyal Araştırmalar Dergisi, cilt 8, sayı 36.

Barr, M. (2017). *Video games can develop graduate skills in higher education students: A randomized trial*. *Computers & Education*, *113*, 86-97.

Bartle, R. (1996). *Hearts, clubs, diamonds, spades: Players who suit muds.* Journal of MUD research, 1(1), 19.

Bayas, B. W. O., Ganchozo, A., Ortiz, D., Vera, A., & Zambrano, Z. (2022). *Video game as an educational tool in primary school applying steam methodology*. Revista Iberoamericana de la Educación, 6(4).

Behnamnia, N., Kamsin, A., Akmar, M., Ismail, B., & Hayati, A. (2020). The effective components of creativity in digital game-based learning among young children: A case study. Children and Youth Services Review. https://doi.org/10.1016/j.childyouth.2020.105227.

Bellanca, J. A., & Brandt, R.S. (2010). *21st century skills: Rethinking how students learn.* Vol. 20. Bloomington, Solution Tree Press.

Blizzard (2021, February 4) *Battle.net service*. https://en.wikipedia.org/wiki/Battle.net

Boytchev, P., & Boytcheva, S. (2020*). Gamified evaluation in STEAM for higher education: A case study*. Information, 11(6), 316.

Bozgöz, A. (2017). *Ortaokul 6. sınıf sosyal bilgiler dersinde ilkçağ tarihi konularından Kadeş antlaşmasının barış eğitimi kapsamında ve öğrenci görüşlerine göre değerlendirilmesi,* Necmettin Erbakan Üniversitesi.

Bozkurt, A. (2014). *Homo ludens: Dijital oyunlar ve eğitim*. Eğitim Teknolojileri Araştırmaları Dergisi, *5*(1), 1-21.

Burguillo, J. C. (2010). *Using game theory and competition-based learning to stimulate student motivation and performance.* Computers & Education, 55, 2, 566–575.

Checa-Romero, M. (2016). Developing Skills in Digital Contexts. *Games and Culture*, 11, 463 - 488. https://doi.org/10.1177/1555412015569248.

Chen, C. H., Yang, J. C., Shen, S., & Jeng, M. C. (2007). *A desktop virtual reality earth motion system in astronomy education.* Educational Technology & Society, 10(3), 289-304.

Çınar, M., Doğan, D., & Seferoğlu, S. S. (2015, Şubat 6-8). Eğitimde dijital araçlar: Google sınıf uygulaması üzerine bir değerlendirme [Sözlü bildiri]. Akademik Bilişim Konferansı, Eskişehir, Türkiye.

Çınar, S., & Çiftçi, M. (2016). *Disiplinler arası stem yaklaşımına yönelik yapılan çalışmaların içerik analizi.* 10th International Computer and Instructional Technologies Symposium (ICITS), Recep Tayyip Erdoğan University

Crawford, C. (1984) *The Art of Computer Game Design*, 1st ed.; McGraw-Hill Osborne Media: Berkeley, CA, USA.

Dickey, M. D. (2011). *Murder on Grimm Isle: the impact of game narrative design in an educational game-based learning environment.* British Journal of Educational Technology, 42, 3, 456–469.

Ebner, M., & Holzinger, A. (2007). *Successful implementation of user-centered game based learning in higher education: an example from civil engineering.* Computers & Education, 49, 3, 873–890.

Epic Games (2018, Feb 7) *Epic Games Store.* https://www.epicgames.com/site/tr/epic-games-store-faq

Eş, F. (2015, August 15). *Hacknet incelemesi*. Fragtist. https://fragtist.com/pc/hacknet-incelemesi/

Falah, J., Khan, S., Alfalah, T., Alfalah, S. F., Chan, W., Harrison, D. K., & Chariss, V. (2014). *Virtual reality medical training system for anatomy education.* In 2014 Science and information conference (pp. 752-758). IEEE.

Fidan, Ş., Karaman, Ö. A., & Yıldırmaz, A. (2022). *Steam dijital oyun platformunda bulunan eğitici içerikli dijital oyunların elektrik-elektronik mühendisliği öğretim müfredatına entegrasyonu için öneriler.* Journal of Advanced Research in Natural and Applied Sciences , 8 (4) , 555-568 . DOI: 10.28979/jarnas.1064673.

Fitzgerald, S. (2016, January 19). Infinifactory. https://www.pushsquare.com/reviews/ps4/infinifactory

Freitas, S. (2018). Are Games Effective Learning Tools? A Review of Educational Games. J. Educ. *Technol. Soc*., 21, 74-84.

Gerardi, M., Cukor, J., Difede, J. Rizzo, A., & Rothbaum, B, O. (2010). *Virtual reality exposure therapy for post-traumatic stress disorder and other anxiety disorders*. Curr Psychiatry Rep 12, 298–305 https://doi.org/10.1007/s11920-010-0128-4

Gog (2021, February 16), *Gog about.* https://www.gog.com/about_gog.

Goncalves, R., Pedrozo, A. L., Coutinho, E. S., Figueira, I., & Ventura, P. (2012*). Efficacy of virtual reality exposure therapy in the treatment of PTSD: a systematic review*. PloS one, 7(12), e48469. https://doi.org/10.1371/journal.pone.0048469

Gredler, M. (2013). *Games and Simulations and Their Relationships to Learning*., 571-581. https://doi.org/10.4324/9781410609519-30.

Griffiths, M. D. (2002). The educational benefits of videogames. Education and Health, 20(3), 47-51.

Gros, B. (2003). The impact of digital games in education. First Monday, 8.

Harris, K., & Reid, D. (2005). *The influence of virtual reality play on children's motivation.* Canadian Journal of Occupational Therapy, 72, 1, 21–30.

Hearn, P. (2020, September 26). 8 alternatives to Steam for buying PC games online. Online Tech Tips. https://www.online-tech-tips.com/gaming/8-alternatives-to-steam-for-buying-pc-games-online/

Herbst-Damm, K. L., & Kulik, J. A. (2005). Volunteer support, marital status, and the survival times of terminally ill patients. *Health Psychology, 24*(2), 225–229.

Hock, P., Benedikter, S., Gugenheimer, J., & Rukzio, E. (2017*). Carvr: Enabling in-car virtual reality entertainment.* In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (pp. 4034-4044).

Huggins, R., & Johnston, A. (2009). *The economic and innovation contribution of universities: a regional perspective.* Environment and Planning C: Government and Policy, *27*(6), 1088-1106.

Humble (2022, February 16). *Humble bundle about*. https://www.humblebundle.com/about.

Hussein, M., Ow, S., Cheong, L., & Thong, M. (2019). A Digital Game-Based Learning Method to Improve Students' Critical Thinking Skills in Elementary Science. *IEEE Access*, 7, 96309-96318. https://doi.org/10.1109/ACCESS.2019.2929089.

Itch.io (2021, February 16). *Itch.io about*. https://itch.io/docs/general/about , (last visited: Feb 7, 2021)

Javed, J. (2020, March 29). *eSports and gaming industry thriving as video games provide escape from reality during coronavirus pandemic.* WFAA.

Johnson, C. C., Peters-Burton, E. E., & Moore, T. J. (Eds.). (2016*). STEM road map: A framework for integrated STEM education.* Routledge.

Landers, R. N., & Callan, R. C. (2011). *Casual social games as serious games: the psychology of gamification in undergraduate education and employee training.* Serious games and edutainment applications (pp. 399e423). Springer-Verlag.

Lin, D., Bezemer, C. P., & Hassan, A. E. (2018). *An empirical study of early access games on the Steam platform.* Empirical Software Engineering, 23(2), 771-799.

Lin, D., Bezemer, C. P., Zou, Y., & Hassan, A. E. (2019). *An empirical study of game reviews on the Steam platform.* Empirical Software Engineering, 24(1), 170-207.

Lynkova D. (2021, February 21) Video Game Statisticshttps://review42.com/resources/video-game-statistics/

Mao, W., Cui, Y., Chiu, M., & Lei, H. (2021). Effects of Game-Based Learning on Students' Critical Thinking: A Meta-Analysis. *Journal of Educational Computing Research*, 59, 1682 - 1708. https://doi.org/10.1177/07356331211007098.

Macgregor J. (2018, October 28), *Exapunks Review,* https://www.pcgamer.com/exapunks-review/

Mallory, S. (2019, July). *To the Moon: Kerbal space program as playful, educational experience*. In International Conference on Human-Computer Interaction (pp. 320-332). Springer, Cham.

Malone, T. W. (1980). *What makes things fun to learn? A study of intrinsically motivating computer games.* Stanford University.

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). *STEM: Country Comparisons. International comparisons of science, technology, engineering and mathematics* (STEM) education. *Australian Academy of Learned Academies (ACOLA)*.

Martin, L., Dixon, C., & Betser, S. (2018*). Iterative design toward equity: Youth repertoires of practice in a high school Maker space.* Equity & Excellence in Education, 51(1), 36–47. https://doi.org/10.1080/10665684.2018.

Mayer, R. (2016). What Should Be the Role of Computer Games in Education?. *Policy Insights from the Behavioral and Brain Sciences*, 3, 20 - 26. https://doi.org/10.1177/2372732215621311.

Mayer, R. (2019). Computer Games in Education. *Annual review of psychology*, 70, 531-549 . https://doi.org/10.1146/annurev-psych-010418-102744.

McDaniel, S. H., Salas, E., & Kazak, A. E. (2018*). The science of teamwork. American Psychologist, 73*(4), 51-104.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world.* Penguin Press.

McLaughlin M. (2017, May 23), *Codecombat review,* https://www.pcmag.com/reviews/codecombat.

Microsoft (2021, February 4) *Xbox Game Store.* http://marketplace.xbox.com.

Miljanovic, M. A., & Bradbury, J. S. (2018, November). *A review of serious games for programming.* In Joint International Conference on Serious Games (pp. 204-216). Springer, Cham.

Millî Eğitim Bakanlığı. (2023). Ortaöğretim tarih dersi (9, 10 ve 11. sınıflar) öğretim programı. https://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=1265

Milovanovic, J., Moreau, G., Siret, D., & Miguet, F. (2017). *Virtual and augmented reality in architectural design and education*. In 17th International Conference, CAAD Futures 2017.

Mozelius, P., Fagerström, A., & Söderquist, M. (2017). *Motivating factors and tangential learning for knowledge acquisition in educational games*. Electronic Journal of e-Learning, 15(4), 343-354.

Muntean, C. I. (2011). *Raising engagement in e-learning through gamification*. In Proceedings of the 6th International Conference on virtual learning (pp. 323e329).

National Cancer Institute. (2019). Taking time: Support for people with cancer (NIH Publication No. 18-2059). U.S. Department of Health and Human Services, National Institutes of Health. https://www.cancer.gov/publications/patient-education/takingtime.pdf

Newton, I. (1998). *Doğal felsefenin matematiksel ilkeleri* (A. Yardımlı, Trans.). İdea Basım Yayın.

Nykl, S., Mourning, C., Leitch, M., Chelberg, D., Franklin, T., & Liu, C. (2008). An overview of the STEAMiE Educational game Engine. 2008 *38th Annual Frontiers in Education Conference*, F3B-21-F3B-25. https://doi.org/10.1109/FIE.2008.4720454.

Mukhra, R., Baryah, N., Krishan, K., & Kanchan, T. (2019). 'Blue Whale Challenge': A game or crime?. *Science and engineering ethics*, 25, 285-291.

Oblinger, D. (2004). *The next generation of educational engagement.* Journal of Intercreative Media in Education, 2004(8), 1-18.

Office of the Chief Scientist. (2013). *Science, technology, engineering and mathematics in the national interest: A strategic approach*.

Ölçme, Seçme ve Yerleştirme Merkezi. (2018). 2024 Yükseköğretim Kurumları Sınavı (YKS) kılavuzu. https://dokuman.osym.gov.tr/pdfdokuman/2024/YKS/kilavuzyks2024.pdf

Origin. (2011). Origin service. Wikipedia. https://en.wikipedia.org/wiki/Origin_(service)

Orlosky, J., Itoh, Y., Ranched, M., Kiyokawa, K., Morgan, J., & Devos, H. (2017). Emulation of physician tasks in eye-tracked virtual reality for remote diagnosis of neurodegenerative disease. *IEEE Transactions on Visualization and Computer Graphics, 23*(4), 1302-1311.

Pantling, A. (2020). Gaming usage up 75 percent amid coronavirus outbreak, Verizon reports. Hollywood Reporter. https://www.hollywoodreporter.com/news/gaming-usage-up-75-percent-coronavirus-outbreak-verizon-reports-1285140.

Perignat, E., & Katz-Buonincontro, J. (2019). STEAM in practice and research: An integrative literature review. *Thinking Skills and Creativity, 31*, 31-43.

Petkov, P., Köbler, F., Foth, M., Medland, R. C., & Krcmar, H. (2011). Engaging energy saving through motivation-specific social comparison. In *Proc conference on human factors in computing systems* (pp. 1-6).

Piaget, J. (2013). *Play, dreams and imitation in childhood* (Vol. 25). Routledge.

Pitt, J. (2009). Blurring the boundaries - STEM education and education for sustainable development. *Design and Technology Education, 14*(1), 37-48.

Ranalli, J., & Ritzko, J. (2013, October). Assessing the impact of video game-based design projects in a first-year engineering design course. In *2013 IEEE Frontiers in Education Conference (FIE)* (pp. 530-534). IEEE.

Reger, G. M., & Gahm, G. A. (2008). Virtual reality exposure therapy for active duty soldiers. *Journal of Clinical Psychology, 64*(8), 940-946.

Roberts, S. (2020, April 9). Early string ties us to Neanderthals. *The New York Times*. https://www.nytimes.com/2020/04/09/science/neanderthals-fiber-string-math.html

Rothwell, J. (2013). The hidden STEM economy. *The Metropolitan Policy Program at Brookings*.

Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals* (p. 672). MIT Press.

Schwartz, J. (1993, September 30). Obesity affects economic, social status. *The Washington Post*, pp. A 1, A4.

Smaldone, R., Thompson, C., Evans, M., & Voit, W. (2017). Teaching science through video games.. *Nature chemistry*, 9 2, 97-102 . https://doi.org/10.1038/nchem.2694.

Stephen, B. (2020). This is Twitch's moment. The Verge. https://www.theverge.com/2020/3/18/2twitch-youtube-livestreaming-streamelements-coronavirus-quarantine-viewership-numbers.

Suits, B. (1980). *The grasshopper: Games, life and utopia* (Repr., p. 178). University of Toronto Press.

Toms, O. (2019, November 6). Have you played Robocode?. Rock Paper Shotgun. https://www.rockpapershotgun.com/have-you-played-robocode

Ubisoft. (2009). Uplay ecosystem. https://ubisoftconnect.com/#ecosystem-section

Valve. (2021a). Steam stats. https://store.steampowered.com/stats/

Valve. (2021b). Steam about. https://store.steampowered.com/about/

Videnovik, M., Trajkovik, V., Kiønig, L., & Vold, T. (2020). Increasing quality of learning experience using augmented reality educational games. *Multimedia Tools and Applications*, 79, 23861 - 23885. https://doi.org/10.1007/s11042-020-09046-7.

Vygotsky, L. S. (1978). *Mind in society*. Harvard University Press.

Wong, B. (2021, March 28). A review of Codin Game as a software engineer interview prep tool. Pathrise. https://www.pathrise.com/guides/a-review-of-codingame-as-a-software-engineer-technical-prep-tool/

World Health Organization. (2018, May 24). The top 10 causes of death. https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

Xu, M., Luo, Y., Zhang, Y., Xia, R., Qian, H., & Zou, X. (2023). Game-based learning in medical education. *Frontiers in Public Health*, 11. https://doi.org/10.3389/fpubh.2023.1113682.

Yang, Y. (2012). Building virtual cities, inspiring intelligent citizens: Digital games for developing students' problem solving and learning motivation. Comput. Educ., 59, 365-377. https://doi.org/10.1016/J.COMPEDU.2012.01.012.

Extended Summary

Introduction

In the quest to enhance global education, adopting modern educational approaches is paramount, particularly those that cultivate a workforce with advanced problem-solving skills, critical thinking abilities, and strong teamwork capabilities (Çınar & Çiftçi, 2016). Among these approaches, STEM (Science, Technology, Engineering, Mathematics) education has emerged as a pioneering method, gaining significant attention since the 2000s. STEM education is vital not only for driving scientific and technological advancements but also for promoting sustainable growth. It emphasizes a holistic methodology that integrates research, problem-solving, effective communication, and design skills, rather than treating these disciplines in isolation. Within the context of STEM education, games that blend educational content with entertainment play a pivotal role in fostering students' creativity and cognitive abilities (Perignat, 2019). Digital video games, particularly those developed by independent producers, serve as an excellent medium for disseminating STEM principles. These games, widely available on various gaming platforms, present a valuable opportunity to integrate STEM concepts into mainstream education. For example, the STEAM platform, a leading distributor of such games, has reported over 20 million active users since its launch in 2003. The popularity of video-sharing platforms like YouTube and Twitch has also grown significantly, with a 10% increase in access during the pandemic (Stephen, 2020). Furthermore, the global gaming industry, valued at $162.32 billion in 2020, is projected to grow to $295.63 billion by 2026 (Lynkova, 2021). This remarkable growth highlights the critical role of games, particularly for Generation Z, solidifying their place as an indispensable aspect of modern life.

Despite their widespread popularity, digital games often lack sufficient standards, leading to significant disparities in quality. This inconsistency can result in both beneficial and harmful outcomes. While some games are intentionally designed to be educational and constructive, others, like the infamous Blue Whale game, have been linked to negative impacts on young people worldwide. As a result, selecting games based on age-appropriate criteria is essential to ensure positive experiences and outcomes (Bozkurt, 2014). Beyond entertainment, educational digital video games present valuable opportunities to foster creativity, align with the STEM philosophy, and promote the effective use of time. Research on educational digital games, particularly those offered on the STEAM platform within the STEM framework, remains limited. Nevertheless, existing studies have provided meaningful insights. Lin et al. (2018) explored the impact of positive and negative user reviews during the early access phase of game development, underscoring the critical role of feedback in improving game quality. In a subsequent study, Lin et al. (2019) analyzed 6,224 games available on the Steam platform, focusing on user comments and playtimes. Their findings emphasized the importance of addressing negative feedback for continuous game improvement. Arnedo and Solórzano (2020) reviewed programming-focused games on Steam, evaluating their potential as educational tools for teaching computational thinking and coding skills. Similarly, Miljanovic and Bradbury (2018) assessed 49 programming-based games, analyzing factors such as accessibility, learning outcomes, and user engagement. Barr (2017) demonstrated that commercial digital video games could enhance communication and adaptability skills in higher education, conducting a seven-week study to highlight their potential. On the other hand, Mozelius et al. (2017) identified challenges in balancing entertainment and educational value in digital games, using Kerbal Space Program as a case study. Their research provided actionable recommendations for game designers to improve the effectiveness and appeal of educational games. Mallory (2019) further examined the impact of quality game design on cognitive learning, showcasing Kerbal Space Program as an example of how well-designed games can seamlessly combine education and entertainment. Additionally, Ranalli and Ritzko (2013) explored the use of Kerbal Space Program in a first-year engineering design course. Their study, which included pre- and post-tests, revealed that the game significantly enhanced students' understanding of basic engineering concepts compared to traditional classroom activities.

Fidan et al. (2022) conducted a review of educational digital games to evaluate their integration into Electrical Engineering education through the application of STEM and STEAM principles. Their study provided valuable curriculum enhancement recommendations to maximize the educational potential of these games. Among the platforms offering such content, the STEAM digital game distribution platform stands out for its extensive collection of educational games. Research on this platform has identified a variety of games suitable for classroom use within the STEM framework. These games are specifically designed to enhance students' creativity and deepen their subject knowledge. The games analyzed in this article are notable for their alignment with STEM principles and their educational content. In the subsequent sections, the suitability of these games for various educational departments is examined in detail. Key information about each game, including its producer, release date, PEGI (Pan European Game Information) age rating, price, number of reviews, and percentage of positive reviews, is presented. The PEGI system, a widely recognized video game content rating system, categorizes games based on age restrictions and provides guidance for gamers, educators, and parents. In conclusion, integrating digital games into educational curricula offers a promising approach to enhancing STEM education. These games not only make learning more engaging and interactive but also help students develop critical skills required in today's workforce. By leveraging the popularity and accessibility of platforms like STEAM, educators can incorporate these tools into their teaching strategies, creating more innovative and effective learning environments.

Method

In this study, content analysis and comparative evaluation methods were employed to examine the characteristics of digital game distribution platforms. Platforms such as Steam, GOG Galaxy, and Epic Games Store were compared in terms of their services and user engagement. The Steam platform was analyzed in greater depth through a case study approach, focusing on its extensive game library and the integration of educational games into teaching practices. These methodological approaches highlighted the potential of digital game platforms for STEM education and provided practical recommendations for their use in classroom settings. Data were collected from official websites and relevant literature and analyzed using game statistics and user reviews, ensuring validity and reliability throughout the research process.

Findings

The analysis of digital game distribution platforms, including Steam, GOG Galaxy, and Epic Games Store, revealed notable differences in their services and user interactions. Among these, Steam stands out as a leading platform for integrating educational games into STEM education, thanks to its extensive game library. The study found that educational games focusing on programming, mechanical design, and problem-solving are particularly effective in enhancing students' skills in these areas. Additionally, the affordability of these games—most priced below $5—further enhances their accessibility for educational purposes. The data also showed that educational games enjoy high levels of user satisfaction, with positive review rates exceeding 90%. Although the production of educational games has declined in recent years, their potential to foster creativity, critical thinking, and problem-solving skills in students remains substantial. These findings highlight the need to incorporate educational games into curricula, leveraging their ability to promote holistic learning and equip students with essential skills for the modern workforce.

Discussion, Conclusion and Recommendations

This article examines the integration of educational games into STEM education, with a focus on the role of digital game distribution platforms such as STEAM. The COVID-19 pandemic has underscored the growing importance of these games as effective tools for educational purposes. The study categorizes educational games into seven distinct types and highlights examples like Poly Bridge and Car Mechanic Simulator, which are particularly effective in fostering skill development in areas

such as problem-solving and engineering design. Incorporating these games into educational curricula has the potential to significantly enhance student motivation and engagement in STEM subjects. Furthermore, expanding language options within these games can contribute to greater educational equity, making them more accessible to a diverse range of learners. Future recommendations include providing training programs for educators to effectively integrate these tools into their teaching practices and encouraging game developers to update and adapt their products to maximize their educational impact.