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K-12 학습자를 위한 마인크래프트 활용의 탐색적 연구

Exploring Minecraft as a Tool for Learning in the K-12 Classroom

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요 약

본 논문은 실제의 교실에서 마인크래프트를 활용한 논문을 탐색하여 그 활용의 의미를 탐색하는 것을 목적으로 한다. 이를 위해서 저자들은 교실에서 마인크래프트의 사용에 관해 연구한 문헌을 탐색하였고, 교사들이 이 게임을 학생들의 학습 경험을 위해 어떻게 통합했는지에 대한 사례를 검토하였다. 한편 게임에 대한 교사의 생각과 경험을 알아보기 위한 조사를 병행하였다. 데이터베이스 검색을 통해 수집된 문헌을 분석하여 저자들은 마인크래프트를 교육의 도구로 활용하여 학생들의 참여와 동기부여를 증가시켰음을 제시하였다. 마인크래프트의 개방성은 과학교과를 포함한 여러 교과에서 다양한 학습의 맥락에 맞추어 학습자들이 몰입되는 환경을 제공하고 있음을 사례들은 보고하고 있다. 마인크래프트를 성공적으로 학습에 통합하고 그 경험을 보급하기 위한 경험적인 연구가 축적되어야 한다. 특히 마인크래프트와 같은 샌드박스 게임으로 교사가 학습자의 학습을 도와주는 방법 및 전략을 개발할 수 있도록 많은 사례연구가 이루어져야 할 것이다.

주제어: 마인크래프트, 샌드박스, 게임기반학습

ABSTRACT

This paper aims to explore literature of Minecraft integration in real classrooms. Thus, the authors focused on the synthesis of literature on the use of Minecraft in the classroom and sought to learn real-world classroom examples of how teachers have integrated this game into their learning experiences. A survey was also conducted to explore teachers' thoughts and experiences with the game itself. Through the analysis of the collected articles, the authors report that utilizing Minecraft as an educational tool can lead to increased engagement and motivation for the students involved. Minecraft's openness allows for tailoring learning experiences to various contexts, including the science classroom. Further study is warranted in this area for teachers to continue to learn about and document successful integration of Minecraft into their classroom teaching. It is proposed that more empirical studies should be done to increase the available amount of literature on this topic, especially regarding teacher experiences in learning how to utilize Sandbox games like Minecraft.

Keywords: Minecraft, Sandbox game, Game-based learning

1. Introduction

Minecraft is a popular Sandbox video game among game players. According to gamesindustry.biz[1], the game has sold 176 million copies worldwide. There are different modes of play in Minecraft. There is creative mode, where players start the game with unlimited resources which they can used to build virtually anything they can imagine. Another mode that students enjoy is survival mode, which is focused on exploring a world and gathering resources and food, crafting things from the resources you find, building shelters and surviving challenges like enemy attacks and starvation. The sandbox nature of Minecraft means that there are no set rules or goals that everyone must accomplish, which makes Minecraft an excellent tool for students to use to learn any subject matter. Creative educators have made use of the open nature of the game to modify and create their own worlds for use in the

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classroom.

This paper focuses on the synthesis of literature on the use of Minecraft in the classroom. The authors seek to learn real-world classroom examples of how teachers have integrated this game into their students' learning experiences. A survey was also conducted to explore teachers' thoughts and experiences with the game itself. This paper aims to explore literature of Minecraft integration in real classrooms. The three detailed research questions are: First, how is Minecraft being integrated into classrooms? Second, what is the impact of using Minecraft in classrooms? Third, what are teachers' experiences using Minecraft?

2. Methodology

A narrative review of the literature was conducted to learn more about educators' experiences with the use of Minecraft as a classroom learning tool. Databases were searched including LearnTechLib, ERIC, and Google Scholar. The search terms utilized included: Minecraft in the classroom, Minecraft: Education Edition, game-based learning, learning with Minecraft, and teachers using Minecraft. Fifteen research articles were collected and analyzed for the literature review portion of this study.

To better understand teachers experiences with and thoughts about Minecraft as an educational tool, a survey was conducted. A group of 35 elementary public school educators were asked to share their thoughts about and experiences with playing Minecraft. Twenty-two teachers indicated having little or no knowledge about or experience playing the game. The remaining 13 noted things such as similarity to Lego building blocks, the game being good for creative expression, loving that it is a learning game too, belief that it has applicability to the classroom, and familiarity through the Minecraft themed activities created by Code.org for the Hour of Code.

3. Findings

In order to answer the first and second research questions, literature was collected on the usage and impact of Minecraft in K-12 classrooms. Answering the third research question, a survey was performed. Results are presented in the following sections.

3.1 Minecraft as a Classroom Tool for Learning

MinecraftEdu was a modified version of the original Minecraft game developed by Teacher Gaming in which students could explore dynamic maps to learn subject areas with the guidance of their teacher. Callaghan investigated if MinecraftEdu could be used to pedagogically enhance curriculum and learning processes and positively enhance learning behaviors of students[2]. Callaghan conducted a qualitative collective case study to examine the use of MinecraftEdu in seventh-grade to tenth-grade classrooms in an Australian high school learning environment[2]. A total of 168 students participated in the study. The study was conducted in two possible contexts: a project-based learning module for a period of six months and a Minecraft club that met for 90 minutes per week outside of school hours. Data collection included teacher and researcher observations, student contributions to MinecraftEdu, and an online survey created with Google Forms. Teacher observations revealed that students were excited about using the tool in class and they were more productive and engaged, thus more willing to accomplish their tasks. All 168 students (100%) remained on task during each lesson and students noted they were more engaged in this type of lesson than previous lessons. The authors concluded that MinecraftEdu contributed to the enhancement of learning in the classroom and suggested that games such as Minecraft can accommodate the various learning abilities of students.

Learning experiences in Minecraft can enhance the cognitive development of students when used as a pedagogical tool. Schifter et al. conducted a study within a high school English Literature classroom. The participants in the study included a class of 20 ninth-and tenth-grade students, 19 of which had not played Minecraft previously[3]. The goal was for the students to produce a 3D film of a narrative work which would be filmed inside the game space of Minecraft. The researchers analyzed the plot and character development concepts within the films to determine the students' understanding of their learning. Students repeatedly demonstrated an understanding of the concepts in

ways that were more dynamic than filling out a worksheet.

Cipollone et al.[4] conducted a similar qualitative case study with a high school teacher from the Northeastern region of the United States who utilized Minecraft in his language arts classroom for a six-week unit to teach the concepts of characterization and plot. Participants in the study were a group of 20 ninth-and tenth-grade students. Students were able to collaborate outside of class for planning, and then class time was spent developing and capturing their stories created within a Minecraft world. The researchers found that students were able to showcase their creativity in a low-cost and engaging learning environment. The results of this study also demonstrated the potential of Minecraft as a classroom tool that can provide meaningful learning situations. The authors concluded that it may be time for organizational changes within school systems to allow for more of these types of experiences in the future. A limitation of this study was the singular focus on one classroom and a small group of students. Future studies in this area should be expanded to multiple classrooms and additional content areas. The researchers also recommended that further studies utilize a mixed-methods approach, to include structured tasks within the game for quantitative analysis and qualitative analysis via student interviews to understand the creative and learning process taking place within the game.

Minecraft is also played by many on home video game consoles, like Xbox, PlayStation and Nintendo Switch. Groff et al.[5] conducted a study to identify and understand the educational benefits of leveraging console game-based learning in elementary and secondary schools, including how these benefits could transfer to other contexts. The participants in the study included 150 students ages five to sixteen, 48 teachers, and 19 school leaders, from 19 schools. Schools that already had game-based learning (GBL) initiatives in process were selected for the study so the researchers could fully explore these initiatives. The study was a mixed-methods research design intended to triangulate the three perspectives of the leaders, teachers, and students regarding game-based learning. Data collected included observations as well as individual interviews with the leaders and teachers, and small group interviews of three or four students in a group. The researchers found that there is potential for console GBL in the classrooms as it provides students with an opportunity to engage in activities that can enhance their learning. Further study is warranted in this area. Positive effects were seen in areas such as engagement, collaboration and writing. This study had convenient timing because there was already a curriculum makeover movement taking place at the time. Challenges included parents' concern that students were already spending too much time playing games at home and now would be playing more at school. Teachers were able to alleviate this concern by communicating the learning outcomes of GBL and the types of activities being designed around the games.

Minecraft has real educational value and students can develop skills while learning how to play the game itself. Karsenti and Bugmann[6] explored this educational potential in a study which included 118 elementary school students in third-grade through sixth-grade from two schools in the greater Montreal area. They designed an exploratory action-research Minecraft challenge for the participants in which they would navigate through ten various game levels of increasing difficulty. Data collection for the study included survey questionnaires, individual and group interviews, videotaped observations, and student-generated Minecraft products. The students were able to fully engage in activities that are both educational and fun, and they were able to progress step by step through a series of skills. Students demonstrated improved skills in areas such as reading, writing, social skills, organization, and many others. The authors recommended future use of a structured Minecraft program such as this one and balance between gaming and other types of activities. The action-research format of the study also provides specific details that an educator could take and implement into their classroom right away.

Since Minecraft is a Sandbox game, it allows students opportunities not only to play, but also to create. This generation of learners has an immersive media landscape at their disposal and learning how to understand how things work and become producers of interactive media are important skills for them to learn[7]. Neimeyer and Gerber[8] conducted an exploratory case study to learn more about the digital maker culture within and around Minecraft. The researchers used a priori coding and pattern matching analysis of three components of the maker movement: digital

tools used to create new designs, cultural environments that foster collaboration and sharing, and common design standards. They analyzed five YouTube creator channels and walk-though and commentary videos recommended by Minecraft players. Video creators in the study made videos related to different aspects of gameplay, and they also engaged in thought provoking discussions about the Minecraft game and their creations. This community of Minecraft makers showcased something that educators strive to achieve in classrooms today: collaborative environments where participants are highly engaged and work together to accomplish a common goal. The study found that children and adults were involved in the digital making process related to video games. Further study is warranted to delve deeper into the creators' and viewers' perceptions of the maker culture within videogames and virtual worlds to establish more of a connection as to how this can be applied to the classroom setting. There can be benefits to enabling students to become creators and sharing knowledge of a subject area as well as something they enjoy playing. Student-created walkthrough tutorial videos teaching their teachers how to become more comfortable playing the game could lead to increased usage in the classroom.

3.2 Overall Impact of using Minecraft in the Classroom

Minecraft's expansive world consists of many different landscapes and biomes, which seems to make it a natural fit for the science classroom. Various scientific and mathematical concepts can also be modeled within the context of the game. Minecraft is being used in science classrooms around the world to illustrate concepts such as a 3D periodic table, models of the human body, and circuits[9]. Exposure to any of these concepts can be beneficial to students, which has a positive impact on their learning.

Pusey and Pusey[10] hoped to determine how games such as Minecraft can be effectively used as educational tools in the science classroom, as well as provide practical suggestions for implementation to other educators. They conducted a qualitative study with two science classes from an all-girls private school and one class from a co-ed public school in Australia. Participants were eighth-grade students aged 13 to 14 years old. MinecraftEdu lessons were taught in conjunction with traditional teaching methods during the study which lasted five to six weeks. Student surveys were administered at the beginning and end of the study to assess students' general experience with video games, Minecraft, and Earth Science. Students used higher-order thinking skills to apply their understanding of rocks and minerals and solve problems about fossils within the Minecraft world. Most students reported they enjoyed the use of MinecraftEdu and wanted to use it again, and interest in science increased because of the study. In the lessons where MinecraftEdu was used, both teachers reported an anecdotal increase in student engagement and motivation. Parents gave positive feedback and praised the innovation of the educators. There is not a lot of evidence of the impact on student achievement, but effectively evaluating student learning with new innovations can be a challenge[11]. Further study is warranted to have additional research available on the topic and to evaluate the impact on student learning.

How does using a virtual world environment like Minecraft for science education look at the elementary school level? Smith[12] conducted a study to examine the effectiveness of a virtual world curriculum for teaching elementary students science concepts and skills. The participants in the study were 15 fourth-grade students in a small Midwestern school and 30 elementary teachers from Australia, England, and the United States. Smith utilized a mixed methods research design to collect data using student and teacher surveys as well as pre and post content tests. The researcher triangulated the data from different sources and utilized multiple perspectives and theories. The study showed that students acquired content knowledge from working within the virtual world. The environment was highly engaging for the students and fostered deliberate practice of 21st century competencies. Recommendations for future study included engaging students by using games, virtual worlds, and interactive exploratory technologies containing embedded academic content.

3.3 Teachers' Experience with Minecraft

There can be a learning curve for teachers to learn about using Minecraft in the classroom. Effective teacher training

and familiarity with the games can help teachers successfully integrate game-based learning in the classroom[10]. GBL experiences in preservice education as well as formal and informal professional development can prove valuable to teachers as they begin to bring these types of experiences to their classroom.

Games like Reader Rabbit and Oregon Trail were primarily created for education through entertainment. Games evolved over time and we are now seeing examples of commercial games like World of Warcraft and Minecraft being adapted for educational purposes, in addition to tools being developed for learning game design such as Scratch and Kodu[13]. Wu and Richards sought to understand if classroom teachers are adequately prepared to leverage game-based learning for teaching content specific objectives, and if they are recognizing and acknowledging the popularity of these games and the potential for their use in the classroom. They referenced that 97% of kids between the ages of 12 and 17 were playing digital games every week and about half of them said they played games every day. Continued research in this area is needed because of the ability to facilitate both students' interests in the classroom and the education of teachers' knowledge and attitudes toward using games in the classroom.

Shah et al.[14] conducted a qualitative study in which a pre-service teacher analyzed and integrated Minecraft into a GBL focused English language arts lesson plan. This was part of a larger mixed methods study in which preservice teachers engaged in an 11-week course that taught them about game analysis, game integration and ecological conditions within a school context. The teacher that was selected for this study analyzed Minecraft by identifying the disciplinary content and pedagogical affordances and the various opportunities present in the game for teaching the concept of cause and effect. The study allowed the educator to analyze the pros and cons of this tool and create lesson experiences focused on specific concepts using Minecraft. This work is valuable and it is important to have something like this available to other educators to support them as they try to make correlations between a technology tool and effective integration of that tool into their own instruction. Further study is warranted, and expansion of the study should take place to include additional educators analyzing Minecraft and developing learning experiences for a variety of content areas.

Teachers who have experience with and enjoy playing video games like Minecraft can prove to be a valuable contribution to others trying to learn the game and how it can apply to classroom learning. Smeaton[15] conducted a qualitative study utilizing surveys of teachers who integrate Minecraft into their classroom learning experiences. The survey was shared online via MinecraftEdu's Twitter and posted in a Minecraft teacher discussion forum. The survey was completed by 17 participants out of 50 who viewed the survey (34%) and the responses were positive and supportive of the author's original theory about Minecraft. Respondents indicated that they were successful in using Minecraft as a teaching tool and that learners showed high levels of motivation and participation. Choosing to only publicize the study in an online forum may have affected the sample size. This limitation of a small sample size made it difficult to generalize the results.

One of the benefits of MinecraftEdu and now Minecraft: Education Edition is the ability for educators to shape and modify the open structure of the game to meet educational needs. Jean-Charles[16] examined the benefits of modification (modding) in gaming tools to support learning in the classroom. Thirty-six preservice teachers participated in the study as part of a Multimedia and Instructional Courseware Design course. They developed a computer game over five weeks and implemented it in a classroom environment evaluating it for curriculum connections and adaptation for learners. The educators recognized the benefits of game modification in terms of their professional development and how it can lead to positive student outcomes. As educators become more comfortable with Minecraft and how worlds are developed, they will learn how to modify the game to create and build their own worlds and learning activities.

3.4 Teachers' suggestions

This section summarizes results from the survey on Minecraft usage in their classrooms. Fifteen of the educators indicated some knowledge of the game either through the playing experiences of students in their class or through the playing experiences of their own children. These responses seem to indicate a knowledge gap and a

need for developing an increased awareness about the game itself, why students like it, and how it can be used as a valuable tool in the teacher toolbox.

These same educators were also asked about what they thought the potential benefits were of using Minecraft as a teaching tool with students. There were a variety of responses, which included answers such as increased student engagement, incorporation into various content areas in a fun way, students developing skills like creativity and problem solving, and a way for teachers to design learning experiences that are brought to their students' levels of interest and background knowledge. One teacher stated, "I think it is a win, win situation. Students are learning but having fun at the same time." Ten of the 35 teachers were not sure of the potential benefits—these educators also indicated they had little or no experience with the game in the previous question.

The teachers who were surveyed shared what they thought were potential obstacles to integration of Minecraft: Education Edition in their own classrooms as well as their professional learning needs and supports. The results indicate the most reported obstacle was "teacher knowledge," or lack thereof, with 13 responses. There was an equal amount of responses (seven) from teachers foreseeing no obstacles and others predicting some issues with access to technology or minor technology issues. Time was the next largest reported concern with six responses. The remaining two teachers shared a concern with students being able to focus or stay on task with the learning.

4. Summary and Discussion

The authors of the studies utilized Minecraft in different contexts and for different purposes. Many studies involved high-school-age students or older as participants, and others focused on younger students. Applications of Minecraft in the classroom varied from a formal class or several-week units to smaller time frames and club settings. Some studies also focus on the teacher perspective and their background and experience with regards to playing video games and how this experience can translate into the classroom.

The authors conclude that professional development (PD) opportunities for educators would go a long way to help them become more comfortable and successful with integrating Minecraft: Education Edition into classroom learning. Approaching this PD in multiple ways would be beneficial for educators looking to learn more. Sessions in which teachers can learn more about what Minecraft is, why students enjoy it, and Minecraft's benefits for learning would be a great start. They should get some hands-on time in a Minecraft environment so they can experience the basic controls and how things work within the game. Their comfort level with how the game works, as well as the experience of what their students would learn in each activity, increases with practice. Lastly, teachers should receive embedded real-time professional development working with a coach or fellow teacher with experience using Minecraft in the classroom. This would involve collaborative planning, exploration of existing lesson plans and available worlds, and ongoing support as they implement Minecraft: Education Edition with their students in the classroom. These recommendations align with the responses received from the teacher survey regarding what support they felt they need in their specific situations.

Educators would also benefit from communities of practice to participate and interact with as they are learning something new like integration of Minecraft into their practice. In 2015, a Minecraft Massively Open Online Course was developed to address this difficulty in learning about games while playing them as part of a participatory culture. The course took place over five weeks and utilized Google+ as the online community for interaction among the educators. The course was designed as game-like as possible, which led to the educators being guided by what they wanted to learn and not by what the instructors wanted them to learn. As a result, the moderators spent less time organizing content and more time designing opportunities for learning, engagement, and community, which is a goal to strive for when using games in the classroom[17].

5. Conclusion

Research literature indicates that utilizing Minecraft as an educational tool can lead to increased engagement and motivation for the students involved. Minecraft's openness allows for tailoring learning experiences to various contexts and it also allows students to learn any subject

matter. Most of the studies reviewed in this paper included small sample sizes which made it challenging to draw a broader conclusion about the results. Modifications of the original game have been created for educational contexts. Examples of lessons in different content areas exist, and Minecraft: Education Edition has a website that is a great resource for educators who are just learning how to apply Minecraft as a tool in their classroom. Further study is warranted in this area to continue to learn about and document successful integration of Minecraft: Education Edition into classroom learning experiences. In addition, studies should be done to increase the available amount of literature on this topic, especially regarding teacher experiences in learning how to teach with Sandbox games like Minecraft.

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