JTAR

Journal of Teacher Action Research - Volume 8, Issue 1, 2021,
practicalteacherresearch.com, ISSN # 2332-2233

JTAR

Journal of Teacher Action Research
Volume 8, Issue 1, 2021

JTAR

About the Journal

Founded in 2013, the Journal of Teacher Action Research (ISSN: 2332-2233) is a peer-reviewed online journal indexed with EBSCO that seeks practical research that can be implemented in Pre-Kindergarten through Post-Secondary classrooms. The primary function of this journal is to provide classroom teachers and researchers a means for sharing classroom practices.

The journal accepts articles for peer-review that describe classroom practice which positively impacts student learning. We define teacher action research as teachers (at all levels) studying their practice and/or their students' learning in a methodical way in order to inform classroom practice. Articles submitted to the journal should demonstrate an action research focus with intent to improve the author's practice.

Editorial Team

www.practicalteacherresearch.com

I CAME. I SAW. I CREATED. — AN ACTION RESEARCH PROJECT ON HOW LEARNING WITH MINECRAFT AFFECTS STUDENTS' ENGAGEMENT IN CLASSICAL STUDIES

Christopher Charteris
Marlborough Technology Centre

Herbert Thomas
The Mind Lab

Abstract Video games have the potential to enhance students' engagement in the traditional sense (i.e. sustaining students' cognitive, behavioural, and emotional interest in learning), but also assist what Gee (2003) calls 'active engagement'. While educators are beginning to take the aesthetics of video games and apply these in practice to improve students' interest in, and enjoyment of, learning, the true potential of video games lies within their ability to engender individuality. The video game, Minecraft, is emerging as an appealing digital environment that can provide secondary educators with solutions to address the complex nature of students' engagement in contemporary practice. This project explores how the flexibility of Minecraft's open-world "sandbox" environment lends itself to the pedagogical approach of problem-based learning to enhance students' engagement in the context of New Zealand secondary education. Characterizing the relationship between pedagogy, Minecraft, and students' engagement as a complex problem, the project followed an action research process to develop a digital game-based learning experience for a senior high school Classical Studies class. The students involved focused on using Minecraft to (re)create Greek mythology. Quantitative and qualitative data were gathered through the post-experience survey, teacher observations, and student work. The findings illustrate that problem-based learning with Minecraft promotes a highly immersive environment where students' can be creative and demonstrate their understanding of mythology in ways not possible in the physical space of the traditional classroom. Students were able to actively engage in the learning process to construct an experience according to their personal goals and learning preferences – what students thought and what they chose to do mattered and this improved their confidence and independence as learners. While this project focused on how game-based learning with Minecraft might enhance students' engagement, it also illustrates an innovative instructional approach not commonly found in contemporary New Zealand secondary educational environments.

Keywords: teacher action research, Classical Studies, Greek mythology, Minecraft, engagement, game-based learning

Introduction

This paper reports on an action research project that investigated how the video game *Minecraft*, in combination with problem-based learning affected students' engagement in the context of a senior secondary school class studying Greek mythology. The project was implemented at an all-girls' high school in New Zealand in 2019. The teacher-researcher undertook this capstone project in collaboration with supervisors to partially fulfill the requirements for the degree of Master of Contemporary Education offered by The Mind Lab, a New Zealand Qualification Authority certified tertiary institute.

Since the age of sixteen, the teacher who led this research has found Classical Studies to be a stable source of inspiration and meaning. Wanting to share this passion with his students, he aims to develop innovative ways of delivering the subject to help revitalize his teaching practice, so today's digitally oriented students may gain insight into what the world of antiquity offers. The idea of introducing *Minecraft* in practice arose when his interest in video games was revived in 2018 – after ten years of inactivity. During preliminary research, the teacher noticed how different elements of some video game environments combined to create an immersive and gratifying experience. Encouraged to pursue ways in which video games might be applied in pedagogical contexts by course supervisors, the teacher initiated an action research project that sought to utilize the versatility of the *Minecraft* environment with the aim of establishing an innovative way of learning about Greek mythology.

Seymour Papert (1990), one of the pioneers in computer-based learning, believed that the computer's most significant educational potential was in supporting the empowerment of the individual. Underpinned by Papert's vision, this project aimed to explore the relationship between *Minecraft*, problem-based learning, and students' engagement in a senior secondary Classical Studies classroom. It aimed to answer the central research question: How might the use of *Minecraft*, in combination with problem-based learning, affect students' engagement in Classical Studies?

A body of literature about how students can learn in preparation for 21st-century life has grown exponentially over the last decade. Yet, this research struggles to make its way into daily classroom practice (Ananiadou & Claro, 2009; Schleicher, 2012). Such research calls for educators to place greater emphasis on designing technology-enhanced, student-centred learning tasks in the hope that students might develop competencies, like creativity and problem-solving, that could help them to participate and succeed in a future characterized by dynamic change and technological advancement (Microsoft and McKinsey & Company's Education Practice, 2018; Scott, 2015; Voogt & Knezek, 2018; Voogt & Roblin, 2012). While this push for greater student-centricity and inclusion of digital technologies in schools is predominantly characterized as a pragmatic solution to the pending displacement of low-skilled workers by automation (Microsoft and McKinsey & Company's Education Practice, 2018), it aligns with, and can be underpinned by, the philosophical notion that education should be about the empowerment of the individual as opposed to instruction and being taught (Papert, 1990). This philosophy runs counter to the prevailing pedagogical approaches practised in some contemporary New Zealand high schools. A report published

by the Education Review Office (2018) found that curriculum design in high schools is largely based on preparing students to pass the National Certificate of Educational Achievement (NCEA), which attracts content-driven, teacher-centred practices, like lecturing. In a digital society where preserving and enabling individual autonomy are intensifying concerns, re-energizing classrooms with emerging digital technologies, and broadening pedagogical approaches to allow for more student-centricity might enhance students' enjoyment of learning and engagement in competency development (Voogt & Knezek, 2018). Through applying the combination of *Minecraft* and problem-based learning, this project offers researchers and practitioners a small, but concrete example of how the combination of a popular digital technology and student-centred pedagogy can support students in being actively engaged in learning.

Literature Review

The first part of the literature review is organized according to the works of some key figures who have lived at the intersection of video games and education. Together, their publications help to establish our (the authors) knowledge on digital game-based learning. The constructionist theory put forward by Papert & Harel (1991) is complemented by authors like Gee (2003), Kiili (2005), Prensky (2010), and Van Eck, (2006) who attempt to bridge the divide between theory and teaching practice by describing the relationship between video games and learning. Where these authors provide us with a *why* and a *how* that helped inform the pedagogical design of this project, Ito (2009), in her role as an anthropologist, contributes to our historical understanding on the subject by providing a socio-cultural look into the reasons for the evolution of video games in the modern classroom. The second part of the literature review provides a survey of relevant classroom-based studies that seek to understand and show how *Minecraft* might support teachers in providing novel, engaging ways of learning for students. The literature review concludes by defining our approach to establishing what *engagement* means in the context of this project.

Relevant Experts. Papert (1990) believes that the most significant role digital technology can play in education is in supporting the empowerment of the individual. His learning theory, constructionism, stipulates that learning occurs when students are actively involved in creating artifacts (Papert & Harel, 1991). Problem-based learning is an example of constructionist theory in action: it is an approach where students learn about a subject through solving a series of problems that require them to construct their understanding of that subject by making a product (Hmelo-Silver & Barrows, 2006; Papert, 1990). Some harmony exists between problem-based learning and the way people learn through the video game experience (Gee, 2003; Kiili, 2005). Indeed, Kiili a digital game-based learning expert, states, "Games provide a meaningful framework for offering problems to students. In fact, a game itself is a big problem that is composed of smaller causally linked problems" (2005, p. 17). While researchers tend to focus on how video games encourage problem solving through providing customizable and immersive experiences for players, they do not necessarily provide specific practical insights as to how video games might be applied in classroom settings (Gee, 2003; Prensky, 2010; Van Eck, 2006).

Gee (2003) argues that popular off-the-shelf video games support effective learning through empowerment, problem-solving, and facilitating deep understanding. He further states that video games support learning because the actions players choose to take affect the game's outcomes. Video games can provide a highly customizable learning experience where players co-create the game through the decisions and actions they take, which improves players' sense of control. Additionally, Gee (2003) suggests that video games support learning through fostering problem-solving. Players are required to apply knowledge to solve problems during gameplay in an iterative fashion, which improves content retention, creativity, and self-confidence. Finally, Gee (2003) believes that video games promote academic self-efficacy through situated learning: not only does knowledge take on a deeper meaning when it is applied in a virtual environment where it has practical utility and is incorporated into players' experiences, but also because video games reward players for applying knowledge, players experience a sense of achievement that boosts their self-confidence.

In contrast, Ito (2009) presents a cultural history on the use of video games in classrooms. She contends that educational gaming software developed during the 1980s and 1990s represents a microcosm of broader binary tensions going on in society. For example, some digital games are used to reinforce traditional, structured methods of learning (*Where in the World is Carmen Sandiego? Kahoot*), where others place more control in the users' hands to foster individual development (*SimCity*). While reducing video games used in classrooms during this period to instruments promoting one of two sides oversimplifies the matter, Ito argues these opposing dimensions drove the development of educational gaming software. More notably, she states that, "Today's children… are growing up in a media ecology where producing, modifying, messing around with… and sharing digital media are part of everyday life" (2009, p. 185). Aligned with Papert (1990), she concludes that contemporary educators should adopt video games in practice to support the development of the individual; that the student should program the game, and not vice-versa.

Minecraft in Practice. Minecraft – and Mojang, the company that developed the environment – was purchased by Microsoft in 2014. Since then, the *Education Edition* has been developed, which is purposefully designed for use in classrooms. *Minecraft* is an unusual video game as there are no set goals or predetermined storylines for the player to follow. The open-world environment supports sandbox style gameplay, where the player constructs the game by following their curiosity, setting their own goals, and through manipulating the highly malleable environment towards those ends. Figure 1 shows a typical landscape the player sees when they spawn into a new *Minecraft* world. While typical players use the game as a platform to build all manner of things, from engineering a zombie apocalypse to recreating architectural wonders, its flexibility to effectively support the interests of the user makes *Minecraft* an appealing pedagogical tool.

Figure 1: A Typical Minecraft Landscape

Since *Minecraft's* release in 2011, a small body of literature has emerged, which seeks to understand how the environment can be utilized by teachers in practice. Karsenti, Bugmann & Gros (2017) provide a case study of how gamification (the application of game design elements in pedagogical contexts) illustrates *Minecraft's* potential for improving students' enjoyment of learning and supporting their development of creativity, collaboration, and problem-solving skills. Though their study was broad and overtly positive regarding the educational benefits of gamification and *Minecraft*, the wide range of data collected and analyzed comprehensively establishes *Minecraft* as an educational game. Additionally, Marcon (2017) and Craft (2016) used *Minecraft* as a pedagogical tool in high school settings to support students' literacy practices. While Marcon's (2017) classroom study is primarily concerned with how Gee's (2003) game-based learning principles might be used as a lens to interpret girls' literacy practices when playing *Minecraft*, it hardly addresses the design of the learning task students used and so has limited practical utility for classroom teachers. In contrast, Craft's (2016) pedagogical approach is clear. To make learning Latin more immersive for his students, Craft (2016) introduced a socio-cultural project where students watched instructional videos he created, conducted individual research, and rebuilt artifacts of ancient Rome in *Minecraft*. He encouraged students to continually revise their artifacts based on their research to promote accuracy. This cyclical element was a strength of the project as students were able to situate knowledge in the virtual environment, which in turn, embedded new learning. Though Craft (2016) also cites Gee's (2003) principles as influential, he established meaningful connections between video game design and learning theories. For example, he observed that good video games and the Zone of Proximal Development (Vygotsky, 1980) both encourage players/students to operate at a level of challenge just beyond their current ability. Craft (2016) used this principle to guide his teacher interactions with students, so he was more likely to provide the kind of scaffolding that supported individual progress during the project. Of the studies mentioned here, Craft's (2016) is the most salient. His work propels Minecraft beyond a trending gimmick in education. The key reasons for this appear to be his passion for teaching the Latin language, his ability to play Minecraft, and a deep understanding of the theory behind the pedagogy that informed his students' digital game-based learning experience. A precondition for such learning is student engagement.

Engagement. The transdisciplinary nature of this digital game-based learning project made the notion of engagement complex. Following principles of complexity leadership developed by Snowden & Boone (2007), instead of imposing a singular definition of engagement, three definitions were drawn from relevant sources:

1. In education, engagement is generally defined as a meta-construct for behavioural, cognitive, and emotional engagement in learning activities at school (Fredricks & McColskey, 2012).
2. In video game research, engagement is commonly understood as a player's level of game involvement and is viewed as a progression from immersion, presence, absorption, to dissociation (Brockmyer et al., 2009).
3. In digital game-based learning, Gee (2003) defined engagement as either active and critical or passive and inert. He argues that where video games encourage the former, school environments promote the latter.

Where the first two definitions emphasize students' (or players') interests, enjoyment and involvement in learning or playing, Gee's (2003) approach is more concerned with how video games provide environments that foster active engagement in learning. While the teacher-researcher worked with all three definitions, Gee's (2003) approach to engagement emerged as the most important. Firstly, the learning principles he developed to explain how video games actively engage people in learning were more relevant to understanding how students were participating in this project. Secondly, his approach to engagement focuses on how learning with video games can support the empowerment of the individual, which resonates with the constructionist theory that underpinned the pedagogical approach taken (Papert & Harel, 1991).

Methodology

The central aim of the project was to understand how *Minecraft* and problem-based learning might affect students' engagement in Classical Studies. The project followed the principles and process of McNiff (2010) and McNiff & Whitehead (2005) who indicate that action research is a systematic inquiry that improves practice, generates new theory, and is subjected to the critique of others. These elements were desirable in a classroom-based project such as this where collaboration and pedagogical risk-taking for the sake of innovation were paramount.

The action research process followed these steps:

1. The identification of a problem
2. The imagination and development of a solution
3. The implementation of the solution
4. The evaluation of the solution
5. The modification of practice based on that evaluation

(McNiff & Whitehead, 2005)

Participants. The project involved sixteen female Classical Studies students aged between 15 to 17 attending an all-girls state secondary school in New Zealand. It occurred over three

weeks and encompassed twelve one-hour lessons in a school computer lab where all machines had the *Minecraft Education Edition* software installed. Though most students had prior experience playing *Minecraft*, the class was provided with a one-hour introductory lesson where those with less experience could learn how to use or reacquaint themselves with the game. All students involved signed consent forms that outlined the purpose of the project, and how the data would be collected and treated. Ethics approval was obtained from the Mind Lab Ethics Panel before project implementation began.

Instrumentation and Collection. The instruments included the post-experience survey, the teacher's reflective journal, and a digital text produced by students in *Minecraft*. These instruments, which are detailed below, were selected because, in their totality, we believed they would provide a rich picture of the project's outcomes: where the post-experience survey aimed to capture a broader view of students' perspectives of their game-based learning experience, the reflective journal and mythic game students built in Minecraft offer a more specific, in-depth analysis of how students engaged in the experience. In collaboration with supervisors, the teacher decided that this combination of instruments would improve the credibility of the research as they enabled multiple perspectives of the same phenomenon to be interpreted and understood (Ivankova, 2014; McNiff, 2002).

The Post-experience Survey. The post-experience survey consisted of sixteen items and two questions that were designed to generate quantitative and qualitative data respectively to establish a balanced picture of students' engagement in their learning experience. The arrangement of the survey into three sections was influenced by the arrangement designed by Bolstad (2017), who also reports on a small-scale, game-based learning study performed in the context of New Zealand high school education.

Accordingly, the survey was divided into three sections. The first two sections formed the quantitative data component of the survey. Where the first section used ten items to measure students' perspectives of the learning experience in general, the second section used six items to measure students' perspectives regarding the *Minecraft* environment. The third and final section of the survey generated qualitative data and was comprised of two open-ended questions, which provided the opportunity for students to comment more specifically on aspects of the experience they enjoyed or found interesting, as well as comment on aspects of the experience they disliked.

The survey was performed in class shortly after the conclusion of the game-based learning task and was completed by fifteen of the sixteen student participants (one was absent). The survey was provided to students in a Google Form, which they accessed via a Google Classroom. Prior to completing the survey, the students met with the teacher in a school computer lab where each had individual access to a computer. The teacher then invited students to participate in the survey, provided general instructions about how to access and complete the survey, the importance of answering honestly, and that their responses would be recorded anonymously. The survey process took approximately twenty minutes to complete.

The Reflective Journal. McNiff (2010) states the central purpose of action research is to help teachers transform their practice for the benefit of their students. With this purpose in mind, the teacher kept a reflective journal during project implementation, which was critical towards improving his understanding of how the intervention he put in place was affecting the way students engaged with Greek mythology. The journal was completed and dated on a regular basis during the project and contained six entries that totalled 3700 words.

A typical journal entry was comprised of two components. The first component involved the teacher transcribing field notes made during his observation of students in class. The aim of these observations was to record how students engaged with the intervention and typically involved writing down what he saw students doing or saying in real time, which in turn, provided a stimulus for reflection (McAteer, 2013). The second component involved a reflective entry where the teacher would attempt to situate the field notes in the theory and literature used to inform the project. Entries in the journal followed this structure based on the teacher's preference, which is an acceptable approach in action research and reflects its "intensely personal nature" (McAteer, 2013, p. 5).

The Digital Text. The work students produced in Minecraft was a critical source of evidence for understanding how students were engaging with the learning task and how students were manipulating the *Minecraft* environment towards that end. Given the democratic nature of action research, McNiff & Whitehead (2005) emphasize to teachers the significance of utilizing the views of participants to inform the research and to inform practice. Moreover, in the context of this project, the *Minecraft* artifacts produced by students are expressions of their involvement in the experience that helped inform the teacher's understanding of the intervention. Where the post-experience survey explicitly asks for students to provide their perspectives on their engagement in the experience, their work produced in *Minecraft* provides more objective data that may evidence students' engagement in a more authentic manner.

At the conclusion of the project, the students shared their *Minecraft* worlds with the teacher via the export and import file sharing functions built into the platform. The four images presented in Figure 4, Figure 5, Figure 6, and Figure 7 are screenshots showing aspects of a mythic game a trio of students created. These images were selected by the teacher to illustrate key elements of his observations, clarifying the relationship between *Minecraft*, pedagogy, and students' engagement. The intent was to understand the intervention and further illuminate its complexity through the complimentary power of imagery – rather than suggest that these images represent the totality of work completed by all participants in this regard.

Quantitative Data Analysis. The quantitative data generated by the students' responses to the sixteen items in the post-experience survey were analyzed by aggregating the results across a five-point Likert scale ranging from 1 (strongly disagree*)* to 5 (strongly agree). The Likert scale is commonly used in research practices to measure the attitudes and perspectives of participants. While the survey enabled the participants to have their say and share their views on the project in a sincere and independent way, which is crucial in the

context of action research, the Likert scale was selected as an appropriate approach to the analysis of the quantitative data because it can transform an individual's subjective opinion into an objective measure (Joshi, Kale, Chandel, & Pal, 2015; McNiff & Whitehead 2005). Additionally, the bipolar nature of the Likert scale made it user-friendly and easily understood. This was an important consideration in measuring the views of people who are still relatively young.

Qualitative Data Analysis. One of the central aims of teacher action research is to empower teachers with the means of generating new theory about practice (McNiff & Whitehead, 2005). We consider this aspect of action research significant. Not only does it enable teachers to transform their practice for the benefit of students, but also encourages teachers to contribute new knowledge and ways of delivering innovative practices to the profession in an evidence-informed manner. Accordingly, we adopted an inductive approach to the analysis of the qualitative data, generated by the final two survey questions and teacher's reflective journal. This means that the data generated were coded according to the emergent themes identified by the teacher (Male, 2016). Furthermore, the themes identified across students' responses to the two open-ended survey questions were then quantified and presented via tables (Male, 2016). In contrast, the themes identified in the teacher's reflective journal are summarized and presented in narrative form (McAteer, 2013). Presenting the themes identified in the reflective journal in this format clarifies how *Minecraft* and problem-based learning worked to affect students' engagement.

Results

The Post-experience Survey. The survey results showing students' overall perspectives on game-based learning and *Minecraft* are illustrated by Figure 2 and Figure 3.

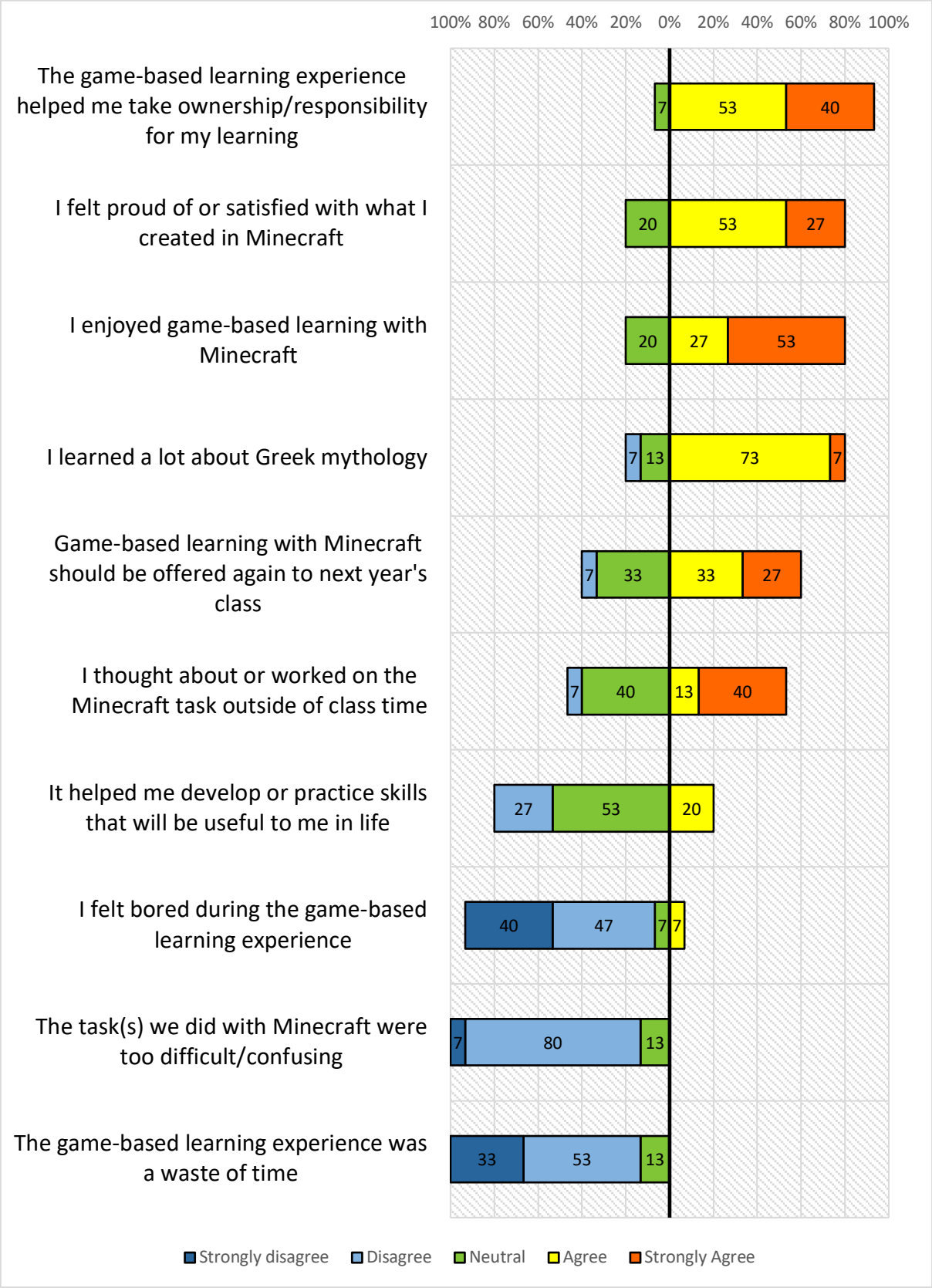

Figure 2: Students' thoughts on game-based learning with Minecraft

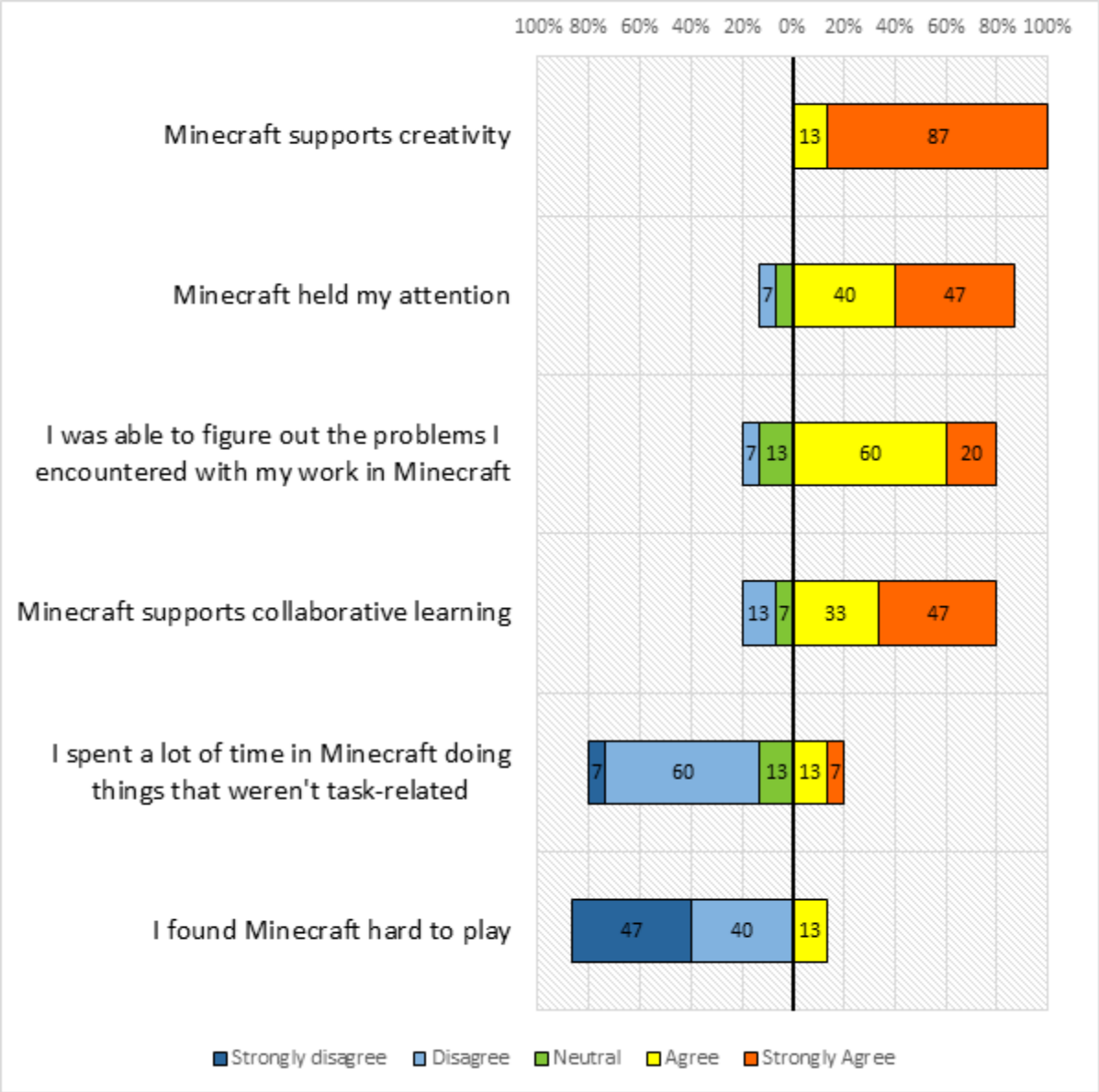

Figure 3: Students' thoughts about Minecraft

The responses indicate that most students found the experience valuable. Nearly all students (14 out of 15) agreed or strongly agreed that they were able to take ownership and responsibility for the learning process while most students (12 out of 15) agreed or strongly agreed that:

- They felt proud or satisfied with their *Minecraft* creations
- They enjoyed game-based learning with *Minecraft*
- They learned a lot about Greek mythology

Most students (13 out of 15) disagreed or strongly disagreed that:

- The task was too difficult
- The experience was a waste of time
- They felt bored during the experience

Most students (9 out of 15) said that the game-based learning experience should be offered again to next year's class (only 1 disagreed).

It was interesting to note that students gave a more diverse response as to whether the experience helped them to develop or practice skills that will be useful in life. Most students (8 out of 15) gave a neutral response to this question while some agreed (3 out of 15) and some disagreed (4 out of 15). However, in contrast, most students (12 or more) agreed or strongly agreed that *Minecraft*:

- Supports creativity
- Supports collaborative learning
- Supports problem-solving

The anomaly presented here might indicate that while students understand learning with *Minecraft* supports creativity, collaboration and problem-solving, they do not necessarily see or understand how these skills might be transferred and applied to different contexts. This might indicate a need for educators to emphasize to students how competencies might be transferred as well as providing opportunities for students to apply this in practice (Voogt & Roblin, 2012).

Finally, most students (13 out of 15) agreed or strongly agreed that *Minecraft* held their attention. Two thirds of students (10 out of 15) disagreed or strongly disagreed that they spent much time in *Minecraft* doing things that were not task-related and most students (13 out of 15) disagreed or strongly disagreed that playing *Minecraft* was hard.

The survey invited students to write comments in response to what they liked or disliked about the experience. In accordance with Male (2016), who recommends quantifying qualitative data, the comments generated by the two open-ended questions of the survey were coded according to emergent themes and are presented in Table 1 and Table 2. A brief explanation of the key themes identified is also provided with some illustrative comments from students.

Table 1: What was the most enjoyable or interesting part of the experience?

Theme	**Number of Comments**
Being creative	4
Personalizing learning	4
Novelty	3
Other	3

Students' responses stressed that having the freedom to explore and act on their curiosity was a highlight of the experience. Having the opportunity to perform the task "in our own way" was commonly reported as an essential aspect of the experience. The following comments are examples of the first three themes:

- "Building and creating the scenes. Being able to adapt and bend to fit our perspective and the game was really fun and made me and my partner use our creativity."
- "I liked that it allowed creativity and let me explore the myth I was studying in my own way."
- "I got to learn some stories from Greek mythology in order for me to create an art. Example, Demeter is goddess of agriculture, it gives me a vision using my imagination creating Demeter's world or how is it look like. The one that I enjoyed the most is that, as I collect data, I tend to look at some stories as well and not just sticking with our topic. I find myself flexible when in this learning experience."
- "Being able to do something less conventional in terms of learning the course material was really interesting."

In other comments, one student said she gained empathy for the ancient context; another commented that she enjoyed the collaborative aspect of the experience. The last comment expressed that seeing the finished product evoked a sense of pride.

Table 2: What did you dislike about the experience?

Theme	**Number of Comments**
Aspects of gameplay	5
Time management	4
Other	1

The following comments illustrate the first two themes:

- "There is a limit to how much you can do with *Minecraft*, especially in limited time."
- "Came across some issues that we weren't able to get around because of the time frame though I was still proud of the final result."
- "*Minecraft* didn't have all the tools I wanted to use (certain animals, inventory items)."
- "The blocks are all cubes so it's hard to make things that aren't square and sometimes it can get a bit tedious when clearing blocks to make foundations or manmade lakes."

- One student remarked that the task was difficult because she felt she was not a creative person.

The Reflective Journal. During the project, the teacher took field notes of a group of three students in their digital game-based learning experience and used these to inform a reflective journal. Upon analysis of the journal, three key reasons emerged that explain how students were engaging with the task. The teacher concluded that *Minecraft* and problem-based learning enhanced students' engagement because it:

- enabled customization of learning;
- improved perseverance and creativity; and
- improved students' sense of achievement and confidence.

For the sake of clarity and providing practical insight, the journal findings are summarized here in narrative form alongside images that show examples of students' work in *Minecraft*.

Students of this project were asked to solve the overarching problem of using *Minecraft* to create an interactive digital text based on a Greek myth. The journey towards solving this problem was predominantly characterized by negotiating a series of *intentionally designed* and *unforeseen* mini problems that accrued during their experience. Understanding the binary nature of problems students encountered when creating myths in *Minecraft* provides valuable insight into how problem-based learning improves students' engagement.

Where Figure 4 displays a bird's-eye view of an interactive digital text created by three students based on the life of the Greek god, Hephaestus, Figure 5 displays the player's point of view at the beginning of this game. Note the colour-coded paths in these two images; each path leads the player to simulations of events that occurred in the life of Hephaestus, such as an encounter with Eurynome and Thetis (as shown in Figure 6). These events equate to mini problems that students designed and solved during their experience, and when viewed in totality, form the solution to the overarching task. What is important to note, is that having autonomy over what mythic events to include or exclude and how these events were to be rendered in *Minecraft* improved students' emotional and intellectual engagement. This is because students would typically include events from myths they found appealing on some level (for example, they found an event humorous, or peculiar). Indeed, the most common reason students cited for their enjoyment during the experience was the freedom to customize the response to the task.

Figure 4: The Fall of Hephaestus

Note. A birds-eye view of a video game based on the life of the Greek god, Hephaestus, produced by three students in Minecraft.

Figure 5: The Opening Scene

Note. The image displays the player's perspective during gameplay of a digital text created by students.

Figure 6: Hephaestus Saved

Note. The image shows the player's encounter with Thetis and Eurynome, the two goddesses who received and nursed Hephaestus after Hera expelled him from Olympus.

Furthermore, when students encountered unforeseen problems during their experience, it placed greater demand on their creativity and improved their perseverance. Figure 7 shows *The Arm of Hera*, a machine the trio built in their digital rendering of the Hephaestus myth. Building this machine presented them with unforeseen challenges. The initial designs went awry, prompting them to engage in a feedback loop that is approximately described as a process of design, create, test, reflect, and repeat until the desired outcome was achieved. During the making of, *The Arm of Hera*, a machine that simulates the experience of Hephaestus being thrown off Mount Olympus for the player, one student commented that her avatar was thrown off the mountain multiple times while the group figured out ways to improve the accuracy of the circuits used to power the pistons responsible for launching the player.

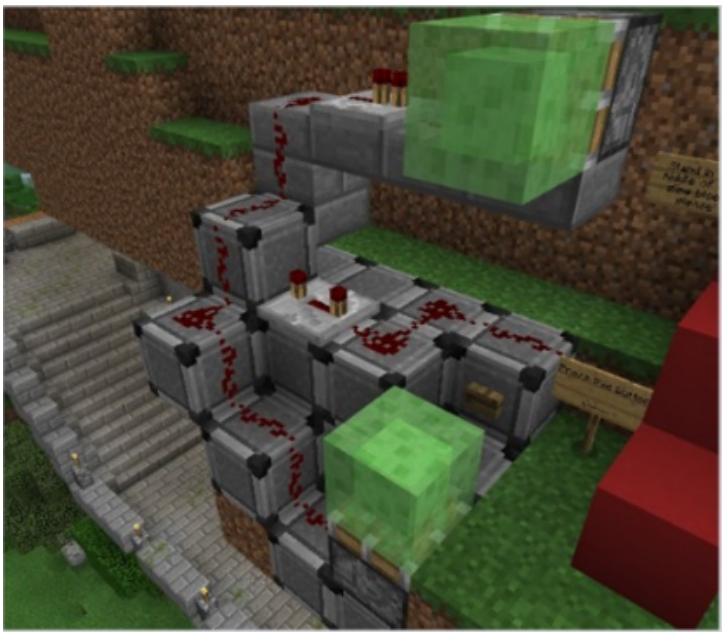

Figure 7: The Arm of Hera

Note. An image of a machine created by students that simulates that act of being thrown off Mount Olympus by Hera for the player.

Moreover, the unforeseen problems that students encountered in *Minecraft* invited students to draw on their imaginations to produce solutions. The vast range of on-demand tools and materials in *Minecraft* enabled students to succeed when faced with the unforeseen problems that arose as these resources supported the practical implementation of ideas that the students wanted to test. The supplementary nature of the relationship between *Minecraft* gameplay and the human imagination enhances students' engagement in problem-solving as it engenders greater creativity and perseverance in the face of challenges then one would normally anticipate from a more traditional approach to this type of text making task.

Finally, students' sense of achievement and confidence improved as a consequence of using problem-based learning with *Minecraft*. Students could act on their curiosity and bring the designs of their imagination into being. This creative process of bringing something intrinsic and abstract into a tangible form, at least visually and in the experiential sense, was associated by the students with a sense of pride and accomplishment. Looking at their finished products was typically cathartic for the students. They felt good about their learning and what they had produced. The combination of pedagogy and *Minecraft* struck an environmental balance that enabled students to produce artifacts that reflected aspects of themselves and their efforts.

Discussion

This project aimed to explore how the combination of *Minecraft* and problem-based learning might support students' engagement in learning about Greek mythology. The results illustrate that problem-based learning with *Minecraft* promotes a highly immersive

environment where students' can act on their imagination and curiosity meaningfully and demonstrate their understanding of Greek mythology in ways not possible in the physical space of the traditional classroom environment. Notably, problem-based learning with *Minecraft* enhances freedom of expression as students can practice and develop creativity and express their individuality through designing and solving challenging problems in customized ways, which improves their commitment to, and enjoyment of learning mythology. Students of this project were able to actively engage in the learning process to construct an experience according to their personal goals and learning preferences. Therefore, the findings resonate with Gee who states, "Good video games allow players not just to be passive consumers but also active producers who can customize their own learning experiences" (2003, p. 194). Simply put, what students thought and what they chose to do mattered and this improved their engagement because they felt empowered. Given the global contemporary trend encouraging educators to adopt more technology-enhanced, student-centred learning practices, the results of this project attest to the combination of *Minecraft* and problem-based learning as one viable, and promising solution (Scott, 2015). The beauty of such a combination is that it can be used by teachers across academic disciplines and sectors; its utility is not limited to the field of Classical Studies.

Where the efficacy of digital game-based learning is concerned, the pedagogical findings agree with the sentiment put forward by experts like Prensky (2010), Van Eck (2006), and Kiili (2005) who advocate a need for educators to deploy video games in the classroom. One of the most valuable outcomes of the project was in defining the mechanics of, and inner workings behind, the nature of problems students solve when using the *Minecraft* environment. Kiili states: "Games provide a meaningful framework for offering problems to students. In fact, a game itself is a big problem that is composed of smaller causally linked problems" (2005, p. 17). On that note, the results of this project contribute further knowledge that defines how and why problem-based learning in *Minecraft* affects engagement. Where the nature of problem-based learning was originally hidden and ambiguous, the emergent nature of the action research process enabled the teacher to reveal knowledge that clarifies how the relationship between problem-solving and *Minecraft* might produce an engaging learning experience. Such clarification might encourage other educators to see *Minecraft* as a viable platform to deploy in the classroom.

When using *Minecraft* in practice, this project highlights that it is essential for teachers to think about how education theory and pedagogy can inform the design of the learning task. One of the strengths of the project that helped facilitate students' engagement was the cohesion between constructionism, the pedagogy of problem-based learning, and *Minecraft* (Hmelo-Silver & Barrows, 2006; Papert and Harel, 1990). The unity between theory, pedagogy, and technology provides a foundation that drives students' learning experiences. Indeed, this recommendation reflects Karsenti et al. who state that teacher use of *Minecraft* should be "supported, educational, and purposeful" (2017, p. 27) as well as Craft (2016) who successfully utilized socio-constructivism to design and inform the learning activities his Latin students engaged in with *Minecraft*. While it might appear to be common sense to suggest teachers implement *Minecraft* through established theory and knowledge, it is important to emphasize that *Minecraft* is an emerging technology whose potential is not

fully realized in classroom practice. By binding *Minecraft* in this way, teachers can take informed pedagogical risks that are more likely to yield outcomes that could lead to sustainable innovations.

The results of this project endorse the views of Marcon (2017) and Craft (2016) regarding the efficacy of Gee's (2003) game-based learning principles in supporting teachers' understanding of how they might take advantage of *Minecraft* in the classroom. Given Gee's (2003) influence on these smaller classroom studies that use *Minecraft*, there is a temptation to simply conclude that his principles are generic, but rather, the reason these studies found his work meaningful is because it bridges the divide between two worlds: the world of the classroom teacher and that of video games. While Gee's (2003) principles are general insofar as they are abstractions he derived from thinking about his experiences with "good" video games and integrating those experiences with his knowledge of how people learn, they have teeth; they carry immense practical utility and can support innovative practices with *Minecraft*. For example, where Craft (2016) found the cyclical element of Gee's (2003) principles useful for embedding his students' learning of Latin (content) in the *Minecraft* environment, this project found the cyclical element of Gee's (2003) principles as a useful mechanism in supporting students' creativity and problem-solving (competencies). The divergence in outcomes that the application of Gee's (2003) principles can produce is highly desirable in the current climate of education where innovation is a priority (Scott, 2015). There is little doubt that Gee's (2003) game-based learning principles can continue to assist teachers and researchers in further illuminating the potential of *Minecraft* to support dynamic learning opportunities for students.

Though this project is primarily concerned with enhancing student engagement, the survey results unexpectedly revealed a discrepancy in students' understanding of the competencies their *Minecraft* experience supported (for example, in creativity and problem-solving) and how these competencies might be relevant to their lives. Given that the future job market is likely to place greater value on creativity and problem-solving and that being able to create artifacts with technology is an important component of maintaining one's individuality in a digitally sophisticated society, the next iteration of this action research will seek to address this issue by deploying *Minecraft* and problem-based learning in an interdisciplinary project (Ito, 2009; Microsoft and McKinsey & Company's Education Practice, 2018; Voogt & Knezek, 2018). It is envisaged that such a project might enable students to see how skills in creativity and problem-solving can be transferable between contexts, and therefore, more valuable, and relevant to their lives.

Conclusion

At its core, this project explored how a teacher could deliver to students an innovative way to engage with Greek mythology. The results showed that problem-based learning with Minecraft is highly engaging and useful towards cultivating individuality. Most students found the experience enjoyable and valuable. It enabled them to make and actualize decisions about their learning and to solve problems creatively and independently through making task-related artifacts in the Minecraft environment. Given that competency

development and personal responsibility for learning are important towards preparing students for a dynamic future (Microsoft and McKinsey & Company's Education Practice, 2018; Scott, 2015; Voogt & Knezek, 2018; Voogt & Roblin, 2012), the approach offered by this project provides a useful schematic for teachers looking for such additions to invigorate the curriculum.

Whether or not students gained a deep understanding of Greek mythology during the project was not a focus of this research, but is an obvious and important question that needs an answer – for teachers may not wish to sacrifice quality of learning for the sake of enhanced student engagement. Clarifying this relationship could provide a more convincing basis for teachers to see Minecraft as a powerful educational tool. Though Craft (2016) illustrates the potential of Minecraft to support academic rigor in learning Latin, it is recommended that future studies build upon this by examining how Minecraft might support academic progress in learning different aspects of Classical Studies, especially in relation to other proven methods.

On a final note – and perhaps most importantly – we conclude that, when harnessed through careful pedagogical consideration, the Minecraft environment enables Classical Studies teachers and their students to breathe life into the ancient world in an appealing, virtual form. In binding the old with the new through pedagogical design, this project, though small in scale, helps describe the face of progress in the contemporary Classical Studies classroom.

About the Authors

Christopher Charteris graduated with a Bachelor of Arts in Classical Studies from the University of Canterbury in 2008. Following this, he taught Classical Studies for ten years at secondary level. He was awarded a scholarship that enabled him to complete a Master of Contemporary Education from the Mindlab in 2019. Christopher lives in New Zealand, currently teaching at a Technology Centre for 10 to 12-year-old students. Academically, he is interested in the wisdom of ancient mythology and how it could be used with gaming technologies to encourage freedom of thought and individual development. Email: chris.jo.charteris@gmail.com

Herbert Thomas, Ph.D. holds a Ph.D. in Computer-integrated Education and a master's degree in Linguistics. Before his appointment as Manager of the Centre for Educational Development at CPIT, he was Team Leader of the Electronic Learning Media unit in the Digital Media Group at the University of Canterbury. Previously, he held the position of Head, Division e-Learning at the University of the Free State, South Africa. He has taught English at both secondary and tertiary levels and has been involved in the field of e-learning and e-learning management for more than 15 years. His research focus is on matters relating to definitions of learning in the digital age; the design of learning spaces and environments; education and complexity; and the management of learning and teaching in the tertiary education sector. Email: herbert@themindlab.com

References

Ananiadou, K., & Claro, M. (2009). 21st century skills and competences for new millennium learners in OECD countries. Retrieved from http://repositorio.minedu.gob.pe/handle/123456789/2529

Bolstad, R. (2017). Playing for peace: Complex role-play gaming in high school history. Retrieved from https://www.nzcer.org.nz/system/files/Playing%20for%20Peace%20-%20case%20study.pdf

Brockmyer, J. H., Fox, C. M., Curtiss, K. A., McBroom, E., Burkhart, K. M., & Pidruzny, J. N. (2009). The development of the Game Engagement Questionnaire: A measure of engagement in video game-playing. *Journal of Experimental Social Psychology*, *45*(4), 624-634. doi: 10.1016/j.jesp.2009.02.016

Craft, J. (2016). Rebuilding an Empire with Minecraft: Bringing the Classics into the Digital Space. *The Classical Journal, 111*(3), 347-364. doi:10.5184/classicalj.111.3.0347

ERO. (2018). What drives learning in the senior secondary school? Retrieved from https://www.ero.govt.nz/publications/what-drives-learning-in-the-senior-secondary-school/

Fredricks J.A., McColskey W. (2012) The Measurement of Student Engagement: A Comparative Analysis of Various Methods and Student Self-report Instruments. In: Christenson S., Reschly A., Wylie C. (eds) Handbook of Research on Student Engagement. Springer, Boston, MA. doi: 10.1007/978-1-4614-2018-7_37

Gee, J. P., (2003). What video games have to teach us about learning and literacy. New York, NY: Palgrave MacMillan.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning*, *1*(1), 21–39. doi: 10.7771/1541-5015.1004

Ivankova, N. V. (2014). *Mixed methods applications in action research*. Sage.

Ito, M. (2009). *Engineering play: A cultural history of children's software*. MIT Press.

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Likert scale: Explored and explained. *Current Journal of Applied Science and Technology*, 396-403. doi: 10.9734/BJAST/2015/14975

Karsenti, T., Bugmann, J., & Gros, P. P. (2017). Transforming education with Minecraft. Retrieved from https://education.minecraft.net/wpcontent/uploads/Minecraft_Research_Report_Karsenti-Bugmann_2017.pdf

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education*, 8(1), 13-24. doi: 10.1016/j.iheduc.2004.12.001

McAteer, M. (2013). *Action research in education*. Sage. doi: 10.4135/9781473913967.n5

McNiff, J., & Whitehead, J. (2005). Action research for teachers: A practical guide. Retrieved from https://ebookcentral.proquest.com/lib/themindlab/reader.action?docID=1075096

McNiff, J. (2010). *Action research for professional development: Concise advice for new action researchers*. Dorset: September Books.

McNiff, J. (2002). *Action research: Principles and practice* (2nd ed.). Routledge. Retrieved from https://kapanjadibeda.files.wordpress.com/2010/08/action-research-princip-and-practice.pdf

Male, T. (2016). Analysing qualitative data. In I. Palaiologou, D. Needham, & T. Male. (Eds.), *Doing research in education: Theory and practice* (pp. 177-191). Retrieved from https://www.researchgate.net/publication/301788881_Analysing_Qualitative_Data

Marcon, M. N. (2017). Exploring Minecraft as a pedagogical tool to motivate and enhance girls' literacy practices in the secondary English classroom (Thesis submitted in partial fulfilment of the requirements of the degree of Master of Education conferred by the University of Monash, Australia in 2015). doi: 10.4225/03/58b79d6f1e9b2

Microsoft & McKinsey & Company's Education Practice. (2018). The class of 2030 and life-read learning: The technology imperative. Microsoft. Retrieved from https://education.minecraft.net/impact/

Papert, S. (1990). A critique of technocentrism in thinking about the school of the future. Retrieved from http://www.papert.org/articles/ACritiqueofTechnocentrism.html

Papert, S & Harel, I. (1991). Situating Constructionism. Retrieved from http://www.papert.org/articles/SituatingConstructionism.html

Schleicher, A. (2012). *Preparing Teachers and Developing School Leaders for the 21st Century: Lessons from around the World*. OECD Publishing. France. doi: 10.1787/23127090

Scott, C. L. (2015). The futures of learning 3: What kind of learning for the 21st century? Retrieved from https://repositorio.minedu.gob.pe/handle/123456789/3747

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review*, *85*(11), 68-76.

Van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE Review*, *41*(2), 16-30.

Voogt, J., & Knezek, G. (2018). Rethinking learning in a digital age: Outcomes from EDUsummIT 2017. *Technology, Knowledge and learning*, *23*(3), 369-375. doi: 10.1007/s10758-018-9383-y

Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, *44*(3), 299-321. doi: 10.1080/00220272.2012.668938

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*. Harvard University Press.