Minecraft as a Tool to Enhance Engagement in Higher Education

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Abstract. The popularity of online teaching has increased in the last decade, especially in the last two years, where many institutions were forced to close their campuses due to Covid-19 restrictions. Although online teaching may provide an easy alternative to on-campus teaching, it often introduces a number of challenges. One of the major challenges is the lack of student engagement. Teachers typically use student engagement as an indicator to identify student strengths and weaknesses to tailor their teaching and delivery methods to meet student needs. Hence, the success of the learning process often relies on student engagement. Educational games are typically used in schools, especially during early years, to enhance student engagement. However, they are rarely used in universities as the games are typically designed for children. Recently, a number of advanced educational video games, such as Microsoft Minecraft Education Edition (MC:EE), have been released. Unlike traditional educational games, designed for children, these games can be used in universities. To provide insight into how educational video games can be used in a university setting, we ran an experiment on a group of university students to teach them fundamental programming concepts using Python programming language. In this experiment, MC:EE was used as the main delivery tool. The feedback received after the experiment was mainly positive. Based on the feedback and experimental results, educational video games can enhance student engagement during online lessons.

Keywords: Video games · Online teaching · Innovative Education · Minecraft Education.

1 Introduction

Online teaching is fast becoming a viable alternative to face-to-face teaching. Even more so since the emergence of Covid-19 pandemic [1], where some institutions have been forced to move teaching off-campus [2]. However, the use of online teaching introduces a lack of student engagement. Without an adequate level of

engagement, it might be difficult to identify student strengths and weaknesses or modify the teaching and delivery methods to meet their needs. Hence, an inadequate level of engagement typically leads to poor student performance [3].

Student engagement refers to the level of interest, attention, and effort shown inside the class [4]. In online classes, the level of student engagement is often lower than that of on-campus classes [5]. This might be because it is easier for students to get bored or feel isolated [6]. To address this issue, Martin and Bolliger suggest considering learner-to-content, learner-to-instructor, and learner-to-learner engagement in the design and delivery of online courses [7]. One way to achieve this is to use unconventional delivery methods, e.g., educational video games.

This paper explores the effect of using a video game, Microsoft Minecraft Education Edition (MC:EE) [8], on student engagement during online lessons. In detail, the rest of the paper is organized as follows. Section 2 discusses the use of games in education. Section 3 describes the experiment methodology. Section 4 and 5 describe the experiment results and result analyses, respectively. Section 6 presents a set of guidelines for using video games in education. Section 7 concludes the paper.

2 Related Work

Educational games have been widely used in different education settings. Liu and Chen [9] conducted a study on a group of elementary school students to evaluate the effectiveness of using a card game, Conveyance Go, to assist students to acquire certain knowledge and skills. A group of 18 fifth-grade students was used in the study. The study reported that using the game had enhanced students' knowledge and attitudes towards learning new skills.

Knautz et al. [10] carried out an experiment to evaluate the effectiveness of game-based learning using an interactive text adventure game. A group of 91 students undertaking an information literacy course was used in this experiment. The evaluation results showed that 75% of the students were engaged in the game, which improved their overall performance and grade point average (GPA). The results also showed that the failure rate decreased by 13% after using the game.

Mathrani et al. [11] used a game called LightBot [12] to teach programming fundamentals. The experiment involved two different groups of students. The first group contained 20 students who had yet to commence the programming course, whereas the second group contained 24 students who had completed the course. The experimental results showed that the use of the game improved student perception and engagement in the two groups of students.

Liao et al. [13] carried out a year-long study on a group of elementary school students to assess the use of game-based learning to improve student engagement and performance in writing. A group of 245 third-grade students was used in the study. The study results showed that the student interest, engagement, and performance improved after using the tool.

Felszeghy et al. [14] conducted an online competition using Kahoot [15], a game-based quizzing tool, on a group of first-year university students to evaluate the use of game-based learning. They found that using the tool has improved the students' overall performance and engagement.

In a more recent study conducted by Dorfner et al. [16], a custom Bingo game was used to deliver a biomedical engineering course. A group of 38 students was used in the study. Zoom [17] and Blackboard [18] were used to facilitate communications during the online class. The study results showed that 68% of the students were more engaged, and 72% were more motivated and focused when the game was used during the class. As some students were not engaged in the experiment, the authors believe that games may not be able to replace pedagogy, but they can be used as additional delivery methods to improve the student learning experience.

Video games are more widely used in schools, rather than in post-18 education settings. This observation has motivated us to set a goal to integrate video games into teaching and learning in a higher education setting. We have decided to investigate the feasibility of this idea by running a small-scale trial lesson, whereby students will learn how to write simple computer programs using the Python programming language.

3 Methodology

After exploring video game options such as MC:EE [8], Scratch [19], CodeMonkey [20], and Blockly Games [21], we chose MC:EE, because of its integrated Python programming language interface. Furthermore, MC:EE licensing requires only an office 365 account credential which all our staff and students already possess. Finally, Minecraft is a very popular game among students [22].

Our study involved ten students from the Department of Operations, Technology, Events and Hospitality Management (OTEHM) at Manchester Metropolitan University studying in the BSc (Hons) Business Technology programme. The participants were between the ages 18-21. Three were first-year students and seven were second-year students. Among the participants, there were six males and four females. All participants were recruited on a voluntary basis, i.e., without receiving any monetary benefits.

Prior to the class, the required tools and installation instructions were emailed to the participants. All participants were able to install the tools with the given instructions. The participants were then asked to attend a one-hour online class. The class was delivered in a virtual campus created using MC:EE environment. At the beginning of the class, students were given an overview of the session tasks. The class was semi-supervised, whereby students were given the freedom to work on the tasks without being interrupted by the teaching staff. However, students could reach out to tutors if they needed assistance. Figure 1 displays four screenshots to show students' active engagement with the given tasks in the virtual campus.

Fig. 1. Screenshots of students working collaboratively in MC:EE.

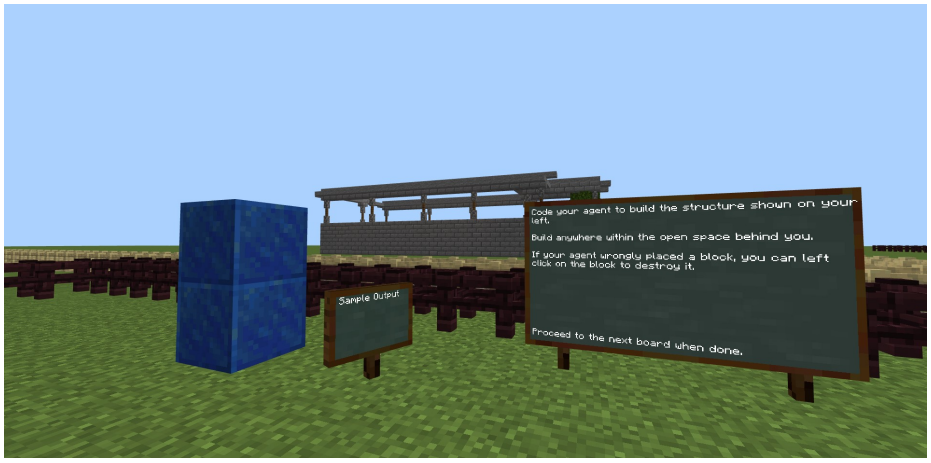

Fig. 2. A sample task in the session.

Five programming tasks with increasing difficulty were given to the students. The instructions to complete each task were written on a noticeboard as shown in Figure 2. A sample output was displayed next to each noticeboard as a reference. In the example shown in Figure 2, students were asked to build a structure of two blocks stacked vertically on top of each other. The learning objective of this task

was to allow the students to understand and apply a fundamental programming concept called sequence control structure.

The students could recreate the sample by giving instructions to their agent. An agent is an in-game robot which can be programmed to build a structure. The instructions can be given through a Code Builder interface. The interface provides three methods of input: (i) Block code, (ii) JavaScript code, and (iii) Python code. In this experiment, the students were asked to use either block code (see Figure 3) or Python code (see Figure 4). Students with no or minimal programming background used block code, whereas students with some programming experience used Python code.

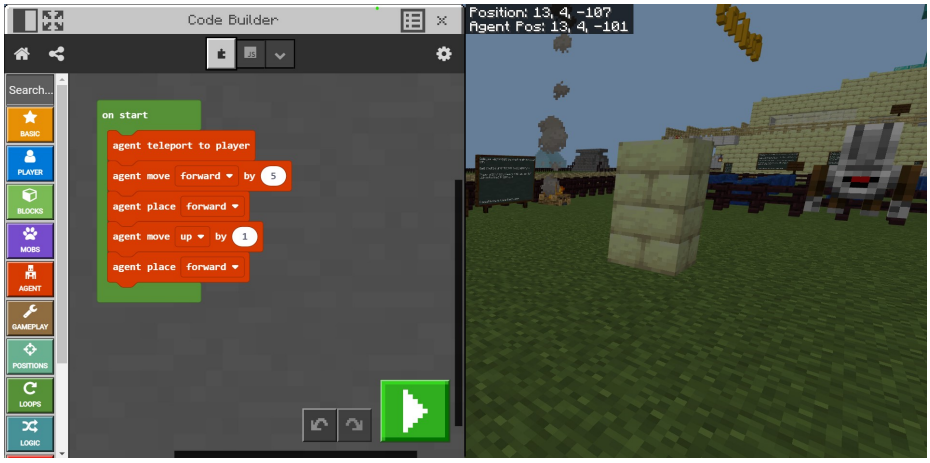

Fig. 3. Completing a task using block code.

After completing a task, the students proceed to the next task area to complete another task. This is repeated until all tasks are completed or until the one-hour session has finished. After the session, the participants were asked to complete a feedback form to evaluate the use of MC:EE to improve teaching and learning. The form contained five questions as presented in Figure 5.

Fig. 4. Completing a task using Python code.

Questions

1. Do you have experience playing Minecraft prior to the session?
2. How much did you enjoy the session?
3. Do you agree that MC:EE can be used as an effective educational tool for teaching and learning?
4. How challenging were the tasks given in the session?
5. Do you have comments or suggestions?

Fig. 5. Feedback form

4 Results and Discussion

The feedback form consisted of four quantitative questions and one qualitative question.

4.1 Prior Experience

This question aimed to understand whether existing knowledge in Minecraft affects the overall learning experience of the students within this experiment. Figure 6 shows that six participants have prior experience in playing Minecraft before the session, whereas four participants have never played the game before. This observation shows that the result obtained from analysing the remaining questions are likely to apply to a wider population who may not have prior experience in Minecraft.

Question-1: Do you have experience playing Minecraft prior to the session?

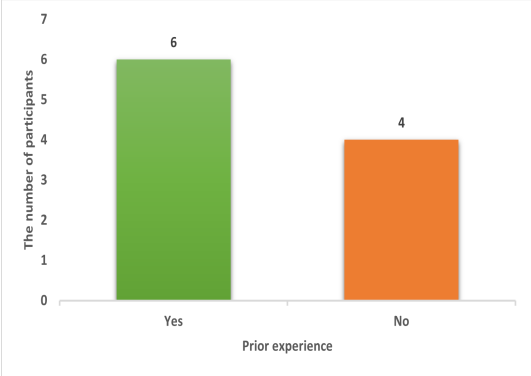

Fig. 6. Prior Minecraft experience.

4.2 Level of Satisfaction

This question aimed to examine the level of satisfaction of the participants after using MC:EE. Figure 7 shows that all students are either satisfied or very satisfied with the session. This indicates that MC:EE is an effective tool to increase the level of excitement and satisfaction inside the class.

Question-2: How much did you enjoy the session?

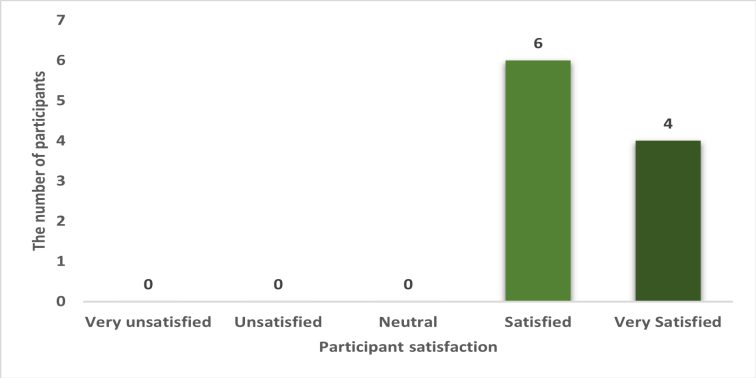

Fig. 7. MC:EE session satisfaction.

4.3 MC:EE for Teaching and Learning

This question aimed to examine whether the participants believe that MC:EE could be used as an effective educational tool for teaching and learning. Figure 8 shows that apart from one student who was neutral, all students either agreed or strongly agreed that MC:EE could be used as a delivery method. This gives us a strong indication that MC:EE can be used as an effective educational tool in teaching and learning.

Question-3: Do you agree that MC:EE can be used as an effective educational tool for teaching and learning?

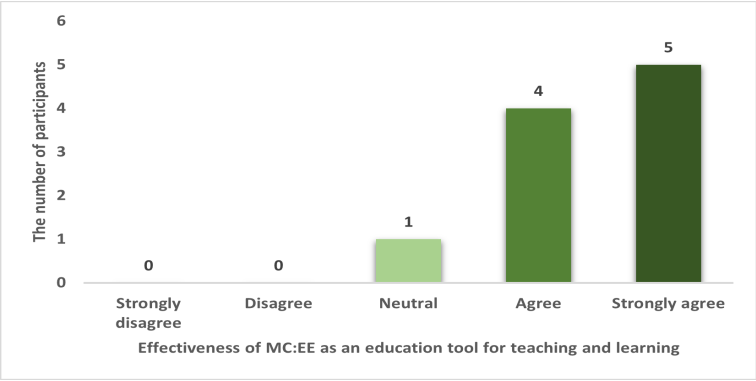

Fig. 8. MC:EE effectiveness as an educational tool for teaching and learning.

4.4 Tasks Difficulty Level

This question aimed to examine whether MC:EE could be used as an effective educational tool to cater to different groups of students based on their level of understanding of a topic. Figure 9 shows that one participant considered the tasks unchallenging, seven were neutral, and two considered them challenging. This result shows that the difficulty level of the task within the session can be increased or decreased to cater for different groups of students depending on their level of understanding of the topic.

Question-4: How challenging were the tasks given in the session?

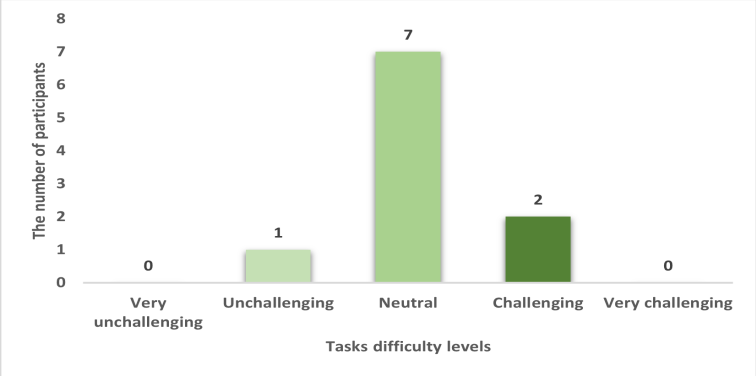

Fig. 9. Tasks difficulty level.

4.5 Qualitative Feedback

This question aimed to capture any other insights not captured by the quantitative questions above.

Question-5: Do you have comments or suggestions?

- "It was interactive"
- "... the game element of it was great."
- "... Can work well with as a group, in a competitive sense."
- "High level of interaction between players and the game."
- "... playing a game while learning which is a big plus in my books."
- "I like being able to move around, seeing other people in the space ..."
- "This was a well thought out activity which was engaging and gradually built my skills ..."

The feedback shows that MC:EE is a highly interactive tool that added an extra layer of social interaction among learners.

5 Analysis

The participants provided largely positive feedback. Figure 7 shows that all participants enjoyed the session. Furthermore, as can be seen from Figure 8, all participants (except one) agree that MC:EE could be used as an effective educational tool for teaching and learning. Hence, the use of MC:EE can improve the learning experience. Figure 9 shows that the tasks in the session were not challenging enough. This is probably because the participants may already have some prior knowledge of Python from a previous unit, they have undertaken during their first year of study. This is not an immediate concern because the main purpose of the lesson was to see how students would react towards using the MC:EE tool and not so much on the tasks themselves. Furthermore, the difficulty level of the tasks can be easily customised in MC:EE. Based on the qualitative feedback, the general theme is that participants find MC:EE social, interactive and engaging.

The feedback and analysis show that educational video games could enhance the level of student engagement considerably. While the feedback shows promising results, it is premature to make a generalised conclusion. We recommend conducting further studies involving (i) a larger number of participants, e.g., more than 25 students, (ii) a wider range of units, and (iii) other age groups are required to support the results of this study. To facilitate these studies, we are working with colleagues across the department to implement the following plan in the coming semesters. For (i), we are planning to integrate the trail described in this study into a workshop activity for the entire cohort (approximately 100 students) of first-year BSc (Hons) Business Technology students. This should demonstrate whether the positive feedback obtained in this study scale to a larger number of participants. For (ii), we are working closely with colleagues teaching in the BA (Hons) Events Management and Master of Business Administration programme to use MC:EE in some of their workshop activities. This should demonstrate whether MC:EE can also be used effectively for other (non-coding) units. For (iii), we are working with colleagues teaching in the master's degree apprenticeship for experienced working professionals to integrate MC:EE into one of the theory-based units workshop activities. This should demonstrate whether MC:EE is useful among working professionals.

6 Further Discussions

To successfully use video games in different disciplines or professional areas, we suggest applying the five-step process introduced by Huang and Soman [23]. The process is as follows.

1. **Understand the education context and target audience**.
   What is the background around education? Who is your learner?

2. **Define your learning goals**.
   What are the learning objectives?

3. **Structure the learning experience**.
   What are the learning stages/milestones?

4. **Identify resources**.
   What are the resources needed to use video games?

5. **Apply gamification**.
   Which gamification approach should be applied? e.g., personal or social?

In addition to applying the steps, we recommend conducting periodic reflection to identify and address issues that may come up during the process.

7 Conclusion

In this paper, we conducted an experiment to evaluate the use of MC:EE to improve student engagement during online lessons. Based on the experimental results, we suggest the use of educational video games to attract student attention and engagement, especially when the learning material is delivered in an intensive format such as block teaching. The use of such methods could encourage students to be more engaged and motivate them to expand their knowledge beyond what is taught in class.

Even though the experiment has shown promising results, the number of participants involved in the experiment is rather small. Therefore, these results may not apply to a large group of participants, or when additional variables are introduced (e.g., units other than coding). Hence, we plan to conduct further experiments with a large number of participants across a wide range of units to validate the results.

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