Minecrafters: An educational model for developing collaboration

Dr Janette Hughes, Faculty of Education, Ontario Tech University, Canada, janette.hughes@ontariotechu.ca,
Dr Laura Morrison, Faculty of Education, Ontario Tech University, Canada, laura.morrison@ontariotechu.ca,
Tess Butler-Ulrich, Faculty of Education, Ontario Tech University, Canada,
tess.butlerulrich@ontariotechu.net,
Jennifer Robb, Faculty of Education, Ontario Tech University, Canada, Jennifer.Robb@ontariotechu.ca

Abstract

In response to significant global events such as the COVID-19 pandemic, educational environments are undergoing a fundamental transformation towards collaborative online spaces and networked learning. Networked learning includes (a) the process of learning with and through other people and resources and (b) the environment (i.e., the internet) and platforms (i.e., YouTube, websites, social media, discussion forums) that support these connections or networks (Hodgson & McConnell, 2019). This shift in how learning is done necessitates a reevaluation of pedagogical methods to foster the development of students' global skills and competencies. These competencies, as defined by the Council of Ministers of Education Canada (CMEC), are recognized as essential for individuals to not only adapt but thrive in our current and future world. This world is characterized by unprecedented simultaneous challenges, often referred to as a 'polycrisis,' and rapid advancements in artificial intelligence (A.I.) that have the potential to reshape every aspect of human existence. Therefore, it is imperative that we delve into a deeper investigation and understanding of innovative pedagogical approaches to ensure students are adequately prepared for the evolving landscape. Collaboration is arguably one of the most important of the global skills and competencies as it underpins many of the essential skills youth need to thrive in educational and non-educational settings. More specifically, collaboration underpins the type of networked learning rising in popularity in formal and informal learning settings (Bülow & Nørgård, 2021). As a result, this exploratory research focuses on Minecraft: Education Edition (M:EE) as a tool for developing collaboration through critical making and team-based learning. Over a five-day spring-break camp, two cohorts of students (grades four to six and grades seven to eight) participated in open-ended design-based learning challenges online (in the virtual meeting platform, Google Meet, and in the virtual world, M:EE). Data analysis revealed that collaboration manifested itself in three primary modes: co-constructing knowledge, peer-teaching, and conflict management. Analysis further revealed that younger versus older students build and collaborate in the online environment very differently, which at times mirrored the 'real world' classroom. These findings have implications for designing age-appropriate online learning experiences to support collaboration in a networked environment, especially within virtual simulation and creation worlds like Minecraft.

Keywords

Networked learning; elementary education; collaboration; digital technologies; educational gaming; global competencies; Minecraft

Introduction

In light of significant global events like the COVID-19 pandemic, K-12 education has shifted toward collaborative online environments and networked learning (Ryberg, 2021). Networked learning encompasses two key components: firstly, the process of acquiring knowledge through interactions with both individuals and various resources, and secondly, the use of the internet and online platforms like YouTube, websites, social media, and discussion forums, to facilitate these connections and networks (NLEC, 2020). This shift in educational paradigms necessitates a reassessment of the pedagogical strategies used to cultivate students' global skills and competencies. These global skills and competencies, as defined by the Council of Ministers of Education Canada (CMEC), are universally recognized as indispensable for individuals to not only adapt but also thrive in our contemporary world (CMEC, 2016). The ability to effectively collaborate with others appears to be one of the paramount global skills and competencies, as it serves as the cornerstone for numerous essential abilities, including developing interpersonal and intrapersonal skills necessary to participate in teams effectively and ethically. Students need to

be able to learn with and from others in both physical and virtual environments (CMEC, 2016). To be more specific, collaboration forms the foundation for the kind of networked learning that is gaining prominence in both formal and informal educational settings (Sobko et al., 2019). One collaborative virtual environment that has become popular in K-12 education is Minecraft Education Edition (M:EE). M:EE can be leveraged to support networked learning as it is based on social constructivist and constructionist approaches to education. The research question therefore driving the first phase (analysis and exploration) of this Design Based Research (DBR) (McKenney & Reeves, 2019) study was: what types of collaboration skills and strategies do different groups of students bring to networked learning environments? It is crucial to answer this question in order to design the scaffolding required to support students' collaboration skills in a formal classroom setting when using networked learning strategies and platforms, like M:EE.

M:EE to Support Social Constructivist Learning

Minecraft
Minecraft is classified as a sandbox game, enabling the player to pursue self-directed gameplay objectives with few constraints imposed by the structure of the game (Ocio & López Brugos, 2009), and it is primarily driven by player creativity (Schifter et al., 2013). Players can construct virtual worlds in the game in modes like "creative mode" where there are no threats to the avatar's survival; or, players can attempt to survive various challenges (like hunger and predation) in modes like "survival mode" (Mojang, n.d.-a). Minecraft is especially popular due to its multiplayer capabilities. Online multiplayer servers enable friends or strangers to play together in the same world. The game includes a text-based chat function that allows players to talk to each other, see when a player joins or leaves the game, or be notified of achievements. The chat is also used for commands, which can enable players to switch game modes, adjust a player's spawn location, or access other controls dependent on the server's settings. As a result of these features and affordances, Minecraft has been examined as a tool for learning through social constructivist principles (Schifter et al, 2013; Banks & Potts, 2010; Riordan & Scarf, 2017). The open-endedness of Minecraft's environment has great potential for socialization (Riordan & Scarf, 2017). Schifter and colleagues (2013) note that Minecraft affords opportunities for showcasing creativity while also developing important classroom collaboration skills. Large or small groups of players are primed for socialization and collaboration through dynamic opportunities for reaching group goals, creating builds, and surviving the threats Minecraft's environment poses.

Minecraft Education Edition (M:EE)
Minecraft has gained significant traction in the classroom (Gallagher, 2014; Barron, 2013). Minecraft's open-endedness, freedom to experiment, and opportunities for problem-solving and self-expression make it an appealing choice to teachers as a pedagogical platform that can support networked learning. M:EE, released in 2016, claims on its website that it "helps prepare students for the future workplace, building skills like collaboration, communication, critical thinking and systems thinking" ('M:EE training materials,' 2020). The educational version includes Code Builder, which offers students the ability to learn basic coding with tools such as Scratch or Microsoft MakeCode. M:EE is grounded in social constructivist (Vygotsky, 1978) and constructionist (Papert, 1980) theories; it promotes classroom collaboration through creating and building as students make meaning together (Schifter et al., 2013). While Minecraft creates the platform for social constructivist learning to thrive, the pedagogical approach of the teacher is key in terms of setting the stage for successful learning (Beavis et al., 2014; Mehrotra, 2012). The concept of the Zone of Proximal Development (ZPD) is a central tenet of a social constructivist approach. The ZPD in this context is defined as the distance between a student's level of actual development and their level of potential development, or what they might be able to do with the assistance of a more knowledgeable other. In the case of this study, that knowledgeable other might have been one of the facilitators or a peer. Dezuanni (2020) suggests that the concept of "peer pedagogies provides a productive way to think about Minecraft and learning because it accounts for the unique ways knowledge is exchanged in informal and formal ways on digital platforms" (p. 183).

Further, Minecraft's networked platform may allow users to easily construct a "Community of Practice" (CoP), an informal learning organization that allows for knowledge exchange and collective learning. Communities of Practice are found across contexts. Schools, clubs, and work are common examples of settings where CoPs are formed and possess "an identity as a community, and thus shapes the identities of its members. A community of practice exists because it produces a shared practice as members engage in a collective process of learning" (Wenger, 1998, p.4). Communities of Practice can promote social constructivist principles and action by providing

a medium for interaction and opportunities to socially negotiate, learn from and teach others, and problem-solve within the specific environment of their CoP. Minecraft's virtual environment may support building a CoP based on a common interest and goal-setting to complete design-based challenges where students must negotiate their personal goals and visions with their peers, and accommodate new knowledge that emerges through social interaction (Vygotsky, 1978; De Felice et al, 2022). Within a virtual game environment, these interactions

> form conventionalized ways of behaving or practices. Newcomers to communities learn these practices by observing more competent individuals and by successfully engaging in progressively more difficult tasks. As newcomers become more competent in the community's practices, they undergo a series of changes in identity. (Reese, 2008, p. 12)

Several key concepts of CoP theory (Wenger, 1998; Lave & Wenger, 1991; Wenger-Trayner & Wenger-Trayner, 2014) were demonstrated in the participants' collaboration, including mutual engagement (social interaction and collaboration within the community that can create a learning environment where students can observe, imitate, and learn from each other); joint enterprise (shared goals or purpose that brings students together and shape the community's identity), and shared repertoire (a set of tools, language and resources that help define the community's practices and facilitate communication). As individuals participate and become situated within a CoP, learning is facilitated through a dynamic combination of engagement (communication, collaboration, producing artifacts); imagination (building a shared vision of practices, identities, and behaviours for CoP members), and alignment (Wenger, 1998; Lave & Wenger, 1991; Wenger-Trayner & Wenger-Trayner, 2014).

Literature Review

Global Competencies, Collaboration, and Networked Learning Platforms in Education
Global competencies are attitudes, skills and knowledge that are necessary for youth to develop in order for them to become productive citizens who are well-equipped to manage the rapidly changing societal and technological landscape. In 2016, the Ontario Ministry of Education released a working document identifying the six global skills and competencies necessary for success in school, work, and social life. These six categories include: critical thinking and problem-solving; innovation, creativity, and entrepreneurship; learning to learn/self-aware and self-directed learning; collaboration; communication, and global citizenship (Ministry of Ontario, 2016). For the purposes of this article, we focus on how a networked game (Minecraft: Educators' Edition) might foster collaboration skills specifically.

Collaboration in learning occurs when two or more students work together to complete a task. Research suggests that collaboration can positively impact learning, cognitively, affectively, and socially (Casey & Goodyear, 2015; DeBack et al., 2023; Johnson et al., 2000; Kyndt et al., 2013; Slavin, 1980). Within the Ministry of Ontario (2016) document noted above, collaboration includes descriptors such as 'participates in teams; establishes positive relationships; learns from, and contributes to, the learning of others; co-constructs knowledge, meaning and content; assumes various roles on the team; manages conflict; networks with a variety of communities/groups; respects a diversity of perspectives' (p. 56). While collaboration is one of the six categories, it is also embedded (both subtly and overtly) throughout the descriptions of each of the categories. In many ways, collaboration underpins and upholds the other categories. For example, it is difficult to effectively communicate, if one does not also have effective collaboration skills. OECD (OECD, para.4) explains the importance of collaboration in today's world:

> Collaborative problem solving is increasingly recognised as an important 21st century skill as it has several advantages over individual problem solving: labour can be divided equally, a variety of perspectives and experiences can be applied to try and find solutions, and team members can support and stimulate one another, in turn enhancing the creativity and quality of solutions.

One potential path to achieving the development of the aforementioned global skills and competencies is networked learning platforms, like networked games (i.e., M:EE). There are thousands of new educational games released every year, some with specialized foci to improve targeted skills in children.

Networked Learning Gaming Platforms for Collaboration
Collaboration can further be conceptualized as the capacity to co-construct knowledge with others, and to become active producers and creators of content, rather than solely consumers of it (Ministry of Ontario, 2016). Some

popular technology-based tools that support collaboration range from flipped classroom models to ePals, an electronic mail exchange with youth across the globe (Jackson, 2013). It is now possible to collaborate independent of time and geographic location, a previously formidable challenge. Trespalacios and colleagues (2011) report that video games are powerful collaborative tools because students naturally want to be part of a social experience. Students both value being a part of a team and reaching goals as well as helping each other survive threats. Videogames present unique experiences in which students are both motivated to engage with content and predisposed to social learning and collaboration. Peppler and Solomou (2011) studied creativity, communication, and collaboration in social media game environments using Quest Atlantis, a collaborative online platform that immerses players in socially-negotiated education activities. This study was primarily focused on creativity and the ways in which ideas spread amongst social circles, rather than factors that promote the development of these global competencies. Eighty-five elementary students played the 'Architects' mission, which prompted players to create their own 3D buildings, using a story narrative based on the novel *The Fountainhead* by Ayn Rand, as a backdrop. The students were divided into two creative cultures: The first culture was led by Roark, a character from *The Fountainhead,* which had open-ended architectural guidelines, and the second was led by Keating and had substantially more rigid architectural guidelines such as, 'All buildings must have a brick texture on the front side' (Peppler & Solomou, 2011, p. 16). The houses designed by players on the Roark team were colourful and had varied textures, while those on the Keating team built structures more reserved in colour and textures. However, perhaps the most compelling observation from the study was transferable ideas. The authors noted that there were distinct architectural trends that spread between the two camps that served as a means of cohesion mediated by conversation. There were also many instances of effective collaboration within groups that held the architectural values of the group, despite participants being from different schools and only collaborating in-game. The authors suggest that this study supports the notion creativity is a cultural construct -- design and creativity are dictated by the cultural values of a system, something that is apparent in society and emulated in virtual collaborative spaces. As students play, they are motivated and engaged in the tasks at hand, and excited to share and learn from each other. Collaboration, then, might be promoted using digital game-based platforms through online conversation, the spread of ideas, and the co-construction of knowledge.

Team-Based Learning Environments

Digital game-based learning (DGBL) has been noted as a promising educational strategy to promote learning interest, motivation, positive social interaction, and collaboration (Sung & Hwang, 2013). Chen and Hwang (2017) sought to examine the effect of DGBL strategies on student awareness of their collaboration, communication, collective efficacy, and learning achievement. To achieve this, the researchers implemented a team-competition ubiquitous gaming approach (TCUG). The activity was developed to complement a natural science course and took place on the school campus. The digital games were framed by an overarching story about a king and a witch. Students were, on average, 11.5 years old. The study found that the TCUG environment benefitted the students' learning achievements more than the control group and was found to be a facilitator of collaborative learning.

Moreover, as learning environments make the shift to online spaces, novel considerations concerning student well-being emerge. Social isolation and lack of social presence in computer-mediated learning environments can be a detriment to students (McInnerney & Roberts, 2004). Team-based learning (TBL) is an instructional method in education in which small teams of students collaborate and work together for the entirety of the semester and can potentially serve as a response to social issues facing students. As technology has redefined the notion of a classroom and students in online classrooms often lack social interactions with peers, Gomez and colleagues (2010) sought to investigate how computer-supported team-based learning mediates motivation and enjoyment of learning and the impacts on student outcomes. To understand the relationships between TBL environments, motivation, and enjoyment, the authors designed TBL-based activities using WebBoard, a learning management system (LMS). Findings from this study suggest that motivation is a mediator of team interaction and self-perceived learning. However, the most telling finding is that students who have positive peer relationships with team members and who believe their team is contributing to the group also report higher perceptions of learning. When technology is implemented in meaningful ways, collaboration can naturally occur as a result if the system supports it and if all team members are willing to participate in group interactions. Team-based learning environments when coupled with digital game-based learning may be a powerful tool to support youth's global competencies, specifically in collaboration.

Methodology

This exploratory study was a part of a larger Design Based Research (DBR) study. DBR enables 'producing new theories, artifacts, and practices that account for and potentially impact teaching and learning in naturalistic settings' (Barab & Squire, 2004, p. 2) through 'iterative [micro] cycles of development, implementation, and study' (The Design-Based Research Collective, 2003, p. 7). As part of a larger research project exploring technology-enriched learning and support for global competencies development, this study was considered the first micro-cycle, prototyping the design of the virtual learning environment and activity structure for subsequent iterations (Kennedy-Clark, 2013). This design allowed for 'inductive exploration, discovery, and holistic analysis' (Harrison et al., 2017, para. 8) of participants' global competencies through their engagement with each other, the virtual classroom, and M:EE, supported by rich data from multiple sources including interviews, field notes, photos, and videos (Creswell, 2013). Given the personally-subjective nature of learning, highlighting participants' contrasting experiences with collaboration in the virtual space facilitated a multidimensional understanding of the research question.

Participants

Students who were enrolled in Grade 4 (age 9) through Grade 8 (age 13) were invited to attend the camp, which was divided into sections based on grade level: junior-level students (Grades 4 to 6) could register for the morning session (blue group), and intermediate-level students (Grades 7 and 8) could register for the afternoon session (green group). Consent to participate in the study was not required for camp attendance; however, data were only collected from campers who provided signed parental consent and participant assent forms. Of the 23 registered campers, 11 consented to participate in the research: eight in the morning session (three girls, five boys) and three (all boys) in the afternoon. The participants had a range of experiences with, and access to, technology both at home and in school, but all had played Minecraft in some capacity.

Context

This study was conducted entirely online. Google Meet was selected as the video-conferencing platform underlying all camp activities due to the simplicity of its user interface, affordances for collaboration and communication (e.g., breakout rooms, digital whiteboard integration, screen sharing, voice and text chat), and availability to the research team as part of their institutional software license.

M:EE was also employed as a virtual context for learning during the camp in this study. Temporary accounts were created under the host institution's software license and provided to participants for the duration of the camp. Participants spent approximately 1.5 hours of each camp session in Minecraft, engaging in a combination of independent and collaborative design activities. Participants used both the text-based chat in Minecraft and voice chat in Google Meet to communicate while in-game.

Design of the Spring Break Camp

The virtual Spring Break camp was offered during the third week of April. To explore the collaboration that could emerge through the use of M:EE, our virtual camp was developed around a team design and building challenge that spanned five-days. Participants attended camp for two hours per day. Each day always began with a welcome and social-emotional check-in. The daily welcome/socio-emotional check-in and the midpoint screen break both served as community-building activities (opportunities for students to share a bit about themselves, their perspectives, and experiences). A minimum of 45 minutes per session was devoted to the team design challenge, with the remaining time allocated for supplementary activities to support participants' team builds and digital competencies (e.g., creating Redstone circuits, coding). The camp was administered by a team of six facilitators and researchers: two graduate students that oversaw camp activities and acted as the primary facilitators, two undergraduate students who acted as co-facilitators and led drop-in sessions on coding and Redstone circuit design, and two researchers -- a doctoral student and post-doctoral fellow -- who engaged in data collection activities.

On the first day, teams were presented with their challenge: to design and build the Minecraft village of the future. Facilitators guided the teams through brainstorming ideas and mapping their villages in Google Jamboard, after which they were given access to the multiplayer server to begin building. The server was hosted in creative mode and participants were permitted to roam freely, enabling them to visit the other team's village to observe, gather ideas, and offer feedback. The challenge was entirely participant-driven, with team facilitators available to answer questions, provide support, and mediate conflict.

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Data Collection

Data were collected from those students who consented to participate in the research over the course of the five-day camp. Data sources included a pre-survey that asked students about: i) technology use; ii) coding experience; iii) Minecraft experience; iv) socio-emotional skills; v) problem-solving skills; vi) communication skills; vii) collaboration skills; viii) creativity skills. The survey was conducted in order to get a base-level understanding of the students' technological, socio-emotional, and global skills and competencies coming into the research project. Survey development was guided by the Ontario Ministry of Education's document on "Socio-Emotional Learning Skills" (OME, 2024) and the Council of Ministers of Education Canada document on "Pan-Canadian Global Competencies Descriptions" (CMEC, n.d.). Other forms of data collection included researcher observations/field notes, which were taken both in-the-moment and expanded/refined at the end of each day and at the end of the week; screenshots of the students' in-progress and final builds in the Minecraft world; students' end-of-day reflections on Flipgrid (a multimodal tool used to record participant reflections and usually used in education due to its ability to create private classrooms); transcripts of the chat in Google Meet and Minecraft; transcribed student interviews and finally, facilitator/researcher verbal reflections and analysis recorded at the end of each session (5 videos, approximately 30 minutes in length). Each of the student interviews was approximately 15-20 minutes in length. Students had the option to answer the interview questions on mic or in the chatbox.

Data Analysis

We drew on Saldana's (2016) process of first and second cycle coding. We first started thinking about the patterns that we saw emerging in-the-moment over the course of the week through our researcher field notes and during our facilitator/researcher verbal reflections at the end of each session. This practice was helpful to start thinking about potential patterns and themes we wanted to explore more deeply in the first cycle of the post-project analysis. In this way, we were borrowing from Miles et al. (2020) who recommend the use of analytic memoing as a way to capture 'thoughts that occur throughout the data collection' process (p. 108). Part of the reason for scheduling the facilitator and researcher debriefs directly after each session was to compare our impressions, as researcher-observers, with the facilitators' impressions. We wanted to add a layer of credibility and dependability to the research and explore any areas where our researcher perspectives either aligned with or contrasted the facilitators' lived experiences and perceptions of what had occurred each day. At the end of the camp, two of the researchers engaged in a formal first cycle of analysis of all the data sources using descriptive coding (Saldana, 2016; Miles et al., 2020). These two researchers met to discuss what they had both observed in the data and individual codes were then negotiated and grouped into seven categories in the second cycle of analysis. Narrative descriptions, supported by evidence from the study, were crafted in the process of further reflection and analysis. These narrative descriptions were then expanded to form the framework for presenting and discussing the findings.

Findings

Below we present the major thematic findings that emerged from our data analysis related to collaboration. The major themes align with the descriptors from the Ministry of Education's (2016) definition of 'collaboration'.

Co-constructs Knowledge, Meaning, and Content

We observed both groups of students (blue group - grades 4-6 and green group – grades 7-8) collaborating over the course of the week in both the Google platforms (Meet and Jamboard) and in the M:EE world, supported, in some cases, by their joint enterprises (shared goals) that facilitated learning as described by the CoP framework. Below we discuss how the students co-constructed knowledge, meaning, and content as they planned their biome designs on Jamboard and as they engaged in the building process in M:EE.

In the planning stage, the students in both groups collaborated on the virtual Jamboards by adding their ideas and building off one another's suggestions. These plans were then taken into the M:EE world. For the most part, the groups created final products close to their initial plans, barring "The Pandas" from the green group (one of the older groups). The Pandas followed their initial plan and then added a plethora of other builds throughout their biome that appeared to be random. Their world lacked cohesion, as a result.

The students in this group described their collaboration process in the post-project interviews as effective and efficient. For example, one participant shared:

> I thought the team did a very good job [of collaborating]. Like when we were in the planning --
> our ideas -- once one person would say something, we would build off of that. And then I thought

> our communication in the [Minecraft] chat was very good. Like we all had our own thing. There was no griefing, there was no problems. We were all able to get stuff done efficiently.

From the researchers' perspectives, however, the type of in-game collaboration described above was more difficult to see. For example, it mostly appeared as though the students were working on independent projects that happened to exist within the same space. The only collaboration observed was when one student would occasionally provide help to another team member. However, there did not appear to be a cohesive vision in this group's world which is often created through open and clear communication and negotiation of ideas. While the students may have been building within the same biome, they appeared to be building beside one another as opposed to *with* one another. It is possible the students' definition of collaboration meant working beside one another without conflict as opposed to actively working together on a shared vision.

When we realized the students needed help collaborating early on in the week, we added scaffolding. We asked the students occasionally to stop what they were doing, to observe each other's builds, and to provide constructive and positive feedback (a classroom activity otherwise known as 'a star and a wish'). This was done in an attempt to open up dialogue between the students and to begin the process of cohesive visioning and negotiation. Another strategy we employed to encourage collaboration was what we referred to as 'build narration'. For this, the facilitators described each student's Minecraft build in an attempt to encourage interest in one another's projects. In the Green group, one facilitator went around to each of the builds and described her observations about them on mic for all to hear. For example, when she approached the floating castle one of the participants had built, she shared her intrigue at the interesting cart system used to enter and exit the castle, in addition to the unusual features within the castle's rooms.

While both of these strategies encouraged the students to occasionally observe what they each were working on in the M:EE world, neither sparked active collaboration (i.e., working together on a shared vision). Overall, the students appeared more willing to interact with the facilitators over the course of the week. The facilitators actively shared their identities and their feedback, which perhaps allowed the students to more easily view them as real people and not just floating heads within the virtual space. This led us to wonder what else we could have implemented in such a short period of time (in addition to the community-building activities we had implemented each day) to create the necessary levels of trust and social presence required for collaboration.

The higher level of interaction with the facilitators we observed in the Green group was also present in the Blue group. Some children in the Blue group knew each other prior to the camp, which may have contributed to how vocal and interactive they were, in general, as compared to the Green group. However, in the following days, some campers gathered after camp to finish their village on time. Especially in the last two days, most of the campers helped one another in order to complete their buildings in time. They asked for and offered help and shared jobs to finalize their village.

Unlike with the Green group, the 'build narration' used with the Blue group had a greater effect on encouraging collaboration. For example, one of the facilitators supporting the TreeTop Villagers team from the Blue group noticed that progress on their zoo building had stalled. She raised this to the team, describing the grey brick structure and beginnings of animal pens that had been constructed, and then asked what else they might want to do with the space. This reignited interest in the project, both from the original builder and other members of the team who began to negotiate ideas over voice chat in Google Meet. The team members collaboratively added miniature habitats, animals, a rail system, and decorative items to complete the build.

Some instances during camp exhibited high levels of alignment, a pillar of the CoP learning framework that describes teams' collaborative efforts to achieve a shared vision. Engaging in a joint enterprise may have supported the alignment seen in The Treetop Villagers' worldbuild. Each team member made an effort to build in the trees, which was a central tenet of their team identity.

Learns From, and Contributes to, the Learning of Others

Peer teaching and learning were present over the week as part of the students' collaborative processes. Within the M:EE world, students built alongside one another, took inspiration and ideas from one another, and asked for and received 'just-in-time' support from more knowledgeable others (MKOs) (Vygotsky, 1978). One key element to forming a CoP is mutual engagement (Wenger, 1998) which fosters an environment in which students can learn from one another as they engage in social interaction.

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One student from The Pandas, who indicated on his pre-survey things like 'I actually mostly work alone' appeared to offer and ask for the most help from his peers over the course of the week. In his post-interview he explained that the collaboration happened 'when one of us either couldn't figure something out or just needed help. Like we would work on our own stuff. But anyone was able to join and help'. He also explained that 'the big success' of the week was 'being able to work with other people, to create awesome designs.' This student explained that he 'helped with the castle...with the aquarium'. He also helped the facilitators and some peers within his group learn how to fly. In this case, the participant started using wings and fireworks to fly which prompted others to inquire about how they could do the same. A mini-tutorial was then held and everyone on The Pandas team learned how to fly with wings and fireworks.

This type of peer teaching and learning was witnessed in the Blue group, as well. As students built within the M:EE world they observed and copied certain design elements and build strategies from one another. One student explained that he 'learned a lot of new blocks' from his peers like the 'structure block and how to use a beacon. And those piston rings'. Another student in this same group shared 'what I learned from my peers is that sometimes it's better to work as a team than just work alone … sometimes you do need help on hard things'.
While collaboration on a shared vision was noticeably different between the two age groups, peer teaching and learning appeared to be similar in both the Blue and Green groups. Participants in both groups freely asked for and provided help to one another and they also adopted and adapted ideas and strategies from one another.

Participates in Teams and Establishes Positive Relationships/Manages Conflict

Students in both the Blue and Green groups demonstrated the abilities to establish positive relationships within their teams and to manage conflict. While the students in the Green group did not appear to actively collaborate on their builds, they did occasionally check in with their peers to make sure new builds were approved. In their post-project interviews, the students explained that they considered the opinions of others on their team. One student emphasized that he considered others' opinions 'a lot, because I don't like doing things that other people don't like.' The student who claimed he mostly worked alone on the pre-survey, shared in the post-project interview that his 'takeaway is -- I mostly just learned a lot about working together as a team … I learned to be more accepting of other people's ideas'. Another student shared: 'I learned that communication and positivity are really important in group work'. The establishment of positive relationships and management of conflict was also recorded in the researchers' field notes. For example, the team recorded observations related to the lack of 'griefing' the students engaged in, which helped support positive relationships and contained conflict.

One of the students from the Blue group, Jay, appeared to be particularly skilled in conflict management. He also demonstrated maturity navigating potential challenges with his peers. For example, in the post-project interviews, when asked about how much the students considered others' opinions while working in their groups, he said:

> I think I understood their opinions fully, because I remember I told Roger, 'Oh here's the house
> we're making', and he said, 'Oh, can I make it a different way' and I said, 'Yeah, sure. I didn't like,
> I didn't get angry or say "no, you have to make this"'.

Jay also explained that when another teammate started changing one of his builds in the biome he used polite communication strategies to address the problem without escalating it. Jay shared: 'while I was making the boats, [my] other teammate, he changed it a little. So, I told him– I asked him, 'could you stop please?' and he stopped, so I asked politely.' As a result of Jay's awareness of how his communication might be received by his peer, he was able to effectively navigate an otherwise difficult conversation. Although Jay may not have shown noticeable growth in these skills as a result of the camp (because he appeared to enter the camp with highly developed collaboration, conflict management, and communication skills), the M:EE world provided him with the opportunity to practice these skills. An important feature of CoPs is that they provide a context in which to practice and improve skills by interacting, learning from, and teaching others (Wenger, 1998). Jay became a leader or model for the others in his group; he actively helped others with their builds and with conflict resolution.

Discussion/Implications

Based on our findings in this project, we learned that communication and collaboration within the M:EE world, and in the virtual classroom in general, may be affected by the students' age group (i.e., primary/junior versus intermediate) and also whether or not students know each other outside of class. Therefore, it is important to

include a variety of trust and community building activities, especially when working with intermediate students who may be more hesitant to make themselves vulnerable in the online environment. We also found that, if possible, using M:EE in a hybrid learning scenario, where students can first build trust and rapport with one another in person, may make virtual collaboration more seamless.

Students may become single-minded when it comes to focusing on their own builds in M:EE, so having a facilitator narrate or comment on different student builds can spark student interest in one another's work, which may promote and support collaboration. Drawing attention to the work of others and noting what the facilitator liked or found interesting about the build can shine a spotlight on the different ways students approach their tasks. This strategy serves to redirect students' focus in ways that might provide them with further inspiration for their own work.

Some instances of team social interaction during the camp align with the 'structural' (Pyrko et al., 2016) pillars within CoPs: mutual engagement and joint enterprises, suggesting that M:EE can function as a social learning environment. Although most teams did not have a defined language or set of tools and resources to guide their actions within their team, teams such as The Pandas felt they had positive communication with one another and allowed others to build what they wanted. The perceived lack of conflict and allowing other team members to follow their own particular vision could also be thought of as a function of the community. Through team-based challenges in M:EE, the foundation of a shared repertoire can be laid. The TreeTop Villagers successfully co-constructed the tree world in M:EE that they had mapped out together in the planning and visioning phase. This feature (building their structures in the trees) was central to their identity as a team and the end result was overall cohesive with clear alignment.

The open quality of the M:EE world can facilitate collaborative peer learning and distributed learning (as opposed to traditional or didactic instruction). As the study with Peppler and Solomou (2011) found, seeing each others' work can spark ideas and inspiration for students in the online environment. Working in the same space also means students can easily provide help to one another, problem-solve together and act as MKOs (Vygotsky, 1978) to one another (Reese, 2008). Therefore, it may be beneficial to group students in teams where they can build in the same biome in order to encourage engagement, inspiration, and idea-sharing. It is possible that students who do not identify as strong in F2F collaboration might feel more inspired by or more comfortable collaborating in the online setting. Prior research has demonstrated that shy youths are more comfortable forming social relationships online than in face-to-face contexts (Wolak et al. 2003).

While some students may enter the M:EE world with well-developed conflict management skills, the shared building environment may provide all students with an opportunity to develop their emotional intelligence through the building and design tasks that require students to build positive relationships and manage conflict. As a result, facilitators must intentionally scaffold student learning related to effective communication strategies. For those with already well-developed social skills, the environment may offer an opportunity to also act as a role model for others.

Finally, giving students the opportunity to collaborate with one another in a virtual environment, like M:EE, is one way to help students practice their verbal and written communication skills, especially as they relate to collaboration while benefiting from social learning experiences that come from belonging to a CoP. In an environment where gestural communication is limited, students may be challenged to use their words (written and verbal) exclusively and effectively to convey what they mean. With online communication being more important than ever before, students need practice in these venues. Students who need help developing these skills may require additional support from the teacher as effective communication includes elements such as empathizing, perspective-taking, and the use of respectful language.

Clearly there are many ways in which the M:EE environment can help students develop and practice skills related to collaboration. What is apparent in the data is that the environment, itself, naturally lays the foundations for collaboration; however, intentional facilitator scaffolding is necessary.

Conclusions

Competently utilizing digital technologies is both recreationally engaging and crucial for developing relevant skills and competencies that will allow youth to thrive in modern society. Collaboration underpins other important competencies such as communication and emotional intelligence. Minecraft was examined as a tool to foster

collaboration. Data analysis revealed that collaboration manifested itself in three primary modes: co-constructing knowledge, peer-teaching, and conflict management. Analysis further revealed that younger (grades 4-6) versus older (grades 7-8) students build and collaborate in the online environment very differently, which at times mirrored the 'real world' classroom. Findings also suggest that Minecraft: Education Edition can be a potential tool to build Communities of Practice (CoP) through social constructivist learning opportunities. These findings have implications for designing age-appropriate online networked learning experiences, especially within the Minecraft environment. Despite not being given direct instructions to achieve collaboration (other than being placed into teams), participants contrived strategies and plans (and were flexible in these plans) while in-game to help achieve group goals without facilitator interference. Minecraft's text-based chat offers a conduit for connection to those who may be less confident in face-to-face or voice communication and supports their integration into the group more completely. However, online communication skills need to be developed through opportunities to practice.

From our study, we conclude that the networked learning platform, Minecraft can be utilized to develop the global competency of collaboration - especially relating to positive group interactions and conflict management skills as students navigate the challenges of sharing a digital environment and acting within a team instead of as individuals. Although the landscape of Minecraft supports collaborative behaviours in teams, facilitators and educators should provide additional support to accommodate a diversity of learners.

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