Gender Differences in Using Minecraft for Learning: Insights and Implications for Teaching Practice

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Abstract	
Keywords: game-based learning, gender differences, gender-sensitive integration, Minecraft, technology-enhanced learning, video games in education	The educational use of video games is increasingly promoted in the literature for all levels of education. Minecraft, one of the most popular video games of all time, has already found its place in classrooms around the world. Numerous studies and systematic literature reviews indicated that this video game can be effectively used to master curriculum content, develop skills, and increase students' motivation and interest in learning. Also, Minecraft is perceived as a gender-neutral game that appeals to both boys and girls of various ages. However, research has shown that girls play this game less than boys and that gender is one of the factors influencing the educational experience when this video game is used for learning. Furthermore, the issue of gender differences remains under-researched, and gender is often inadequately analyzed in studies. This paper aims to examine the extent to which gender differences are present in the use and educational effects of Minecraft, as well as to highlight the need for gender-sensitive integration of this game into teaching practice.

1. Introduction

In 2023, while evaluating the submitted applications for the contest "I Love Biology," organized by the Centre for Educational Technology, Didactics' Training, and Career Guidance of Biology Teachers (University of Belgrade, Faculty of Biology), I was pleased to see that one girl presented the topic of biodiversity (including both positive and negative human impacts) through the video game Minecraft. However, the application from this fifth-grade female student prompted me to reflect on the applicability and effectiveness of this video game from a gender perspective since it was actually her younger brother who created the Minecraft content that she showcased in the video.

This paper aims to address two research questions:

RQ1: How does the literature define and analyze the educational potential of Minecraft?

RQ2: To what extent are gender differences present in the use and educational effects of Minecraft?

2. Educational potential of Minecraft

Game-based learning enables experiential learning and active teaching while creating opportunities for collaboration and creativity development (Kersánszki et al., 2024). Accordingly, the use of digital games has become a growing trend in education (Shute et al., 2019; Tablatin et al., 2023), and Minecraft, as one of the most popular video games of all time, is already being used in classrooms around the world (Cigognini & Nardi, 2024; Costafreda Mustelier et al., 2021; Esclamado & Rodrigo, 2024; Nebel et al., 2016).

Minecraft, an open-world video game without an active narrative or predefined strict goals, was created by Markus Persson in 2009 and released by Mojang in 2011 (Al Washmi et al., 2014; Lane & Yi, 2017). In the game, players can build structures out of blocks (similar to LEGO bricks) within a three-dimensional virtual world that is generated at the beginning of gameplay. This virtual world includes various biomes, animals, non-player characters, and monsters, along with day and night cycles (Foerster, 2017; Short, 2012).

Minecraft is available on various devices and can be played individually or online as a multiplayer game (Alawajee & Delafield-Butt, 2021; Dezuanni et al., 2015). In addition to the Survival mode (with different difficulty levels), where players have to gather resources and escape or defend themselves from (nighttime) monsters, there is also the Creative mode that provides unlimited access to resources and does not involve threats from monsters (Anderson et al., 2017; Bos et al., 2014; Foerster, 2017). Beyond these

two main modes, there is also the Adventure mode, which offers specially designed experiences on specific themes, such as solving mysteries or simulations from different fields (Lane et al., 2022).

The Creative mode is considered more suitable for educational use (Bos et al., 2014), and some studies have also used various game modifications to create tailored educational experiences (Al Washmi et al., 2014; Dezuanni et al., 2015; Lane et al., 2022; Vicari et al., 2019). Since 2016, a special version of Minecraft, designed for educational institutions, has been available (Baek et al., 2020; Marrara et al., 2021; Slattery et al., 2025). Minecraft Education is an educational platform and a virtual collaborative learning environment that is based on the popular video game. This version includes certain restrictions compared to the standard version of the game (for example, modifying existing objects or building in specific areas can be disabled), but it also offers new teaching resources and additional features that teachers can use to control the environment (Furukado et al., 2024; Kersánszki et al., 2024; Slattery et al., 2025). For instance, it includes the Code Builder tool that can be used to teach programming within the game itself (Slattery et al., 2025; Voštinár & Dobrota, 2022). Also, the official Minecraft Education website (https://education.minecraft.net) offers pre-made lessons for specific school subjects (Furukado et al., 2024). Additionally, during the COVID-19 pandemic, the Minecraft Education version was widely used in online teaching (Cigognini & Nardi, 2024).

Numerous studies have examined the educational potential and effects of the standard version of Minecraft, modified versions, and the Minecraft Education edition in the classroom (Baek et al., 2020). The main educational benefits of Minecraft come from its game mechanics. In other words, blocks can be arranged to represent various objects and shapes, while the presence of diverse plants and animals allows visualization of different ecosystems and biomes. Moreover, the game can be relatively easily modified (even without programming knowledge) to suit various topics (Nebel et al., 2016).

Systematic literature reviews indicate that Minecraft can be successfully used for mastering curriculum content, developing skills, and increasing students' motivation and interest in learning at all levels of education (Alawajee & Delafield-Butt, 2021; Baek et al., 2020; Slattery et al., 2025). In addition to its use in social sciences and humanities, a significant number of studies focus on natural sciences, specifically the teaching and learning of biology and ecology (Short, 2012; Vicari et al., 2019; Wu et al., 2025), chemistry (Furukado et al., 2024; Short, 2012), physics (Marrara et al., 2021; Short, 2012), mathematics (Al Washmi et al., 2014; Bos et al., 2014; Foerster, 2017; Jensen & Hanghøj, 2020; Kørhsen & Misfeldt, 2015), computer science and programming (Kutay & Oner, 2022; Voštinár & Dobrota, 2022), as well as geography and geology (Costafreda Mustelier et al., 2021; de Sena & Stachoň, 2023; List & Bryant, 2014; Short, 2012). This video game also supports a STEM-based approach to learning (Kersánszki et al., 2024; Lane et al., 2022; Tablatin et al., 2023).

The study conducted with 12 teachers in Canada has shown that Minecraft has the potential to support the development of 21st-century competencies, such as collaboration, communication, creativity, innovation, and critical thinking. However, whether these competencies will actually develop depends primarily on the teachers' decisions regarding how the game would be used in the classroom, and especially on the quality of the designed activities since Minecraft is merely a tool for implementing them. It is also essential that teachers work with students to develop guidelines for appropriate collaboration and communication when using this video game in educational settings (Hébert & Jenson, 2020).

It is important to note that systematic literature reviews (Alawajee & Delafield-Butt, 2021; Baek et al., 2020; Slattery et al., 2025) highlighted that the quality of the analyzed studies is often limited and that generalized claims about the effectiveness of Minecraft in teaching and learning should be approached with caution. Slattery et al. (2025) also pointed out statistical issues in some of the research papers, as well as the fact that a certain number of studies failed to adequately examine gender differences and/or failed to report information regarding this variable.

We should be mindful that the sustainable and purposeful integration of Minecraft in teaching depends on various factors and the teachers' ability to overcome existing barriers. Manahan and Rodrigo (2023) identified first-order and second-order barriers based on their study involving five male and four female teachers (employed in both private and public educational institutions in the Philippines) who completed training on the educational use of Minecraft. First-order barriers include: 1. logistical impediments (such as lack of school computer equipment and/or policies related to the "bring your

own device" concept), 2. lesson scheduling (e.g., lessons in Minecraft often exceed the typical duration of a class period), 3. technical resources (in the case of online teaching, schools need to provide computers that students can borrow), 4. curriculum alignment (available pre-made lessons and Minecraft worlds are not always suitable for achieving the objectives of a specific lesson), and 5. changes in teaching and learning modalities (using Minecraft in a classroom setting differs from using it in online teaching). Second-order barriers include: 1. limited teacher experience (adapting and/or designing lessons in Minecraft requires a certain level of skill and can be time-consuming), and 2. classroom management concerns (due to the limited duration of a class period, it can be challenging to guide students' activities and manage their behavior within Minecraft's virtual worlds). The same authors emphasized the importance of school leadership support in overcoming these barriers, as well as fostering collaboration and networking among teachers who actively use this video game in their teaching (Manahan & Rodrigo, 2023).

3. Gender and the use of Minecraft in education

Minecraft is considered a gender-neutral game, although Alex (the default female avatar) was only added in late 2014/early 2015 (Anderson et al., 2017). Also, it is not possible to create hypermasculine male avatars or hypersexualized female avatars in the game due to the fixed blocky design of the characters, and gender identification is optional, as players can use skins without human characteristics (Potts, 2015).

The game is appealing to both boys and girls of various ages, likely because, in addition to the Survival mode, there is also the Creative mode (Al Washmi et al., 2014; Beavis et al., 2015; Esclamado & Rodrigo, 2024). Moreover, nearly all children who play video games are familiar with Minecraft (Voštinár & Dobrota, 2022). However, a study involving parents (N = 755) of children aged 3 to 12 in Australia has shown gender differences regarding this game. Statistically significantly more boys (54%) than girls (32%) had played Minecraft, according to parents' responses (Mavoa et al., 2017). Similarly, the research conducted by Cigognini and Nardi (2024) found statistically significant gender differences in prior experience with Minecraft, both in the 2019 sample (58% of boys and 25% of girls) and in the 2021 sample (67% of boys and 43% of girls). These differences in prior experience present a significant barrier when integrating Minecraft into teaching, as

the lack of prior experience affects students' self-efficacy when using this game for learning (Cigognini & Nardi, 2024). Furthermore, experienced children (typically boys) may dominate competitive or collaborative tasks, or even disrupt and sabotage lessons (Nebel et al., 2016; Voštinár & Dobrota, 2022). For example, de Sena and Stachoň (2023) reported that when testing their prototype of the Minecraft-based game about climate zones with student pairs (aged 15 and 16), the average completion time was 11 minutes. However, the fastest pair finished in just six minutes. This pair consisted of a boy and a girl, but the boy immediately took control of the game, while the girl mostly observed and commented on his play. Similarly, Al Washmi et al. (2014) pointed out that children with extensive prior experience with Minecraft were engaged in behaviors that disrupted and prevented others from playing (such as destroying orientation signs or "killing" teammates), while children without experience needed time to understand the game concept before solving math tasks within it. The authors of this research did not specify the gender of the children with and without prior experience with Minecraft. Additionally, Voštinár and Dobrota (2022) highlighted that if the teacher lacks sufficient authority, then the experienced boys can quickly make the Minecraft environment unusable for instruction by destroying objects and/or building inappropriately.

The study conducted at a summer camp on the topic of renewable energy sources through the use of Minecraft, involving children aged 10 to 16, indicated that girls' interest and participation were minimal, as the camp included 14 boys and only one girl (Kersánszki et al., 2024). Research by Anderson et al. (2017), Ames and Burrell (2017), and Voštinár and Dobrota (2022) also showed that girls were significantly less likely than boys to apply for extracurricular activities that involved the use of Minecraft. However, in the study conducted by Lane et al. (2022), on the potential of using Minecraft to foster interest in STEM, girls' participation in the summer camp exceeded 50% in both 2018 and 2020. The authors emphasized that their goal was to attract girls and members of minority communities, as these groups have been historically underrepresented in STEM fields. The higher participation of girls (55%) was also reported in the research conducted by Kutay and Oner (2022), in which Minecraft was used to teach computational thinking to children from low-income families. It remains unclear why certain extracurricular programs and research projects

struggled to include girls, even when incentive measures and guaranteed spots were in place. To find the reasons, we should start by paying attention to how and where these Minecraft-based extracurricular programs were advertised and how applications were submitted.

Jensen and Hanghøj (2020) conducted six group semi-structured interviews involving a total of eight boys and four girls from a primary school in Copenhagen to examine the effects of using Minecraft in fifth-grade math instruction. In their analysis of the interviews, the authors focused primarily on the boys' positive experiences. Still, they did mention that one girl (Melanie) was unable to identify the mathematical aspects in this video game (Jensen & Hanghøj, 2020). Drawing general conclusions about the benefits and limitations of using Minecraft in teaching/learning based solely or predominantly on the responses and/or results of boys is highly problematic, as it overlooks the experiences of girls. Drastic examples of this can be found in studies conducted by Kørhsen and Misfeldt (2015) and Voštinár and Dobrota (2022), in which no girls were included since none had applied.

Dezuanni et al. (2015) intentionally included only girls in their research. The results of this study have shown that girls can be successful in Minecraft-based school projects, that they are interested in these activities, and that they can enjoy them. However, significant differences were reported in prior gaming experience and knowledge of the game, as well as in playing styles (Dezuanni et al., 2015).

In the study on the impact of Minecraft on vocabulary acquisition in English as a foreign language, no gender differences were found among children aged 9 to 14 (Weisi & Hajizadeh, 2025). Similarly, Esclamado and Rodrigo (2024) also reported no gender differences in learning outcomes regarding Minecraft-based activities made for eighth-grade students in the Philippines. However, this study found that boys explored Minecraft worlds more than girls, that girls benefited more from taking breaks, and that, after completing Minecraft-based activities, boys showed statistically significantly greater interest in STEM fields compared to girls. Importantly, the study revealed that negative emotions (such as boredom and frustration), experienced during the gameplay, had a greater impact on girls than on boys. Boredom, in particular, was found to negatively affect academic achievement (test scores) and interest in STEM. In other words, girls who reported higher levels of boredom explored the Minecraft worlds less, made

fewer observations, and scored lower on the tests. Additionally, girls who reported high levels of frustration were less likely to complete tasks and showed less interest in STEM (Esclamado & Rodrigo, 2024). The research conducted by Cigognini and Nardi (2024) also found that statistically significantly more girls than boys perceived educational Minecraft-based activities as boring.

Anderson et al. (2017) pointed out that the use of video games (including Minecraft) for learning purposes is increasingly promoted. However, educational institutions tend to focus solely on how these video games can be utilized for teaching and overlook the fact that they may embed certain systems of thinking about gender and/or race (e.g., through narrative or avatar design). They also emphasized that video games have so-called "metagaming" environments (e.g., fan communities, YouTubers and streamers, publications and merchandise, festivals, conventions, or other local events) that influence identity construction. Minecraft may initially appear to be a neutral space or a "blank canvas" where players have complete freedom to create whatever they want. However, players inevitably bring their own social biases and cultural representations into the game, which is why both the game and its metagaming environment reproduce existing gendered, racial, and intersectional stereotypes. The same authors analyzed 25 YouTube videos and attendees and presenters at the Minefaire convention and concluded that Minecraft's metagaming environment is not gender-neutral and lacks gender balance (as most content creators and attendees were male). They also highlighted ways to prevent this video game and its community from becoming exclusionary spaces for girls and minorities (Anderson et al., 2017).

4. Discussion and Conclusions

Although Minecraft is appealing to both boys and girls (Al Washmi et al., 2014; Beavis et al., 2015; Esclamado & Rodrigo, 2024), research showed that girls tend to play it less frequently than boys and that gender is one of the factors influencing the educational experience when this video game is used in school-related settings (Cigognini & Nardi, 2024; Esclamado & Rodrigo, 2024). Achieving a certain level of competence in playing Minecraft is essential for its successful use in educational contexts (Lane et al., 2022) since a lack of prior experience negatively affects students' self-efficacy when using this game for learning (Cigognini & Nardi, 2024).

It is evident that many extracurricular activities and research projects involving Minecraft struggle to attract girls to participate (see Ames & Burrell, 2017; Anderson et al., 2017; Kersánszki et al., 2024; Kørhsen & Misfeldt, 2015; Voštinár & Dobrota, 2022). Also, gameplay styles and emotional responses can differ significantly between boys and girls (Cigognini & Nardi, 2024; Dezuanni et al., 2015; Esclamado & Rodrigo, 2024). For example, compared to boys, girls' learning can be easily disrupted by negative emotions such as boredom and frustration (Esclamado & Rodrigo, 2024).

Slattery et al. (2025) emphasized that understanding the evidence supporting the use of Minecraft in education is crucial if we want to meaningfully and effectively integrate this video game into teaching practice. Systematic literature reviews suggested that Minecraft can be successfully used at all levels of education to master curriculum content, develop skills, and increase students' motivation and interest in learning (Alawajee & Delafield-Butt, 2021; Baek et al., 2020; Slattery et al., 2025). However, the issue of gender differences remains under-researched, and gender is often inadequately analyzed in the literature (Alawajee & Delafield-Butt, 2021; Esclamado & Rodrigo, 2024; Slattery et al., 2025). Additionally, several studies (see Jensen & Hanghøj, 2020; Kersánszki et al., 2024; Kørhsen & Misfeldt, 2015; Voštinár & Dobrota, 2022) made conclusions about the educational potential of Minecraft based solely or predominantly on the outcomes of boys, which is highly problematic as it disregards the experiences of girls. Some studies also misinterpret certain shortcomings in the integration and/or preparation of activities as flaws of the Minecraft game itself (Alawajee & Delafield-Butt, 2021).

We should be mindful that meaningful integration is crucial for the successful use of Minecraft-based activities in educational settings. Still, only a small number of studies focus on this topic, and almost none address gender-sensitive integration. The gender-specific approach does not necessarily mean separating boys and girls, but rather acknowledging their different levels of gaming experience, knowledge of Minecraft, gameplay styles, and needs (e.g., girls benefit from taking breaks and having time for reflection). Furthermore, including preparatory and trial activities for practice (along with establishing guidelines for collaboration and communication), as well as providing support, guidance, and mentorship for group projects, and emphasizing Minecraft's creative aspects can all contribute to fostering a positive and collaborative learning environment, whether in the classroom or online.

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