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Investigating the effects on self-efficacy of communicating in Minecraft, a digitally-mediated environment

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Abstract

This study investigates the effects of communicating in a digitally-mediated environment (*Minecraft*) on students' self-efficacy. *Minecraft* is an open-ended virtual world that encourages a player's imagination and creativity. Such an online environment affords opportunities for realistic interaction with a created world. Increasingly difficult tasks were assigned to students working in pairs over four two-hour sessions and the effects of this activity on self-efficacy are explored through data gathered via reflections. Students acknowledged that during gameplay, cognitive load limited communication. However, regular reflection activities allowed for more effective communication, and during these activities students were engaged both in the game and in communicating with their partners. It is suggested that the use of *Minecraft* in the classroom be undertaken only if sufficient time can be invested, but such time can lead to students becoming more able to establish their own goals. Further benefits of using *Minecraft* as a teaching tool are suggested, as well as directions for future research.

Background

Games, including digital games, are not a new concept as classroom educational tools. As early as the 1970s, the Minnesota Educational Computing Consortium had developed digital games such as *The Oregon Trail* (1971) and *Lemonade Stand* (1979) for school computer labs. While these games are fondly remembered by many, at the time there were many downsides to educational games including the cost of technology, limited access to computer labs, and limited connectivity.

After this early introduction of computers into the classroom, by the early 1990s computers were near ubiquitous in Japanese schools (Kouyoumdjian, 1995). In the

modern day, access to games no longer requires a stationary personal computer that only a handful of people know how to operate. Technology has become faster, smaller and more connected, allowing people to play games in everyday situations. In addition, the increased use of technology has seen interest in games as an educational tool grow. The broader appeal of games, combined with the proliferation of non-violent, exploratory games, gives educators a larger pool from which to draw games suited to their students' needs. Amongst others, Prensky (2001) and Gee (2003) argue for the use of video games as effective education tools to develop students' motivation, interest in subject matter, and autonomy. Whitton (2010, pp. 46-47) connects games with constructivism and active learning through the precepts of situation cognition, cognitive puzzlement, and social collaboration.

One of those games is *Minecraft* (Mojang, 2009). In the base form of this blocky, open-ended sandbox game called 'survival', the player begins on a procedurally-generated landscape with no tools or materials. From that, they must gather materials to construct a safe home in order to survive the night, when dangerous creatures emerge. After ensuring their own survival, the player is left free to exercise their imagination, constructing fanciful buildings, erecting contraptions using a primitive form of logic called 'redstone', or simply exploring their surroundings. These activities create a wide variety of challenges suitable to players of various ability and interest. Whitton (2010, pp. 41-43) blends the concept of flow theory with the concept of gaming and engagement, creating a triad of characteristics that create an engaging educational game: challenge (appropriately-set goals), fantasy (narrative), and curiosity (constructive feedback).

Given the breadth of appeal of this game (having sold over 12 million copies of the game across multiple platforms (*Minecraft*, 2013)), it is not surprising that *Minecraft* has become a teaching tool in fields as diverse as math, history, and reading comprehension (Miller, 2012). However, while it can be presumed that research in the area of *Minecraft*

as a L2 teaching tool is forthcoming, at time of writing available research is limited. The company TeacherGaming has created a packaged version of *Minecraft* with tools useful to a classroom setting. This version presents an easy-to-use interface for creating a *Minecraft* world on a computer and allowing players to log in locally using a modified version of the game, greatly decreasing the technological knowledge needed to operate a server. Other modifications to the game itself include an administrator-level status for the teacher that gives them the ability move students, provide them with resources, and teleport students out of any holes when they become stuck.

Given the dearth of L2 research using *Minecraft* at the time this project was being designed, research with games known as massively multiplayer online role-playing games (MMORPGs) and MUVEs (multi-user virtual environment) were used as a foundation for this study (Henderson, Huang, Grant, & Henderson, 2009), (Whitton, 2010, pp. 187-189). This genre of games has some similarities to *Minecraft*, namely the opportunity for cooperation with other players, either in the same classroom or across the world. The differences are quite large, however. There is not just one world in *Minecraft* as there is in games like *Second Life*; each player can create their own single-player world, or log in to one of many online worlds that are completely separate from each other. However, there is no way to transfer one's items or in-game characteristics from one world to another. Additionally, many traditional MMORPGs, such as *World of Warcraft* (2004), have a storyline and plot that the player is required to navigate at a high level of language -- there is no option for customizing the story to the player's language ability. *Minecraft*, however, relies on the player to create their own narrative, within each students imaginative and linguistic scope.

The literature cited above suggests there is much room for research in effective classroom use of video games, especially in a higher education foreign language setting.

In particular, an open-world game such as *Minecraft* with a student-directed narrative would be ideally suited to the modern multimodal classroom at this institution to create an engaging student experience.

Research Questions

Primary

- Does communicating in a digital environment have an effect on students' self-efficacy?

Secondary

- What effect does the cognitive load of playing have on student's communication?
- How will students negotiate an activity that involves creative freedom within the game?

Methodology

Participants

The participants in this study were 2nd- to 4th-year paid participants recruited from four English classes. Five people responded and four were chosen based on availability to work in pairs. In the initial questionnaire, all participants professed to have played digital games of various genres on a variety of platforms, although some were more experienced than others. One of the participants already had experience playing *Minecraft* and indicated that he had played games of all genres (except for sports) on all platforms. He was also familiar with WASD, the control scheme familiar to players of first-person shooter (FPS) games (WASD denote the keys on the keyboard used for moving the character forward, back, left, and right). Two of the participants indicated a more moderate interest in games, and had not played *Minecraft* but did know the title of the game. The final participant had

no knowledge of the game, and claimed to be primarily interested in handheld and mobile game platforms, playing collectible card games.

Instruments

Personal history questionnaire

Personal data of the participants was collected through a closed-ended questionnaire. Data collected included experience of playing different types of computer games, number of hours played per week, and knowledge of the WASD controls. Information was also gathered regarding experience of English language games and finally their level of knowledge and experience of *Minecraft*.

Minecraft.edu

An education-focused, modified version of *Minecraft* called *MinecraftEdu* was used. This allowed a Local Area Network server to be set up with relative ease, and provided a tutorial world specifically designed by the *MinecraftEdu* team that was used to guide participants through the basic game mechanics such as movement, jumping, and how to obtain materials for building. The first session took place in this world, and had to be completed with guidance from one of the researchers before participants could begin subsequent sessions in another procedurally generated world.

Quicktime

To record both the students actions in the game, and their real-world interactions, Quicktime was used simultaneously with the webcam. Using screen capture, a clear video of the *Minecraft* world can be seen, together with a small window of the students' faces, gestures, and interactions with their partner.

Post-session reflections

Personal reflections on each session were collected via a paper questionnaire. Questions focused on what went well in the session and what difficulties the participants faced. Focus was also drawn towards communication difficulties, and their opinion of the English they used while playing. Finally, participants were asked to identify what their goal was for the next session, to encourage them to think about establishing a clear aim in advance.

Procedure

Directions provided pre-gameplay

Prior to actual gameplay, participants were provided with a list of basic movement and interaction controls in a graphical format, as well as a sheet with a list of basic crafting recipes.

Session 1

Participants were introduced to *Minecraft* through the tutorial world provided by *MinecraftEdu*. This world is designed explicitly to introduce players to the game and teach them basic controls and interactions by completing a series of tasks, beginning with movement controls, using the mouse to look around, jumping, climbing ladders, and so on. These tasks then move to interactions with the world, instructing players about how to obtain resources, the different physical properties that blocks have (some are affected by gravity, others require a specific tool to obtain them, etc.), and how torches can be used to light up dark areas. A researcher was on hand in both real-world and avatar form to guide participants through the course and to provide assistance when needed.

Session 2

During the 2nd session, the participants were introduced to a new world, without the night-time cycle in order to avoid monsters spawning nearby. They were encouraged to explore and interact with the world, for example by digging and chopping down trees. Their first teacher-set task was to build some kind of shelter to prepare for the next session. During this session, it became evident that very little communication took place between the participants during gameplay.[1] The reflection segment at the end, however, resulted in far more interaction. Unfortunately, because this segment involves watching a recording of the earlier gameplay, the communication could not be recorded.

Sessions 3 & 4

Unlike the first two sessions, the 3rd and 4th sessions focused mainly on the students working towards their own goals. In addition to this, to encourage more interaction during gameplay, smaller oral-based reflections were introduced in tandem with the day-night cycle for sessions 3 and 4. This meant that there could be a cycle of 12 minutes of gameplay during day-time followed by 7 minutes at night of reflection and planning for the next day. Added benefits of this decision included having a recording of these interactions, and removing the complication of monsters attacking the characters during night-time. The participants were gently encouraged to work together as a team, and help was provided if requested, but otherwise the students were in control. Unfortunately, for the last session, one participant did not show up, and a researcher took the role of partner for the final session to allow the other participant to finish their self-appointed task.

[1] Indeed, participants highlighted this themselves in the reflections, citing concentration on playing as the cause.

Results & Discussion

Self-efficacy

The original research question asked if communicating in a digital environment has an effect of students' self-efficacy. The following endeavours to summarize students views on their English through analysis of the end-of-session reflections.

From the data collected from the 4 participants, the following comments offer some insight into the participants self-efficacy (e.g. B3 denotes participant letter (B), and the session number (3)):

Positives

"We could discuss to build a house." (B2)

"I got my listening ability improved. I spoke with partner, so I improve my fluency." (C1)
"That was good because I got to speak without thinking too much." (C2)
"So natural. We didn't show any constricted manner." (C4)

"My partner seemingly understood me." (E1)
"I asked more questions than last time. We could discuss much more than before." (E2)
"I made many mistakes but tried to fix them when I noticed." (E3)

The above positive comments from three of the students focus on general improvements and progress in speaking English. Most noticeably, C noted fluency progress during the research, even suggesting an ability to 'speak without thinking too much', and not showing 'any constricted manner.' In addition to C's experience, E also noted successful communication with their partner, progressing from 'understanding', to 'asking more

questions' and 'discussing more', even noticing mistakes and attempting to fix them. This suggests that the activities promoted self-awareness of language ability, and led to self-detected improvements. In this way, it appears that playing *Minecraft* with a partner can have a beneficial effect on students' self-efficacy, in that students were aware of improved ability and communication.

Negatives

"I had to communicate more!" (A2)

"...difficult to explain what I want to say..." (B1, A3, E2, E3, E4)

"My vocabulary was poor, and not enough…" (B1)
"I used wrong words and my partner was confused." (B2)
"My partner' voice was sometimes too small to hear." (B3)
"my voice... small" (B3, E2)

"There's too many things I didn't know that I had problems communicating." (C2)

"I was trying not to make mistakes but I did some." (E2)
"I should ask my partner to say again when I can't hear him." (E4, E3, E2)

In terms of negative views towards self-efficacy, a number of comments raise interesting points from the activity. Firstly, it should be noted that while many students found it 'difficult to explain what (they) want(ed) to say', these same students had acknowledged progress elsewhere in their reflection, suggesting some difficulty, but nevertheless successfully

communicating and improving. Indeed, participant E became far more aware of the reasons for breakdowns in communication, and strived to reduce these issues (quiet voice, grammar mistakes). B also highlighted their own shortcomings, including poor vocabulary, wrong vocabulary, and quiet voice. That the participants became aware of how quiet some of their voices were might have a beneficial effect in the long-run, and this could be investigated further. In terms of vocabulary weaknesses, it might be useful to consider other comments made in this regard:

Game vocabulary issues

"Minecraft has many words that I don't use in usual lives, so sometimes I couldn't remember names of items." (B1)

I used some wrong words (furnace/fire) (B2)

Those vocabulary we used today in the game was particular, so I couldn't understand quickly. (A4)

The participants note that some of the vocabulary in *Minecraft* is not in daily use, an example of which is 'furnace' for 'fire', which also led to problems when confused with furniture. Other examples might include 'pick-axe' or 'sapling'. This 'particularness' also highlighted by students may have been a contributing factor to the difficulties in communication, and should be taken into account. Such vocabulary exists in real life, and although may be low frequency, may also be used in the future by participants. In this respect, *Minecraft* has the upper hand when compared to other similar games which may have specific fantasy vocabulary.

Cognitive load/Absorption

In addition to the effects of a digitally-mediated environment on self-efficacy, this research aimed to investigate the cognitive load of *Minecraft*. Following are some relevant participant comments:

"I couldn't figure out types of materials." (A2)
"I should have said how to make items to my partner as soon as possible after knowing the way.I'm regretting… I was so excited that I forgot to say that thing." (A2)

"I used only simple, easy words while playing. I should use more challenging words." (B3)
"difficult to control." (B1, E3)

"the view was narrow." (C1)
"I'd like a game which urges us to speak more." (C1)
"we got too absorbed into the game, we rarely had any conversation." (C4)

"The words I used during the session was too easy for my English level." (E4)

Here, participants note the difficulties in identifying types of materials (A2), controlling their character (B1, E3), and the narrowness of the view (C1), all of which pose a higher cognitive load on the player. The mental focus required to deal with this may help to explain other comments related to the level of English used while playing, where students reported that their English consisted of 'simple, easy words' 'too easy for my level'. They also reported that they '(were) so excited (they) forgot to say that thing' and were 'too absorbed in the game, (they) rarely had any conversation.' C even wanted a game that 'urges

us to speak more.' This effect was noted by the researchers and led to the adjustment of the sessions, where reflection breaks were introduced during night-time, allowing participants to engage in conversation free from the distraction of actively playing.

Despite the effects during live gameplay, the absorption experienced could be seen as students entering a state of flow, where challenge, fantasy, and curiosity combine to create an engaging situation that is considered to increase interest and enjoyment in games-based learning (Whitton, 2010, p41).

Togetherness

"I want to cooperate with my partners and accomplish stage." (A1)

"We could share some information." (A3)

"We didn't work together." (A3)

"We could solve puzzles together." (B1, E1)

"We need to go to cave together." (B3)

Engagement in the game also led to increased togetherness between one pair (B-E), with their reflections often referring to 'we' and 'together', denoting a stronger bond between the players in achieving objectives and solving problems through cooperation. However, A identified a lack of this togetherness in session 3, despite having explicitly made cooperation a goal after session 1. Even with A's focused efforts, the team operated less effectively with C working predominantly on their own. In fact, C did not write anything with regards to working as part of a team, their comments focusing primarily on their own progress in the game and difficulties they faced. In this respect the A-C partnership did not work well, and they could have been encouraged more to work together, thereby engendering cooperation and communication. Ultimately, despite high potential for

teamwork, it only flourished in one pairing.

Investing, planning, and establishing goals

The following comments have been organized in order of session number, to better highlight progress regarding goal-setting and investment in the game:

"I want to build something (house) and try fishing or mining with my partner."(B1)

"Next time, I won't forget cooperating with my partner."(A2)

"I want to catch pigs… make farms…bake pigs." (A2)

"At the beginning of today, I couldn't make any progress, but…. the progress was so amazing." (A2)

"I couldn't give many ideas what we can make." (B2)

"I'm glad if there's information to where to go next." (C2)

"Since the instruction didn't tell me which items I should use, I got panicked." (C2)

"I want to build house… stairs.. tool box...sign… button on front of the house." (A3)

"I want to finish building the house...put a shoes shelf and desk, chair, also chair in the balcony." (B3)

"I didn't find my ultimate objectives." (C3)

"I like a game which we can define objectives." (C3)

"We set our goal of this project." (E3)

"I asked many time how to do anything I want to do. Generally, game is played by one person and they understand , know, and carry out everything by themselfs. I needed more idea, and with more time, I can be more creative and can make many kinds of thing I cannot come up with now." (A4)

"Today, I could complete building my house! It looked like a real house!" (A4)

"I want to construct huge manshon or castle and make gorgeous dinner. Also, make garden with river and waterfall. I can do everything like real world!" (A4)

At first, participant-created goals are based on the primary sector, or resource collection (fishing, catching pigs, farming, mining), before progressing through to the building of houses, with additional details such as signs, buttons, and shelves. Latter objectives were based on larger aims such as castle construction, gardens, and waterfalls. Predominantly, these goals come from participants A and B, showing a continual adjustment as each goal was achieved by these participants. B bemoaned not having enough ideas in session 2, before identifying a clear focus in the next session, suggesting that although difficult without guidance at first, goals could be created. Interestingly, their respective partners were less enthusiastic about goal-setting, with C identifying lack of information (2), instruction (2), and failing to find ultimate objectives (3) as obstacles and indeed overtly stating a wish for a game with defined objectives (3). E mentions setting a goal for the first and only time in session 3. The observations of C and E, in comparison with their respective partners, show a clear disconnect between each pair in their attitude towards the game. A identified the need for more time to be creative (4), suggesting that goal-setting is quite challenging. This, together with the difference in experience between the participants, suggests that the establishment of goals by participants can benefit more creative students who may relish the challenge, but hinder students who are more comfortable with being instructed on what to do. Without clear aims, participants C and E had fewer rewarding moments such as 'I could complete building my house! It looked like a real house!' (A)

Summary

Generally, the effects of *Minecraft* as a digitally-mediated environment on the participants'

self-efficacy were mixed. As a game, the cognitive load was such that communication became more difficult and occurred at a more basic level, with word retrieval highlighted as a particular problem. However, through the night-time reflection activities and post-session reflections, far more communication took place, with the actions and developments in the game providing stimulus for meaningful communication. Through watching recordings of themselves playing, interacting, and goal-setting, students became far more aware of their weaknesses and were able to identify areas that require attention, such as voice volume. In English class, students may be asked to record themselves and listen for mistakes, but the act of doing so means their recording is inauthentic. Playing *Minecraft* was sufficiently distracting that the participants focused solely on playing, thereby producing a more natural record of their level.

In terms of cooperative learning, the game fostered some togetherness, but this is not always guaranteed and needs to be encouraged by the supervisor.

With regards to freedom of creativity, all students were eventually able to establish goals, with some more ready to embrace the idea than others. An initial lack of prescribed goals to begin with meant slow progress but some participants adapted quickly. Others would have been far more comfortable to receive direct instruction, and in that sense the complete freedom of the game was effectively restrictive for these students. That said, the fact that both teams did ultimately manage to identify clear goals to achieve indicates some growth in confidence amongst less independent students.

Implications

- This study consisted of four 2-hour contact sessions, the first half of which were establishing gameplay and controls. The effects of gameplay may have been different given more opportunities to play the game, both in terms of self-

efficacy, goal-setting, and achievement of stated goals. The sample consisted of only four participants, one of which did not attend the final session, so data from further participants may yield more substantial results.

- Using *Minecraft* in the classroom is a significant endeavour, and the technical ability of the teacher and student should be taken into consideration. The difficulties in setting it up mean this is not for a one-off class. Regular gameplay with investment of time is essential, and with this may come benefits in terms of self-efficacy and goal-setting.
- In light of goal setting being an issue for some participants, it is recommended that educational or research activities undertaken using *Minecraft* have some kind of teacher-guided, student-driven goals, such as a quest sheet (Gillispie, nd), which may help to inspire the users to create their own. Students initially struggle with open-ended activities as they prefer the security of more specific tasks. However, given a slightly more guided approach to an open-ended goal, students show signs of creativity and personal satisfaction having produced something all by themselves. In this sense, the game provided a good example of goal-setting for the participants.
- The cognitive load of playing means 'night-time' reflections are essential for better communication.
- The study focused on self-efficacy only, and research could be conducted into the differing levels of English spoken between daytime play and night-time reflection, as detected by the students themselves.
- For the game to be effective, students need to be interested in some aspect of the game, be it exploration (discovering new areas or exploring caves), building/creating (building structures, landscaping, etc.), or resource collection (creating

novel methods of obtaining resources that would be otherwise tedious). The participants of this study all showed engagement in the game through various tasks, but it should be noted again that these players were recruited voluntarily, and so it is likely that they were already predisposed to this kind of engagement and immersion in the game. Further research or teaching should take into account that such a positive reception might not always be the case.

- This research can serve as framework for a semester-long course in which students are in control of the goals they wish to achieve.[2]

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[2] Since this research was undertaken, a Minecraft-based course has been developed and is now taught as an upper-level elective at university-level.

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