

A screenshot from the game Minecraft Education Edition showing a top-down view of a school building constructed from grey stone blocks. The building has a central courtyard with a blue pool of water. The surrounding landscape is green with scattered trees. In the bottom left corner, there are two square icons with arrows pointing right. At the bottom, a hotbar contains several items: a chest, a stack of stone, a stack of wood, a fire, a torch, a pickaxe, and a glowing item. A white circle highlights a small structure in the distance on the right side of the screen.

# The impact of Minecraft Education Edition in Victorian Schools

**An analysis of three case studies to inform practice**

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## 1.0 Executive summary

This report explores the use of Minecraft Education Edition in three Victorian schools to determine how it is being used to facilitate teaching and support learning. As part of this research project we explored the types of interactions between students in the physical and virtual learning environments, the actions of the classroom teachers to support learning in lessons using this tool, and the extent and nature of training and community development provided by school administrators. Analysis of the data generated lead to the development of a series of recommendations pertaining to:

- setting clear goals and success criteria in targeted lessons;
- providing meaningful feedback to students on their learning;
- ensuring minimum levels of teacher competency with the capabilities and features of Minecraft Education Edition;
- exploring opportunities to inspire and engage students;
- optimising professional Minecraft Education Edition learning communities for all teachers; and
- developing and assessing collaborative social skills.

This report is significant for policy makers, school administrators and teachers because it assists in guiding the optimisation of the use of Minecraft Education Edition to improve the quality of teaching and learning.

## 2.0 Acknowledgements

We would like to acknowledge the support of Professor Lorraine Graham (*Melbourne Graduate School of Education*) and Associate Professor Gillian Kidman (*Monash University*). Additionally we would like to acknowledge the support of the Digital Learning Services Unit at the Department of Education and Training, Victoria.



### 3.0 Guiding research questions

We were invited by the Department of Education Victoria (DETVic) to visit three schools to identify how teachers were implementing Minecraft Education Edition (M: EE), the perceived successes and challenges teachers were experiencing and indications of student learning occurring during these lessons. Importantly this research project examined both the physical environment and the virtual environment. In response to these objectives the research was guided by an overarching primary research question:

*Primary research question:* **How is Minecraft being used as a pedagogical tool in Victorian classrooms?**

*Purpose/background information:* This is the overarching question informing the design of this study. There has been limited research in the Victorian context into the ways in which teachers are utilising Minecraft as a tool for teaching academic content and developing social capabilities. Given the DETVic commitment to evidence-based practice, this research seeks to build a series of recommendations to ensure that Minecraft can be used by educators as an impactful tool for student academic and social learning.

In order to address the underlying components of this primary research question, three guiding questions were also necessary.

*Guiding question A:* **How are teachers supporting learning in the Minecraft virtual learning environment?**

*Purpose/background information:* Over the past decade a number of initiatives have been established by DETVic to ensure that teachers have access to the latest research on teaching practices that make a substantive impact on student learning. Central to this drive has been the High Impact Teaching Strategies. This study seeks to identify how teachers are using such initiatives as part of lessons involving the use of Minecraft as a tool for learning and teaching.

*Guiding question B:* **How do students engage with the assigned tasks and with each other in this virtual learning environment?**

*Purpose/background information:* In previous studies Minecraft had been positioned as a multiuser environment for collaborative activities. This present study sought to understand how students were

engaging with each other in attempting to complete the assigned tasks in the virtual environment, and how these social interactions impacted upon their motivation to achieve targeted learning objectives.

**Guiding question C: What is the nature and frequency of performance of collaborative social skills by the students when completing these tasks?**

*Purpose/background information:* Using the Personal and Social Capability from the Victorian Curriculum as a starting point, this question sought to understand which social skills and behaviours students were using during their time using Minecraft, and the frequency and duration of performance of these skills during key events during the learning activities.

## 4.0 Methodology - participating schools

This research was conducted at schools chosen by DETVic staff. Schools were strategically selected to provide researchers with a wide range of ecologies. This included urban and rural locations, primary and secondary cohorts and year levels from Year 3 to Year 10.

### 4.1 Recruitment

Participating schools and classes were identified by DETVic. Once school administrators, teachers and students had consented to participating in the research project our research team was invited to the school. During these initial visits we clarified the purpose of the project and addressed any questions of concerns. An overview of the three participating schools are present in Table 1.

*Table 1. Overview of the three participating schools.*

	<u>Location</u>	<u>Schooling</u>	<u>Level</u>	<u>Class Description</u>
<b>School A</b>	Urban	Secondary	10	Computing Class
<b>School B</b>	Urban	Secondary	7-10	Lunchtime STEAM Club
<b>School C</b>	Rural	Primary	4-6	General Class

The following sections of this report provide detail contextual overviews of these three schools.

## 4.2 Contextual overview of School A

The first research site involved working with a secondary school in outer metropolitan Melbourne. The school's Index of Community Socio-Educational Advantage value is 943, indicating that many students attending this school experience some level of social disadvantage. Less than five percent of students identify as indigenous and almost thirty percent speak English as a second language. Tables 2 provides NAPLAN data from School A for 2018. For the purposes of historical comparison, NAPLAN data for 2017 is presented in Table 3.

*Table 2. NAPLAN results for 2018 for School A (adapted from MySchool, 2019).*

	Reading	Writing	Spelling	Grammar	Numeracy
Year 7	524	479	520	509	515
Year 9	554	481	546	529	555

*Table 3. NAPLAN results for 2017 for School A (adapted from MySchool, 2019).*

	Reading	Writing	Spelling	Grammar	Numeracy
Year 7	513	476	511	503	518
Year 9	558	511	545	538	557

## 4.3 Participating teaching staff and students at School A

This 'Computing' elective class was taught by an experienced Year 10 teacher who was just beginning to use Minecraft as a teaching and learning tool. In this early stage of use, the teacher had been working with an expert consultant from DETVic.

#### 4.4 Contextual overview of School B

The second research site was a specialist secondary school in metropolitan Melbourne, catering specifically for students with autism or other social-emotional differences. As this school largely serves a student population with diagnosed conditions there is a high staff to student ratio. The school's Index of Community Socio-Educational Advantage is above average at 1070, indicating that many students come from home environments with relative social advantage. According to the latest publicly available data, no students identify as indigenous. Almost thirty percent of students speak English as a second language. As this is classified as a Special School NAPLAN results are not available.

#### 4.5 Participating teaching staff and students at School B

This lunchtime STEAM club was facilitated by a leading teacher who had been working with these students over the past year. Although M: EE is the most popular activity made available through this club, students can also choose to engage in other activities such as playing with LEGO or creating things using cardboard. All of the students voluntarily join this program, and there has been a significant increase in interest over the past three months.

#### 4.6 Contextual overview of School C

The Primary School is situated in a rural township in a rich agricultural area. The school serves the local town as well as neighbouring farming communities. The school's Index of Community Socio-Educational Advantage is around average at 1021, indicating that some students come from home environment with some social disadvantage. No students identify as indigenous and only 2% speak English as a second language. The School is staffed by just the principal and three full time teachers. As for School A, Tables 4 and 5 respectively provide overviews of NAPLAN data for 2018 and 2017.

*Table 4. NAPLAN results for 2018 for School C (adapted from MySchool, 2019).*

	Reading	Writing	Spelling	Grammar	Numeracy
Year 3	404	377	379	392	357
Year 5	541	495	486	496	478

Table 5. NAPLAN results for 2017 for School C (adapted from MySchool, 2019).

	Reading	Writing	Spelling	Grammar	Numeracy
Year 3	499	450	438	453	436
Year 5	443	459	439	459	467

#### 4.7 Participating teaching staff and students at School C

The school considers itself open to exploring the potential of emerging digital technologies, adopting a range of teaching pedagogies. Students have access to a range of different platforms and digital devices. They are encouraged to help each other to solve technical problems and locally manage their shared hardware. M: EE is increasingly a popular activity amongst staff and students. Students in this class were allocated set groups with members spanning four age-based year levels. The teacher was very proficient with using digital technologies, and by working closely with a DETVic expert consultant she had deeply embedded M: EE into the classroom curriculum. Interestingly, the teacher stated that from the outset she viewed M: EE as a tool rather than a game.

### 5.0 Methodology – data generation and analysis

This research project attempts to identify, codify and analyse the different student skills being performed in a sample of three lessons. Additionally, this study examines teacher approaches to using Minecraft in the classroom in order to achieve targeted learning outcomes. There is surprisingly very little research in this area. This is largely a qualitative case study research project that is grounded in the professional experiences and PhD research of Matthew Harrison and Roland Gesthuizen.

#### 5.1 Overview of the research methodology and processes

Six key stages were conceptualised to structure the design of the research methodology utilised in this project.

##### *Preparation phase*

- *Stage 1:* An initial review of the existing literature pertaining to the research questions was conducted.

- *Stage 2:* Three schools were identified by DETVic and ethical approval was sought and obtained at university and departmental levels.

### Data generation phase

- *Stage 3:* Video data and ethnographic notes were generated during one lesson at each of the three focus schools.
- *Stage 4:* Students were interviewed about the lesson to explore their engagement and motivation
- *Stage 5:* Teachers were interviewed about the lesson to explore their pedagogical philosophy and the tool (Minecraft)

### Analysis phase

- *Stage 6:* Key events identified during the lessons were coded, identifying instances of collaborative social skill performance as identified in the Personal and Social Capability.

These stages are summarised in Figure 1, illustrating the methodological processes and data generation methods that were used in this research project:

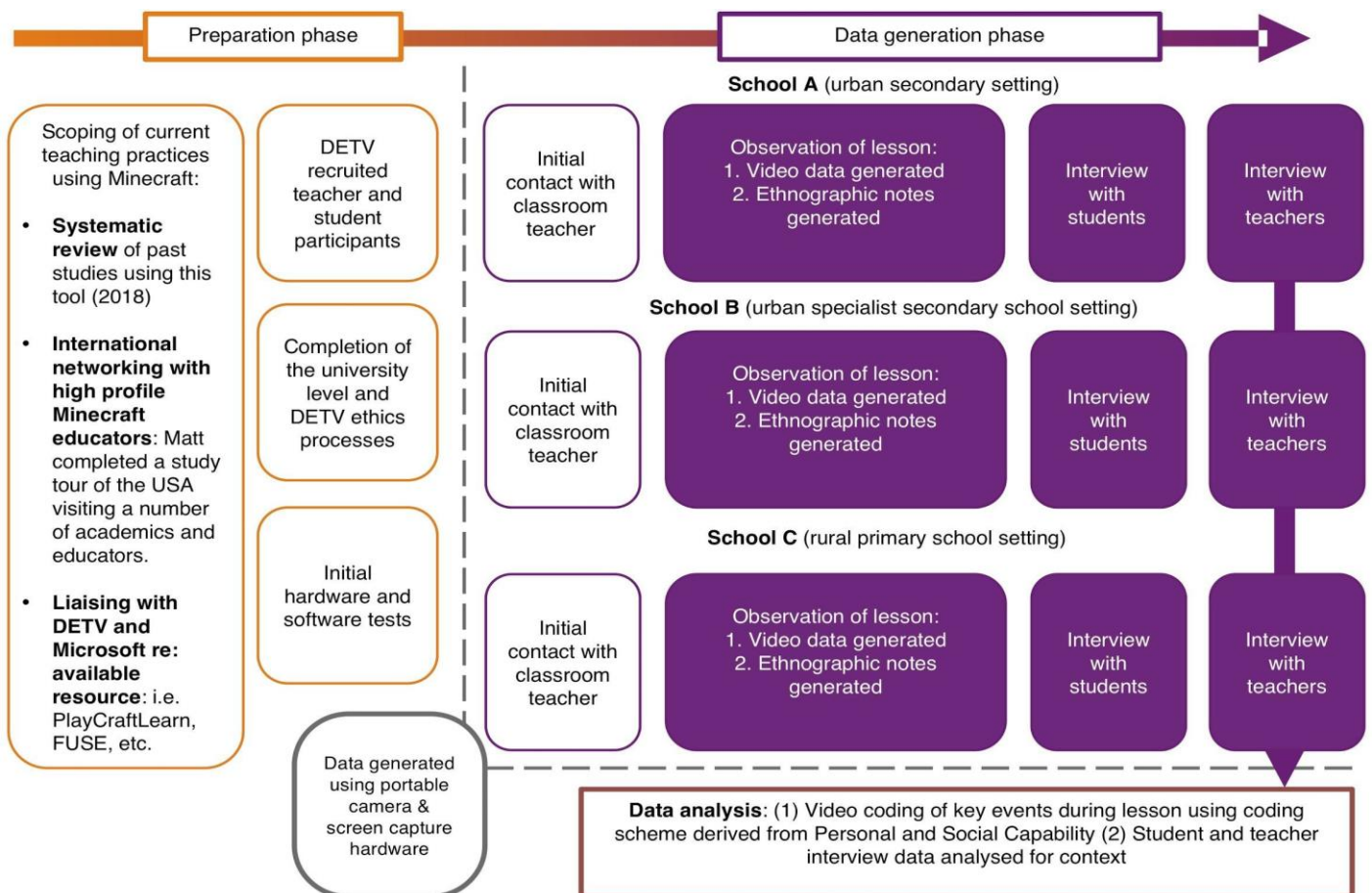


Figure 1. Methodological processes and method of data generation utilised in this research project.

## 5.2 Methods of data generation A - video observation

Video observation provides an ideal means for capturing a detailed record of the knowledge, skills and behaviours that students utilise when using M: EE, both in the physical world and in the virtual environment. As a tool for data collection, video provides a specific incidence of interpersonal interaction (Clarke, 2011; Patton, 2005) and some sense of 'time' and 'place' (Miller & Bell, 2002). Video data of the students' interactions in the physical world, and their actions in the game, allowed for the analysis of the relationship between M: EE and the player. Additionally, video data allowed for a comparison between the displayed knowledge of the skills and behaviours in this pre-play component of the lesson, and the students' ability to perform these skills in the gameplay.

Due to the limited scope of this research project, three key 'events' were identified that were representative of the types of collaborative interactions between the students when using M: EE that were observed in the greater lesson. These events were all three minutes in length. A coding scheme was used to analyse **Event A**, **Event B** and **Event C**.

The coding scheme used in this research project was developed by Harrison (2019) specifically to analyse collaborative interactions in digital games-based learning. Through the use of specialised coding software, this coding scheme was initially used to analyse:

- *Student to student interactions*: Verbal or non-verbal interactions between the students in the physical environment.
- *Student to teacher interactions*: Verbal and non-verbal interactions between the students and the teaching staff.

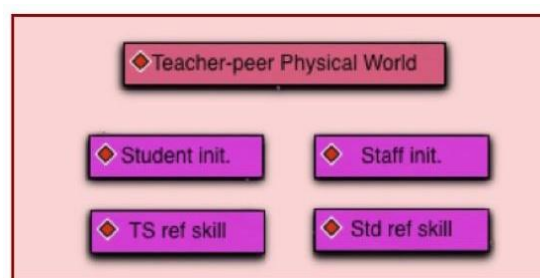
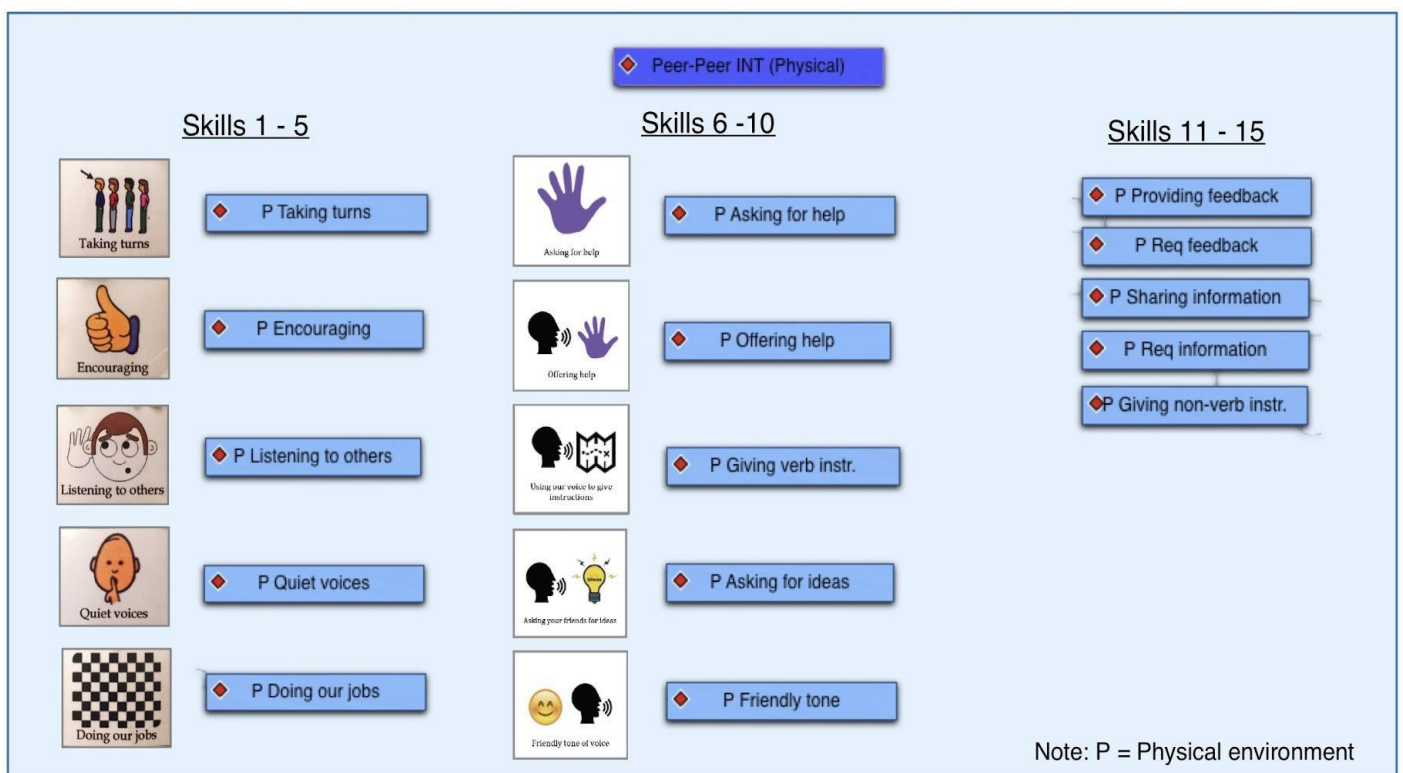
In a *first pass* of data analysis two researchers dual coded the three events, identifying instances of *student to student* and *student to teacher* interactions. Following this first pass coding of the data, a *second pass* analysis of the data was completed identifying specific high value social skills required for effective collaboration. These individual skills were identified as high value through analysis of the two-learning collaborative social skills progressions discussed in Section 8 of this report, and in a study completed by Harrison (2019).

These fifteen high priority collaborative social skills include:

Taking turns	Listening to others	Encouraging
Quiet voices	Doing our jobs ( <i>completing delegated tasks</i> )	Asking for help

Using our voice to give instructions	Giving non-verbal instructions	Offering help
Asking your friends for ideas	Requesting task information	Sharing task information
Friendly tone of voice	Providing performance feedback	Requesting performance feedback

Figure 2 provides a summary of the coding scheme developed by Harrison (2019) used in the first and second pass analysis of Event A, Event B and Event C.



*Student/Staff init.* = Student/staff-initiated interaction

*TS/Std ref skill* = Teaching staff/student references target social skill

Figure 2. Summary coding scheme developed by Harrison (2019).

### 5.3 Methods of data generation B - participant interviews

To provide the data derived from video observation with meaningful context, post-play interviews were conducted in order to gain insights from the teaching staff and the students into their perceptions of the learning and the use of Minecraft as an educational tool. The following are a list of guiding prompts that the participating teachers were asked to respond:

*Interview questions for teachers:*

1. What classes and year levels do you teach?
2. What is your teaching method subjects?
3. How do you use Minecraft: Education Edition in your school?
4. Describe your experience to date using Minecraft?
5. Where do you get information about Minecraft: Education Edition?
6. Where did you learn how to use Minecraft: Education Edition?
7. What opportunities do you see for exploring social regulation in virtual places?
8. What has inspired you to persist with exploring Minecraft in your classroom?
9. Do you have any questions that you would like to ask of us?

In addition to the perspectives of the teaching staff, this research project was interested in the perceptions of the students regarding their own learning during these lessons. The following prompts were used with small focus groups of students at each school:

*Interview questions for students*

1. In which classes and year levels so you use Minecraft?
2. What subjects or topics have you used Minecraft with?
3. How did you use Minecraft: Education Edition at school?
4. Describe your experience to date using Minecraft?
5. Where do you get information about Minecraft: Education Edition?
6. Where did you learn how to use Minecraft: Education Edition?
7. What opportunities do you see for exploring how we work together in virtual places?
8. What has inspired you to persist with solving problems with Minecraft?
9. Do you have any questions that you would like to ask of us?

Together the analysis of the video data and the post-lesson interviews provided a wealth of information that suggested the conditions in which M: EE could be most effectively used in Victorian schools.

## 6.0 Results

Using the previously outlined research methodology and methods, this section reports on the key results emerging from the analysed data at each of the three schools. It begins with a brief synopsis of the lesson, including any explicitly stated learning objectives. This is followed by a deeper report on the structure of the observed lesson. As this project has a particular focus on collaborative problem-solving, this section also examines the types of interactions occurring between the students during the learning activity. As noted in the rationale for this research project, representing the voices of the participating students and teachers is also a high priority. In order to share these voices, the collated reflections of the participants on their use of Minecraft as a tool for learning make an important contribution to the findings of this report.

In addition to the analysis of each particular school, this section concludes with a collective analysis of how the three teachers used ten 'High Impact Teaching Strategies' prioritised by DETVic. These High Impact Teaching Strategies include:

1. **Setting goals:** Lessons have clear learning intentions with goals that clarify what success looks like.
2. **Structuring lessons:** A lesson structure maps teaching and learning that occurs in class.
3. **Explicit teaching:** When teachers adopt explicit teaching practices they clearly show students what to do and how to do it.
4. **Worked examples** A worked example demonstrates the steps required to complete a task or solve a problem.
5. **Collaborative learning:** Collaborative learning occurs when students work in small groups and everyone participates in a learning task.
6. **Multiple exposures:** Multiple exposures provide students with multiple opportunities to encounter, engage with, and elaborate on new knowledge and skills.
7. **Questioning:** Effective questioning yields immediate feedback on student understanding, supports informal and formative assessment, and captures feedback on effectiveness of teaching strategies.
8. **Feedback:** Feedback informs a student and/or teacher about the student's performance relative to learning goals.
9. **Metacognitive strategies:** Metacognitive strategies teach students to think about their own thinking.
10. **Differentiated teaching:** Differentiated teaching are methods teachers use to extend the knowledge and skills of every student in every class, regardless of their starting point.

It is important to note that the use or non-use of any particular strategy is not a reflection on the practice of the observed teachers. Research into the use of these strategies in virtual learning environments is in its

infancy, and as such the form that these strategies might take may be different from what could be expected in a traditional class.

## 6.1 Results from School A

### 6.1.1 Overview of the lesson

The observed lesson in School A was a Year 10 game-programming class that explored design thinking and problem solving. This class was a term long elective class, with this observed lesson being towards the conclusion of a multi-week project. As such, students were completing work that they had started a number of weeks prior to the point of data generation for this report.

#### *Links to the Victorian Curriculum:*

- **Personal and Social Capability - Collaboration Levels 9 and 10:** Develop specific skills and a variety of strategies to prevent or resolve conflict, and explore the nature of conflict resolution in a range of contexts
- **Digital Technologies - Creating Digital Solutions Levels 9 and 10:** Develop modular programs, applying selected algorithms and data structures including using an object-oriented programming language

### 6.1.2 Description of the learning ecology

The classroom in this lesson was observed was a computer laboratory located in a rectangle classroom. The room included a large whiteboard and 26 desktop computers spread around the outside perimeter. School desks and plastic chairs in the middle were in a horseshoe formation in the middle. Students used these desks in the middle for the lesson introduction and conclusion.

### 6.1.3 Description of lesson structure

After marking a class roll and an initial introduction, the teacher outlined her expectations and verbally reiterated the goals for the task to be completed. The students then seated themselves at computers in groups that had already been determined. Due to the physical layout of the room some groups were broken up and seated in different locations. With prompting, students quickly logged themselves into the computer and started work. The teacher moved around the room, quietly talking to particular students to answer questions or provide feedback about their work. The teacher was not logged into Minecraft but maintained a keen awareness of what students were doing whilst looking over their shoulder. The students continued to work on the computers until the conclusion of the class.

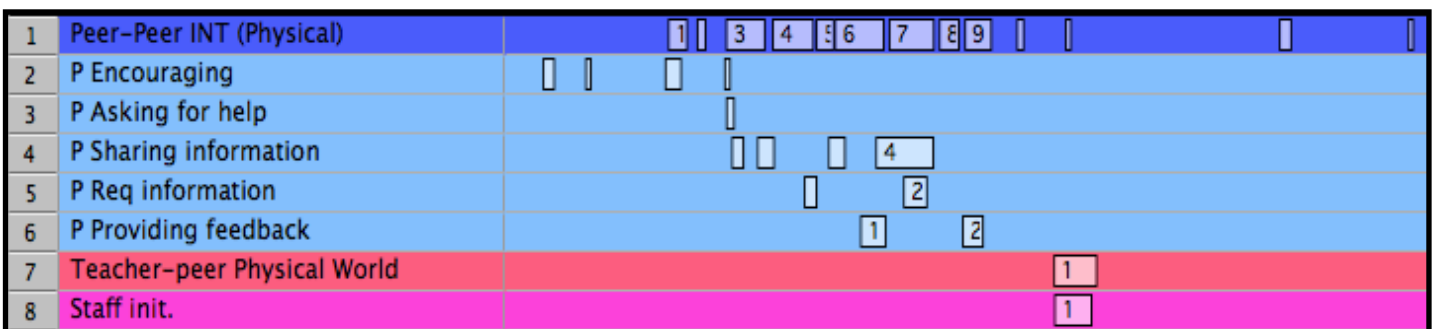
*Use of High Impact Teaching Strategies during this lesson*

The High Impact Teaching Strategies observed during the entirety of the lesson included:

- Strategy 1: Setting goals:** Lessons have clear learning intentions with goals that clarify what success looks like.
- Strategy 5: Collaborative learning:** Collaborative learning occurs when students work in small groups and everyone participates in a learning task.
- Strategy 7: Questioning:** Effective questioning yields immediate feedback on student understanding, supports informal and formative assessment, and captures feedback on effectiveness of teaching strategies.
- Strategy 8: Feedback:** Feedback informs a student and/or teacher about the student’s performance relative to learning goals.
- Strategy 9: Metacognitive strategies:** Metacognitive strategies teach students to think about their own thinking.

**6.1.4 Event A: Student interactions and teacher intervention during the group task**

Event A is a three-minute period of time that was video recorded and coded using the *collaborative problem-solving coding scheme* developed by Harrison (2019). This particular event was selected as the students were collaboratively planning a new section of their game. Event A comprised five participants (coded here as S1, S2, S3, S4, S5) organised into two groups: S1 and S2 were working on a build project with flat terrain, and S3, S4 and S5 worked on a build project in a forest landscape with coding elements. Analysis of the types of interactions highlight some of the social skills that students required to effectively complete their assigned in-game task. The coded timeline for Event A is shown below in Figure 3.



*Figure 3. Timeline showing interactions between the students and the intervention of the teacher in Event A.*

The coded timeline shows the different types of interactions and the order in which they occurred. The total frequency and duration for each coded interaction in Event A is shown below in Table 6.

Table 6. Frequency and duration of interventions for School A.

Intervention Name	Frequency (count)	Total time (hh.mm.ss)	Time Fraction (%)
Peer-Peer INT (Physical)	13	00:00:56.45	31
Encouraging	4	00:00:06.89	3.83
Asking for help	1	00:00:01.37	0.77
Sharing information	4	00:00:19.66	10.72
Requests information	2	00:00:06.77	3.64
Providing feedback	2	00:00:08.78	4.78
Teacher-peer Physical World	1	00:00:08.32	4.59
Staff initiated intervention	1	00:00:07.24	4.02

Thirteen total interactions between the students (shown as *Peer-Peer INT*) occurred in the three-minute period of time, with all of these occurring in the physical environment. It is interesting that the students only made limited use of the in-game chat functions. This might have been due to a lack of knowledge of how to use these functions or it could be the case that they perceive verbal interactions to be more efficient given their close proximity within the classroom. Also of note is the significant reduction in peer- to-peer interactions between the students following the teacher intervention (as shown in Figure 7). The nature of this intervention was a short prompt to remind students about their limited time to complete their projects, which appeared to return each of the five students' attention to their individual roles within the group project.

It is also interesting to note was that the students developed their own specific strategies to regulate their behaviour so that they remained on task. When asked about this, the interviewed students emphasised that they recognised that as they had a limited amount of time to complete their goals and hence needed to closely monitor their allocation of time.

Researcher: Okay, it's interesting. How do you regulate your behaviour online? How do you keep on task and on focus and on doing something?

Students: I set goals pretty much. Get it done in a set amount of time.

Researcher: When do you set those goals?

Students: Before you do anything, I was thinking. Like when you're [inaudible 00:03:38] set of goals would be to do that first. Like setting a goal to get the books that you need first.

During Event A *Sharing information* and *encouraging* were the most frequently performed social skills in the physical environment. It is important to note that teacher reported that she had emphasised the importance of effective communication between team members. The level of sophistication with which students shared information about the task varied greatly from student to student. This seems to suggest the importance of explicitly teaching how to evaluate what someone else might need to know in order to contribute to a shared goal. As School A is a Positive Behavioural Interventions and Supports (PBIS) school, it would be expected that there would be a high frequency of encouragement between students as this is a skill that explicitly taught as part of this program. Observations of this occurring with a frequency in a small sample of classroom data supports the use of such consistent school-wide behaviour programs in contexts, including in lessons using M:EE.

#### *Use of a mobile digital device to find information about the use of Minecraft*

At the beginning of Event A, there was an interesting although brief exchange between the two groups. S1 paused to reflect on her inventory then picked up a mobile device to look up something on the Internet. She leaned across to share the information displayed on her device with S2. After some deliberation, S2 passed the device to S3 then proceeded to make a change to their build. This information was passed down verbally to S4 who returned the device and proceeded to verbally pass the information onto S5. This presents an interesting use of mobile technology in the classroom for augmenting information provided by the teacher. Each student took the initiative to read the information, pass it onto the student sitting next to them and then moving back to the build task at hand. It highlights two learning affordances of mobile technology such as Apple iPads or Microsoft Surface tablets. Firstly, mobile devices such as tablets can be used to quickly look up some important information that may answer a particular problem without exiting or stopping the current activity. Secondly to physically share it with her neighbouring students by simply passing the screen across. We must consider here the learning affordance of an extra screen or mobile device by students when using M: EE to research their ideas and communicate their work, creating mobility-connectivity and curation-mobility.

### *Discussions of coordinates between players*

As M: EE is played in a large open environment, students often found it difficult to know where to find each other in the world. Yet being together in the virtual environment was important for co-constructing substantive structures or coordinating the coding of different Non-Playable Characters (NPC) within the game. With minimal teacher guidance, the students used the terminal 'teleport' command which requires knowledge of providing coordinates on an x axis and y axis. Students were familiar with this language and were observed during this event updating each other on their respective locations using this mathematical language. The teacher noted that some of the students who described themselves as not enjoying Maths classes were the most vocal in sharing their avatar's coordinates and asking other team members to share their coordinates.

This highlights the incidental mathematics learning occurring in a class that was primarily focused on teaching students block coding and collaborative problem solving skills. There is clearly an opportunity to revisit ways that M: EE may stimulate interest and deeper understanding of Mathematics when a teacher encounters affective and behavioural engagement that could support further learning.

### *Players who experienced Minecraft as gamers*

As M: EE has its origins with the commercial game Minecraft, it was inevitable that some students with a background playing computer games at home would draw a comparison. After a brief discussion, they were quick to recognise that these limitations were due to changes necessary for an 'education' release of this software to help regulate student behaviour. In the following exchange, the students lamented the absence of advanced terminal commands and functions that would have given them further control over their creations.

Researcher: How did you experience using Minecraft at school?

Students: We are gamers and we enjoy online chat interactions. We prefer interacting face-to-face when working together on a Minecraft project.

Researcher: What did you notice was different or difficult to do?

Students: Some things are different such as codes for Edu and Java versions and frustrating to not be able to use similar terminal codes (an advanced function). You need to keep your skills up to date or if you return to your old map, it is fossil (outdated)

*Discussions by students and teachers about inspiration*

From the interviews conducted with students, some were 'inspired by' the novelty of new features of Minecraft or design approaches, others were 'inspired to' with guiding statements from the teacher that 'raised the bar'.

Researcher: How did you inspire each other?

Students: We like trying new stuff ... if it looks cool we implement that. For example, when a game looked too empty and plain, we changed the design of the game like half way through to go with a different kind of theme.

Researcher: How did your teacher inspire you?

Students: The teacher, pushed us, constantly telling us to make sure we get everything done so we don't panic. To always put something in revision ... raising the bar.

School A also had an interesting perception of the role of inspiration in her teaching:

Teacher: I'm pretty lucky in that in Minecraft, the result of their actions is logical to them so (students) know what to expect. So if they keep persisting and they keep doing what they're doing, then inspiration (and drive) is an innate thing.

Researcher: So what does a good teacher do in this space?

Teacher: At some point during the class, I am going to sit down next to a student to ask 'What are you trying to achieve?' perhaps adding 'Hey, are you trying to get to the top of the tower?' and 'Hey, if you keep trying or you move around it, you'll find that there's a way to get there.' With a reassurance that there is a way forward, you may find that is all that they need to know. It is also reassuring to some that that there is a way to be part of that group.

## 6.2 Results from School B

### 6.2.1 Overview of the lesson

Rather than a structured lesson, this event was conducted within a lunchtime computer club that was designed to encourage social interactions between students. The teacher described his use of M: EE as a 'virtual playground'. Given the specialised needs of the student population at School B, facilitating the development of social interaction and communication during unstructured play was a high priority for the staff.

#### *Links to the Victorian Curriculum:*

- **Personal and Social Capability - Recognition and expression of emotions Level D:** Name a range of emotions and describe how these are expressed or shown
- **Personal and Social Capability - Recognition and expression of emotions Foundation:** Develop a vocabulary and practise the expression of emotions to describe how they feel in different familiar situations
- **Personal and Social Capability - Relationships and diversity Foundation:** Practise the skills required to include others and make friends with peers, teachers and other adults
- **Personal and Social Capability - Collaboration Foundation:** Use appropriate language to describe what happens and how they feel when experiencing positive interactions or conflict

### 6.2.2 Description of the learning ecology

The classroom was a small computer laboratory located in a relocatable with two walls windows and a quiet retreat room, tastefully decorated as Dr Who's TARDIS. Comfortably furnished with provision for working in a range of different positions, the room included a large whiteboard and two desktop computers near the door, a spread of iPad computers on a table and two laptops on a standing desk. Before and during the lesson, there was some noise from a neighbouring classroom.

### 6.2.3 Description of lesson structure

The teacher carried a chronicle or journal that he put to one side during the lesson. Although there were no notes written on the whiteboard, the school's PBIS values were clearly displayed and contextualised with examples for use when playing M: EE. The teacher started the lesson off with a verbal instruction to students as they greeted and met upon entry to the room. Students then logged in and began playing M: EE on either iPads, laptops or desktop computers. During play the teacher moved around the room engaging in discussions with individual students or small groups. When there were five minutes left of lunchtime, the teacher provided a verbal warning, which was repeated when there were two minutes remaining.

When the bell sounded all students followed their established routines, logged out of their devices and left the room.

*Use of High Impact Teaching Strategies during this lesson*

During the lunchtime club at School the following High Impact Teaching Strategies were observed being utilised by the teacher:

- Strategy 5: Collaborative learning:** Collaborative learning occurs when students work in small groups and everyone participates in a learning task.
- Strategy 7: Questioning:** Effective questioning yields immediate feedback on student understanding, supports informal and formative assessment, and captures feedback on effectiveness of teaching strategies.
- Strategy 8: Feedback:** Feedback informs a student and/or teacher about the student’s performance relative to learning goals.

6.2.4 Event B: Two students engaging in unstructured play across the physical and environments

Event B was a three-minute period of time representative of the types of interactions between two students (coded here as S1 and S2) engaging in a playful game of ‘hide and seek’ in a world they co-created in M: EE. Analysis of the types of interactions highlight some of the social skills that students performed during this game. The coded timeline for Event A is shown below in Figure 4.

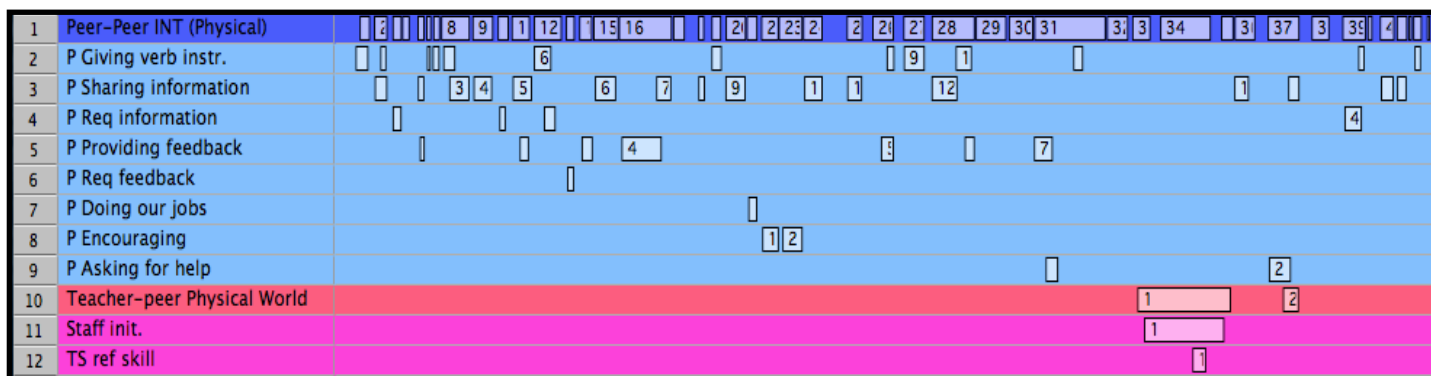


Figure 4. Timeline of Event B.

This timeline shows that there was a sustained high frequency of social interactions between the two students. After a verbal greeting and reassurance from the teacher that they would continue their work from the last session, S1 and S2 logged onto their devices and re-entered a world that they had both previously been co-constructing. There was considerable activity amongst the other students in the classroom during this time, with constant exclamations and excited vocalisations, but notably these two students remained engaged in conversation with each other. The teacher did not directly instruct these

two students but continued to monitor their impromptu game of 'hide and seek'. The only teacher intervention during this time was to move a third student observing the game out of the way of the recording camera set up by the researchers, as indicated in Figure 4.

A summary of the frequency and duration of social skills observed during this three-minute period is shown below in Table 7.

*Table 7. Frequency and duration of interventions for School B.*

<b>Intervention Name</b>	<b>Frequency (count)</b>	<b>Total time (hh.mm.ss)</b>	<b>Time Fraction (%)</b>
Peer-Peer INT (Physical)	45	00:02:13.91	73.89
P Giving verb instruction	13	00:00:19.87	11.11
P Sharing information	16	00:00:37.83	21.11
P Req information	4	00:00:06.57	3.89
P Providing feedback	7	00:00:16.35	9.44
P Req feedback	1	00:00:00.91	0.56
P Doing our jobs	1	00:00:01.27	0.56
P Encouraging	2	00:00:05.69	3.33
P Asking for help	2	00:00:05.35	2.78
Teacher-peer Physical World	2	00:00:17.87	10.01
Staff initiated interaction	1	00:00:13.21	7.22

Given the challenges that many students with autism experience with verbal communication (Elsabbagh et al., 2012) it was unexpected to see such a relatively high frequency of instances of students *giving verbal instructions* and *sharing information*. This could be a result of using M: EE which was of intense interest to many of the students in School B. By using something that motivated the students and with which they had developed the prerequisite vocabulary, M: EE appeared to provide a relevant context for students to practise the use of these verbal communication skills. The teacher noted that he would often support students in identifying the correct vocabulary and tone to use when performing these skills. The use of the game in a more student-directed manner allowed for students to experiment with language and non-verbal communication. Interestingly this required a shift in the way the teacher worked with these

students. Rather than setting assigned tasks, the teacher closely monitored and guided students completing activities that they decided upon in their groups. The role of the teacher was to ensure that conflicts between players could be resolved through coaching at the point of need.

Also highlighted as being important by the teacher at School B was using the social interactions manufactured through the use of M: EE to develop emotional recognition and regulation. The two students were observed in Event B labelling their emotions and the emotional states of others, and then trying to resolve negative feelings within the group playing together. This theme was explored in the post-session interview, with the conversation centring around the importance of agreeing upon the rules in 'hide and seek':

Students: We are all having fun because we are good friends. We have some rules that we decided together.

Researcher: Do people always follow the rules or do they break the rules?

Students: Yeah sometimes people break the rules and people get angry.

Researcher: What do you do?

Student1: First we would tell them via a chat message to stop. You show respect. "If they ask you to stop, you stop". There are many ways to be respectful in Minecraft.

Student 2: We tell them "be polite! ... take five deep breaths ... turn your iPad off."

Student 3: We deal with a griefer (bad faith player) by taking away their tools or the leader can login to the world and erase the team (restart game).

Whilst *providing feedback* and *requesting feedback* were less frequently performed than skills relating to task-based communication, there were surprisingly more instances of these skills being used in School B than in School A or School C. It is unclear why this is the case. It could be attributable to the explicit teaching of providing and requesting feedback in other classes at School B, as this is a strong area of emphasis within the school. This could also be attributable with the context, as many of the students considered themselves to be experts at M: EE. Drawing upon this perceived expertise, they might have felt

that they had requisite knowledge to be able to provide guidance to the other players. The relative high frequency of providing and requesting feedback in this unstructured context requires further exploration.

*Discussions by students and teachers about inspiration*

During interviews conducted at School B some students communicated that they were 'inspired' by the coding opportunities. Others were 'inspired' by the design work contributed by other students or the teacher feedback that connected different ideas. The teacher had a purposeful role in manufacturing 'inspiration'. They were observed strategically moving and positioning themselves in a way that afforded the opportunity to observe what was happening or and to use his knowledge of the students' interests to motivate them to engage with another individual or a group.

## 6.3 Results from School C

### 6.3.1 Overview of the lesson

This lesson was conducted within a composite class exploring the concept of sustainable building and natural disasters. As part of a multi lesson project, students built and tested survival bunkers that had previously been collaboratively designed. Participating students included 23 students in a single class ranging from Year 3 to Year 6. This composite year level range was due to the small population of the school. Students were seated at a mix of devices including Microsoft Surface tablets, iPads and laptop computers.

#### *Links to the Victorian Curriculum:*

- **Science - Questioning and predicting Levels 5 and 6:** With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be based on previous experiences or general rules
- **Science - Planning and conducting Levels 3 and 4:** Suggest ways to plan and conduct investigations to find answers to questions including consideration of the elements of fair tests
- **Science - Planning and conducting Levels 5 and 6:** With guidance, plan appropriate investigation types to answer questions or solve problems and use equipment, technologies and materials safely, identifying potential risks
- **Science - Earth and space sciences Levels 5 and 6:** Sudden geological changes or extreme weather conditions can affect Earth's surface
- **Personal and Social Capability – Collaboration Levels 5 and 6:** Identify the characteristics of an effective team and develop descriptions for particular roles including leadership, and describe both their own and their team's performance when undertaking various roles

### 6.3.2 Description of the learning ecology

Students were in assigned groups of three to four, with the groups remaining the same from previous tasks using M: EE. All of the students and the teacher were very familiar with M: EE. The classroom was a large double-sized relocatable with two adjoining teaching zones, a small storage room and focus room. It was furnished with provision for working in a range of different positions including regular school tables, plastic seats, soft-foam seats, sensory stools and bean bags. The space under the windows was used for storage of reference books and device storage. The learning space included large wall-mounted whiteboards and two portable whiteboards. Before and during the lesson, the noises outside were typical of a farming community with occasional sounds made by chooks or tractors.

### 6.3.3 Description of lesson structure

The teacher led an initial introduction to topic using a whiteboard with notes developed over previous lessons. During this introduction, the teacher iterated the learning goals and success criteria, used the notes on the whiteboard to structure and review key concepts from previous lessons and outlined her behavioural expectations surrounding collaborative work. During this initial phase the teacher led the discussions and clarified a number of conceptual misunderstandings.

Following this initial whole class introduction, students quickly moved to prepare and work on their devices in their established groups. At this stage the teacher moved from group to group working with individuals to check their progress and to provide intensive support. The teacher was not logged into Minecraft but closely monitored what students were doing. The whole class paused at regular intervals to ensure that all students remained focused on the learning goals and were addressing the success criteria. In addition to these 'pauses', the whole class twice returned to the whiteboard to reflect on their learning and to discuss common issues amongst the groups. When the teacher intervened, she used questioning to check understanding of the focus concepts, and where necessary used explicit direct instruction to clarify misunderstandings.

#### *Use of High Impact Teaching Strategies during this lesson*

During the observed lesson at School C the following High Impact Teaching Strategies were observed being utilised by the teacher:

- Strategy 1 - Setting goals:** Lessons have clear learning intentions with goals that clarify what success looks like.
- Strategy 2 - Structuring lessons:** A lesson structure maps teaching and learning that occurs in class.
- Strategy 3 - Explicit teaching:** When teachers adopt explicit teaching practices they clearly.
- Strategy 5 - Collaborative learning:** Collaborative learning occurs when students work in small groups and everyone participates in a learning task.
- Strategy 6 - Multiple exposures:** Multiple exposures provide students with multiple opportunities to encounter, engage with, and elaborate on new knowledge and skills.
- Strategy 7 - Questioning:** Effective questioning yields immediate feedback on student understanding, supports informal and formative assessment, and captures feedback on effectiveness of teaching strategies.
- Strategy 8 - Feedback:** Feedback informs a student and/or teacher about the student's performance relative to learning goals.

- ❑ **Strategy 9 - Metacognitive strategies:** Metacognitive strategies teach students to think about their own thinking.

### 6.3.4 Event C: Three students planning a bunker to withstand an earthquake

Similar to Event A and Event B, Event C was a three-minute period of time representative of the types of interactions between three students (coded here as S1, S2 and S3). During this time, the students were engaged in making key design decisions about their bunker, particularly the features that would help them to survive in the event of an earthquake. The teacher had given them a countdown until their map would be hit by a simulated earthquake. A coded timeline of this event can be seen below in Figure 5.

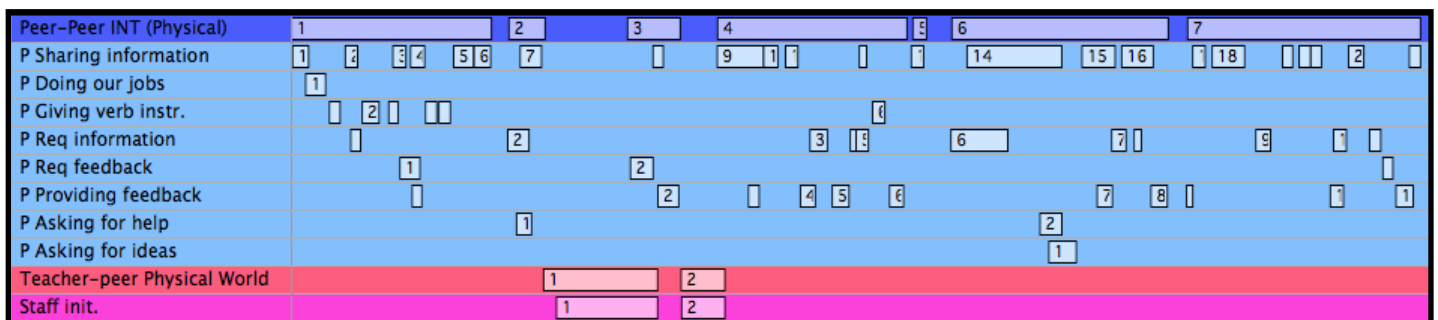


Figure 5. Coded timeline for Event C.

This three-minute period was characterised by a high frequency of interactions in the physical environment between the students. Interestingly they were used to teacher interventions in the form of regular ‘pauses’ to collectively evaluate progress towards the learning goals. This was part of the established classroom routine, and as shown in Figure 5 teacher intervention did not seem to reduce subsequent interactions between the students. The frequency and duration of social skills occurring during these student interactions are shown below in Table 8.

Table 8. Frequency and duration of interventions for School C.

Intervention Name	Frequency (count)	Total time (hh.mm.ss)	Time Fraction (%)
Peer-Peer INT (Physical)	7	00:02:47.54	92.78
P Sharing information	23	00:01:24.52	46.67
P Doing our jobs	1	00:00:03.48	1.67
P Giving verb instr.	6	00:00:12.55	7.22
P Req information	11	00:00:32.35	17.78

P Req feedback	3	00:00:09.24	5
P Providing feedback	11	00:00:27.07	15
P Asking for help	2	00:00:06.48	3.33
P Asking for ideas	1	00:00:04.81	2.78
Teacher-peer Physical World	2	00:00:28.02	15.56
Staff init.	2	00:00:25.64	14.24

Of the three coded events, Event C had the most diversity in terms of the types of targeted social skills being performed by the students. This might be because the skills required for collaboration had been explicitly defined and modelled by the teacher, and the class had engaged in regular plenary sessions where they self-evaluated their use of these targeted social skills. The students in this group were particularly adept at framing feedback for their classmates in a manner that focused on the learning goals and success criteria and avoided the use of feedback commenting on elements unrelated to the task.

#### *Discussions by teacher about professional development*

As an experienced and proficient user of Minecraft, the teacher at School C shared some interesting insights into her experiences of professional development. She attributed the development of her knowledge around the tool largely due to the expert support she received from a digital games-based learning coach allocated by DETVic:

Researcher: How did you first learn about M: EE?

Teacher: By accident, our principal returned from a meeting, excited and gung-ho about Minecraft. I was too but the only time I did eventually see M: EE in operation was sheer chaos. I muddled around with it myself and stayed very enthusiastic. I had no idea. Teachers need support, M: EE cannot be deployed by just throwing stuff at teachers.

Researcher: How did you learn how to use M: EE?

Teacher: When we did our PD day, a couple of teachers were scared about taking kids into a space where they didn't have ultimate control. I knew my kids

really well and we had their trust. You can then keep the momentum going beyond Minecraft, rather than just to fall back to familiar ways of what I'm used to.

As a teacher, I needed to work at the best ways of using this whilst wondering why I wanted it in the corner of my classroom. 'Let's give it a go and we'll see where it'll go'. Our DET M: EE coach was very good, persisting to help me finally develop and adapt this into my classroom literacy and mathematics goals.

The teacher emphasises that the learning experiences that she has been able to offer her students would not have been possible without external expertise. Not only did she require initial instruction on the rules and mechanics of M:EE, but she also required guidance on how to structure her lessons and optimise learning when using the tool.

#### 6.4 Examples of the use of High Impact Teaching Strategies in M:EE

Victorian schools are prioritising the use of ten High Impact Teaching Strategies. While some of the strategies were observed across the three settings more frequently than others, examples of different strategies were observed at some point in the data generation process. The following table details an example of each strategy being used by teachers in the context of a lesson that involved Minecraft. It is important to note that in almost all examples listed in Table 9 demonstrate the use of these strategies primarily in the physical environment.

*Table 9. Observed examples of using High Impact Teaching within an M:EE classroom.*

Strategy	Observed example
1: Setting goals	The classroom teacher wrote the overarching M: EE goal on the whiteboard. When doing this, the teacher emphasised a firm deadline and expectations around the quality of students' products. These goals were reflected upon at the end of the lesson and compared with what had been achieved.

<p>2: Structuring lessons</p>	<p>The classroom teacher adopted a predictable and well timed format for their M: EE lesson with scheduled opportunities to deploy or recover computing equipment, return furniture to set locations, discuss class goals or reflect and report on progress with a M: EE lesson.</p>
<p>3: Explicit teaching</p>	<p>The classroom teacher gave a brief but succinct lesson during an M: EE class about netiquette or online etiquette, carefully unpacking the nature of working online, how to deal with 'griefing' and the need to respect each other's work.</p>
<p>4: Worked examples</p>	<p>The classroom teacher spoke about a previous M: EE classroom project, using it to illustrate some key points about what was expected to be done along with some clear points about what was different with this new build. For new students to this class activity, it was a good opportunity to walk through the stages of an M: EE build.</p>
<p>5: Collaborative learning</p>	<p>The classroom teacher approached by a student complaining about the behaviour of two in her group, distracted by a M: EE generator that was wildly spawning pigs. The teacher deeply reflected on the different leadership roles in the group and approaches to managing behaviour. Discussed as a group how students could better listen to feedback from others, regulate their own behaviour and maintain a focus on their classwork.</p>
<p>6: Multiple exposures</p>	<p>The classroom teacher paused the class activity on multiple occasions to consider the progress of the group task and discuss as a group. On each occasion, the teacher took an opportunity to reinforce the social behaviour contract that had been agreed by briefly considering agreed M: EE rules listed on a whiteboard.</p>
<p>7: Questioning</p>	<p>The classroom teacher with small groups, posed the question 'why you are in the group'. Each answer prompted a further probing questions that helped to unpack what the group felt was the weakest aspect that needed to improve.</p>

8: Feedback	The classroom teacher moved to seat themselves next to a student or amongst a group of students. The teacher shared some honest reflections about how the group was progressing and an open discussion about how they should operate. Students contribute their own suggestions about the 'weakest link' or what was holding back the group.
9: Metacognitive strategies	The classroom teacher spoke to some students and paused their work to deeply consider their evolving role in the group and the dynamics that were playing out. Her questioning help them to explore their mind-set and the thinking that was contributing to this growth along with the associated behaviour changes and challenges.
10: Differentiated teaching	Reported: Classroom teacher noted that an autistic student wanted to be friends and he couldn't work out how to make them in the playground. With some coaching and scaffolding on the whiteboard, he was able to easily make new friends within Minecraft. Following the class, the teacher was able to reflect with the student how these skills could be adapted for outside the classroom.

This analysis of the data generated from School A, School B and School C inform the recommendations that comprise the final sections of this report.

## 7.0 Recommendations for using M: EE as a teaching and learning tool

Drawing upon the analysis of the three case study schools and a review of the literature a number of general recommendations for how best to use M: EE as a teaching and learning tool can be made. The first three relate specifically to actions that individual educators can enact to ensure that no matter their pedagogical approach to using M: EE, learning for all students can be optimised. Recommendations 7.4 and 7.5 are targeted towards school leadership and policy makers and relate to the training and sustainable development of teachers. It is important to note that although this report discusses the recommendations in relation to the use of M: EE as a teaching and learning tool, they build upon the established science of learning and are pertinent to effective instruction in any context.

## 7.1 Importance of clear goal setting and success criteria

It has been well established in research that clear, explicit goals during learning activities are key in achieving academic and social outcomes (Berman & Graham, 2018; Conzemius & O'Neill, 2009; Locke & Latham, 2002). The importance of clear goals was confirmed during analysis of the three case study lessons. Learners using M: EE must also recognise what the actualisation or achievement of this goal looks like, often referred to as the 'success criteria' (Hattie, 2009, Williams, 2008; Yates & Hattie, 2014). In the broadest sense, a goal is a desired outcome or attainment (Locke & Latham, 2002; Woolfolk & Margetts, 2016). Locke and Latham (2002) identified four dimensions of goal-setting that have an impact upon learning: goals direct attention to the task, they energise effort from the learner, they increase persistence, and promote the development of new knowledge and strategies. These dimensions are relevant for all forms of learning, including social skills interventions (Locke & Latham, 2002).

This research found that teachers can most effectively use M: EE when students understand how their use of the tool is connected to meaningful learning goals derived from the curriculum. In this study, goals were most effective when including clear, explicitly stated success criteria. We recommend that teachers use the following strategies to optimise their use for goals and success criteria:

- Where possible learning goals should be negotiated in advance with students before they begin using M: EE and be referred throughout the lesson at regular intervals.
- Teachers should use their knowledge of the curriculum and learning progressions to lead the development of the explicit goals and success criteria and break larger goals down into micro goals.
- Success criteria must clearly state how the students can achieve the overarching goals or micro goals, whether it is actions within the virtual environment of M: EE or in the physical classroom.
- A limited time in which to accomplish the learning goals or to make a defined amount of progress towards the learning goals was shown to help students remain on task during their use of M: EE.
- Students must be accountable in making progress towards their goals. In multi-lesson projects this could be allocating time for a plenary report to the class in the final ten minutes of each lesson. The use of learning journals could be used as an alternative to reflect on progress towards achieving a goal.
- These reports or learning journals must comment on progress towards the learning goals and include evidence such as annotated screenshots or videos of work completed in that lesson with reflections on the content central to the targeted learning outcomes. Minimal attention should be paid to elements superficial to the goals, such as the aesthetic of M: EE or other elements that don't relate specifically to the goals and success criteria. Whether students are giving oral reports or are

creating a learning journal, the processes for self-reflection need to be explicitly taught and modelled by teachers.

## 7.2 Providing meaningful feedback to students on their learning

In order for learners to know how close they are to achieving their goals, learners need to receive feedback that is meaningful to them. Hattie and Timperley (2007) conceptualised feedback as “information provided by an agent regarding aspects of one’s performance or understanding” (p. 81). In understanding what constitutes ‘meaningful feedback’, Berman and Graham (2018) referred to information that provides a learner with a clear understanding of the differences between what a learner currently knows or skills they can perform, what they need to know or be able to do in order to reach their goals and, most importantly, the steps required to be able to bridge this gap. Hattie and Timperley (2007) provided three questions for the learner that they argued are central for bridging the discrepancy between the goal and performance:

1. Where am I going?
2. How am I going?
3. Where to next?

Well-constructed feedback should allow students to be able to reflect on these questions in order to evaluate their goals, their performance and implement changes to address the identified areas of need (Berman & Graham, 2018; Quinton & Smallbone, 2010).

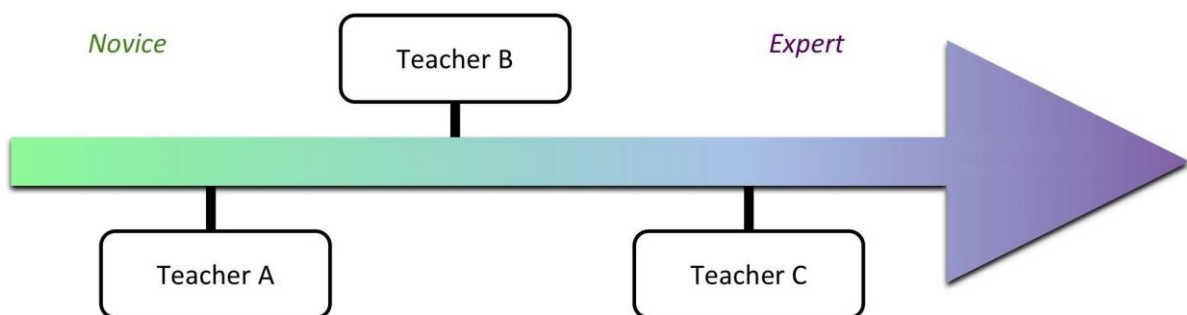
Feedback was found to be key to effective learning outcomes in the case studies at the centre of this research project. Interestingly all three teachers provided feedback in the physical environment rather than doing so in the virtual environment. This might be due to a lack of confidence in using M: EE or to be able to interact verbally with a group of students in real time. Interestingly for the teacher of students with autism in School B, time allocated for feedback in the physical environment was also viewed as an additional opportunity to develop the students’ non-verbal communication skills. When students received timely feedback in the physical environment, whether it be in relation to academic content or social capabilities, we observed students addressing their misconceptions and better understand their own next steps for learning. In order to optimise feedback in lessons using M: EE we make the following recommendations:

- Teachers should be constantly monitoring the actions of students during their use of M: EE. This can be done in both the physical environment, by moving around the room or in the virtual environment. It is vital that students are regularly given individual feedback on their progress towards the learning goals.

- Regular pauses in play can be useful redirecting attention to specific ‘hotspots’ or areas of challenge and provide collective feedback to the groups on specific elements of their collaboration. Examples of this include observations by the teacher on how each group is collectively planning their approach to a task.
- These pauses in play allow teachers to also receive feedback from the students on their experiences and understandings, which provides important information that the teacher can use to guide their instruction. The careful use of questioning here can help the teacher identify student misconceptions and misunderstandings, and also to set smaller ‘micro-goals’ to ensure that all students are making progress.
- Teachers should encourage peer feedback in collaborative tasks, but the skills required for this to be effective need to be explicitly taught and modelled. This includes helping the students to link their feedback to the targeted learning outcomes and adjusting their language so it can be understood by the intended recipient.
- Assessment of students in M: EE is one area that teachers reported finding the most challenging. Section 8 of this report details two assessment tools that can be used to measure individual learner competency in collaborative problem solving. These tools offer developmental pathways for teachers to use to guide their students to the next level of sophistication.

### 7.3 Ensuring minimum levels of teacher competency

For many teachers Digital Games-Based Learning remains unfamiliar, with some teachers feeling that they lack the knowledge of the software required for it to be used as an effective learning and teaching tool. In this research project we observed three different educators who each described themselves as having different levels of sophistication in terms of their understanding of M: EE, and in knowing how best to position this tool as part of an effective lesson. Figure 6 illustrates this spectrum of expertise.



*Figure 6. The spectrum of experience within this study.*

Combined with misconceptions about the inherent knowledge and skills of their ‘digital native’ students, the findings of this research highlight that one key consideration for the effective use of M: EE is ensuring

teachers have the requisite understanding of the software (the technological tool). This is reflected in the TPACK model that delineates three domains of teacher expertise required for the effective use of educational technology to achieve the targeted learning outcomes; a high level knowledge of the curriculum content being taught, a sophisticated understanding of the science of learning (pedagogical knowledge) and knowledge of the technological tool. The TPACK model is depicted below in Figure 7.

### Technological Pedagogical Content Knowledge (TPaCK) for Inclusive Classrooms

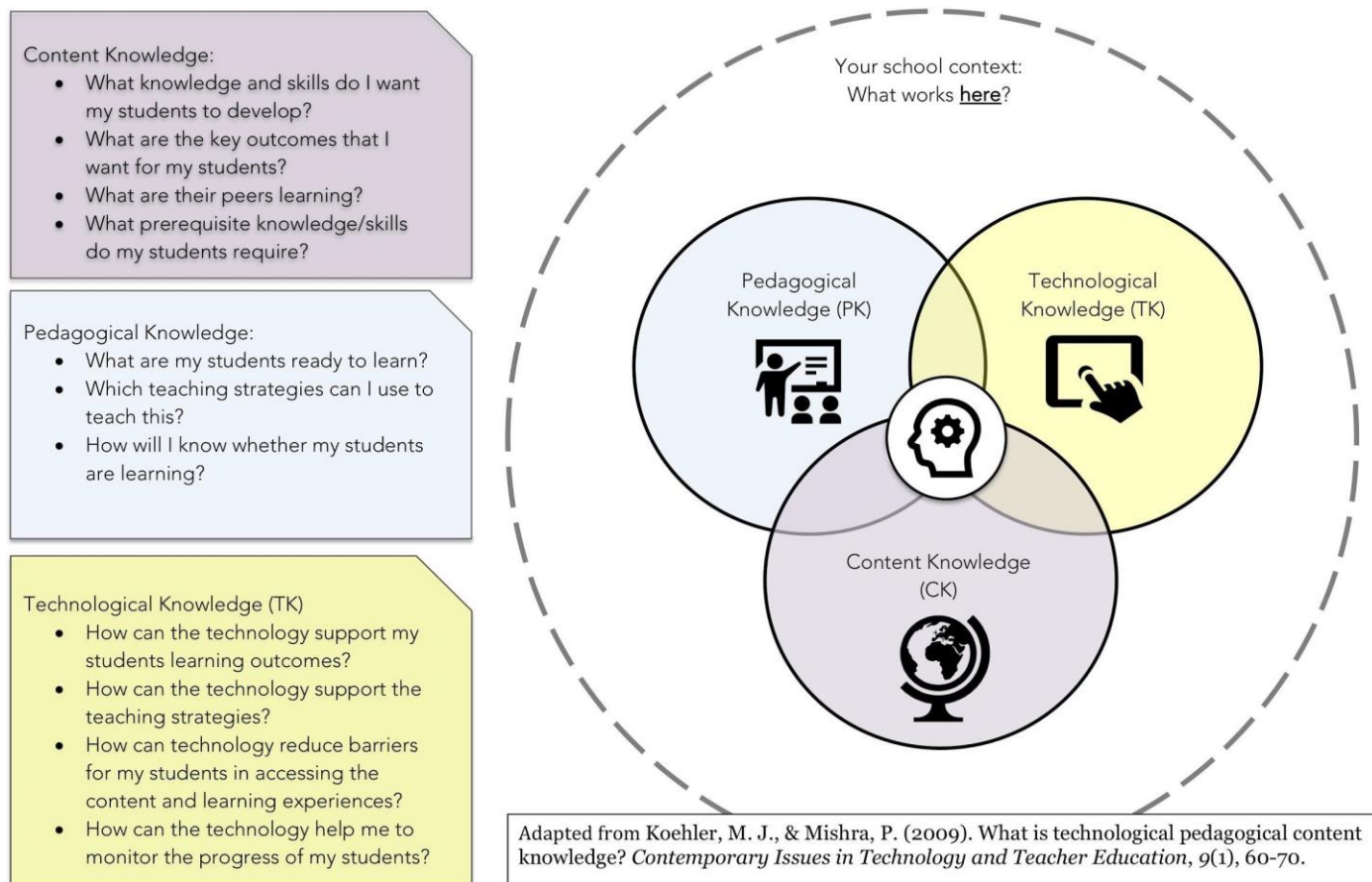


Figure 7. The Technological Pedagogical Content Knowledge (TPaCK) model.

Alongside this model are a number of questions developed in response to this research project that teachers can ask themselves in how best to position M: EE as a tool for teaching and learning. In order to be able to sufficiently address these questions, teachers must understand not just how to use M: EE and its capabilities, but also the limitations and boundaries of the software so as to recognise when a task is best completed using alternative pedagogical approaches.

We recommend that teachers have an understanding of the following M: EE capabilities and features in order to ensure that they have the minimum level of competency:

- Understanding the overarching rules and mechanics of play within M: EE, including the difference between the various modes of play and how they position the player. For example, teachers need

to know the different emphasises and gameplay objectives between *Survival Mode* and *Creative Mode*.

- Knowing the purpose of the 'terminal' command line and some of the most basic functions. A useful reference for educators can be found here: <https://educommunity.minecraft.net/hc/en-us/articles/360047555451-Essential-Commands->
- In academically focused lessons teachers need to make a clear distinction between 'playing games' and using M: EE as a classroom tool for learning. This difference needs to be stated explicitly to ensure students are aware that this is a tool for learning. To accomplish this, teachers will need to use a different language. For example, instead of saying "Let's play Minecraft today" they should be saying "Let's do some learning in Minecraft today." This subtle shift in thinking is important in drawing student attention to the targeted learning outcomes.

#### 7.4 Exploring opportunities to inspire and deeply engage

When analysing feedback from students, consideration needs to be given to the skill contribution and varied expectations presented to a classroom by widely different students. Acknowledging and hearing the voice of experienced students with a gaming or computing background is an opportunity for teachers to secure their investment in classroom learning outcomes, rally student support for collegial problem solving to help resolve technical issues or to encourage deeper exploration with areas such as networking, server hosting or digital curation or citizenship.

All teachers and students interviewed stated inspiration played an important role in designing learning activities. It has been argued that inspiration acts as a motivational concept that is evoked from a source, including the teacher or other students (Thrash, Maruskin, Cassidy, Fryer, & Ryan, 2010). It has been speculated that inspiration is the main element behind cognitive learning or the willpower to learn (Nolen, 2014). Ultimately this motivation comes internally from the student but teacher interventions, complete with personal or emotional ties, also play a role.

From the interviews conducted, some students indicated that they were 'inspired by' the novelty of new features of Minecraft, novel design approaches by fellow students, or even the opportunities to engage in coding. Other students indicated that they were 'inspired to' complete their build challenge with guiding statements from the teacher that 'raised the bar' or teacher feedback that helped them to connect different ideas. Teachers reported that they were best able to inspire students by creating an environment that encouraged students to step out of their comfort zone and share feedback that contributed towards different ideas.

We recommend that teachers have an understanding about the importance of:

- Understanding the value of incorporating social elements of *Design Thinking* into M: EE by using approaches such as the Stanford school model.
- Working towards a mindset that accommodates failure and embraces growth then explores personal strengths. Failure is integral to creativity and therefore must be understood as a necessary step in learning.

### 7.5 Optimising professional M: EE learning communities for all teachers

Sustainable learning requires different types of professional learning for teachers with different levels of competency and experience using M: EE. This range of expertise is to be expected and means that different teachers require different types of professional development in order to ensure continued improvement in the quality of instruction for all classrooms. This study found that teachers with a novice understanding require an initial introduction to the tool and sustained professional development to increase their sophistication of use and to ensure that they are moving beyond simplistic or tokenistic use of M: EE. While beginning teachers require support with understanding the fundamental rules and mechanics, established teachers with a sophisticated understanding of the functionality of M: EE require a higher level of professional dialogue centred on how best to optimise learning. Whilst top-down support is necessary, personal support is also required.

The study identified some barriers associated with exploring teaching using computers and games in the classroom. Rather than adopt a self-guided discovery or transmissive approach to professional development, a transformative approach may be more effective under the guidance of an experienced coach. A skilled and experienced mentor with a strong understanding of how to effectively use digital games in classrooms could work with small cohorts of enthusiastic teachers to collegially plan and trial a unit of class work before wider implementation (Stieler-Hunt & Jones, 2019).

We recommend that in order to develop sustainable learning for all teachers the following actions around optimising professional learning communities need to occur:

- Structure early professional development experiences with M: EE with a skilled and experienced mentor to collaborate on a practical unit of work that can be trialed.
- Schools can help identify amongst their staff and support a *games-in-learning mentor* that reflects the passion and enthusiasm of the professional development coach.
- Experienced Victorian teachers need a community where they can share high-complexity tasks that are beyond what novice users of M: EE are ready to plan and produce.

## 8.0 Developing and assessing collaborative social skills in M: EE

In addition to academic learning, this study found that M: EE can be used to develop collaborative social skills when supported by effective teaching. This research project observed instances of collaboration in all three schools, with students assisting each other to co-design artefacts, to better understand gameplay mechanics and in addressing challenges with block coding. Whilst working in groups, students practised their verbal and non-verbal communication. This was particularly important for developing expressive and receptive language in School B, where the teacher highlighted this as a priority of the lunchtime club.

To optimise social skills development teachers need to understand what their students can do and which skills they need to further develop. The *Victorian Curriculum Personal and Social Capability* guides teachers in the broad scope and sequence of skill development required for social understanding, self and social regulation and effective collaborative problem-solving. This curriculum can be complemented with two sets of fine-grain learning progressions:

1. the *Students with additional needs (SWANs) social processes learning progression* (Coles-Janess & Griffin, 2009), and
2. the *Collaborative problem-solving empirical progressions* (Hesse, Care, Buder, Sassenberg, & Griffin, 2015).

Both learning progressions were derived using ‘task analysis’, which refers to the deconstruction of a task into its component parts (Graham, Berman, & Bellert, 2015; Klett & Turan, 2012). Using developmental continua assumes that there is a linear ‘typical’ progression of social skill development, or an underlying structure that dictates the order in which subsets of particular skills are ideally developed (Coles-Janess & Griffin, 2009). These progressions offer teachers a sequential pathway for supporting students to progress through the broad levels of the Victorian Curriculum.

### 8.1 Using M: EE to develop skills pertaining to the Personal and Social Capability

As highlighted in the analysis of the data generated in all three schools, M: EE offers opportunities outside of the structured classroom for students to develop and practise the performance of key social skills. This was particularly evident in School B, where M: EE was utilised as ‘virtual playground’ where students could practise their social and collaborative problem-solving skills. M: EE allows students with social emotional differences and challenges to build from a potential area of strength and interest to develop the social skills required to build lasting friendships. A particular affordance of the Victorian Curriculum are the Levels A to D that were developed specifically for students working towards the standards established at the

Foundation Level. This is particularly useful for teachers supporting learners with social emotional challenges or differences, such as those typically presented by autism.

Levels A to 10 guide teachers towards the significant milestones that should be expected for learners as they develop. We therefore make the following recommendations for teachers using the *Victorian Curriculum Personal and Social Capability* Levels A to 10 to inform their use of M: EE as a tool for social skill development:


- Teachers should become familiar with Levels A to 10 regardless of whether they are in a mainstream school or a specialist school. As the Victorian Curriculum is developmental in nature, students within the same age group in a single class can be working across a broad range of levels.
- Teachers should explicitly model and define the language of collaboration. Much of this language is contained in the *Personal and Social Capability*.
- For younger students or students who require additional support with collaborative social skills, video self and peer modelling can provide an effective intervention that helps to teach and reinforce key collaborative social skills. Teachers and school policy makers can access more information about video modelling at Anthea Naylor's (*Melbourne Graduate School of Education*) website: <http://www.antheanaylor.com>
- Students should receive regular feedback on their levels of proficiency in regard to collaborative social skills in addition to academic outcomes. Teachers can use the learning progressions in the following sections as a guide for assessing their students.

## 8.2 Assessment using the SWANs social processes learning progression

The *SWANs social processes learning progression* (Coles-Janess & Griffin, 2009) provides a fine-grained tool currently in use in many schools in Australia. This tool provides guidance to assess and support students identified as having social-emotional challenges working towards Foundation Level of the Victorian Curriculum. Many of the participants in this study attending School B were being assessed through the use of an assessment instrument which uses this learning progression. This assessment instrument is known as *Abilities based learning & education support (ABLES)*. Although the *SWANs* tool was designed to meet the requirements of teachers working with students with disabilities, it has the functional intention of “assessing students on the basis of their abilities, not their disabilities” (Department of Education and Early Child Development [DEECD], 2011, p. 5).

An example of the first two levels of this learning progression are presented on the following page in Table 10.

Table 10. Social processes learning progression: Interacting and connecting with people (Coles-Janess & Griffin, 2009).

 <p>Increasing levels of sophistication</p>	<b>Level One:</b> Learning how to be socially receptive
	<p><u>Indicative behaviours:</u></p> <ul style="list-style-type: none"> <li>• The student is learning to focus attention on others and acknowledge their presence.</li> <li>• S/he may be forming emotional bonds with familiar adults.</li> <li>• The student is learning to accept assistance from familiar adults and may be learning how to undertake simple tasks with their coactive support.</li> </ul>
	<b>Level Two:</b> Learning how to be socially responsive
	<p><u>Indicative behaviours:</u></p> <ul style="list-style-type: none"> <li>• The student is learning to participate, with the support of familiar adults who direct and regulate the student's involvement.</li> <li>• Increasingly, the student is directing attention towards other people, but his/her interest may not lead to active participation.</li> <li>• The student may express affection towards, and a preference for, particular others and yet engage in activities alongside rather than with them.</li> <li>• If the student does interact with other students, this may not evolve into friendships.</li> <li>• The student is learning to operate in the social environment by following the direction of familiar adults. For instance, under direct supervision the student may be able to follow class rules and routines, greet others, control impulses, use property safely, and interact fairly with other students.</li> </ul>
	<b>Level Three:</b> Learning how to be socially active
	<b>Level Four:</b> Learning how to be socially perceptive
<b>Level Five:</b> Learning how to be socially self-sufficient	
<b>Level Six:</b> Learning how to be socially flexible	

Based on the findings of this study we recommend that:

- Teachers become familiar with the different levels and indicative behaviours found in the SWANS social processes learning progression. This is especially important for teachers working with students with social emotional challenges or differences, such as autism. For the full learning progression please see Coles-Janess and Griffin (2009).
- We also suggest that teachers and school administrators contact DETVic about accessing the ABLES assessment instruments. More information is available from <https://www.education.vic.gov.au/school/teachers/learningneeds/Pages/ablesassessment.aspx>

### 8.3 Assessment using the Collaborative Problem-Solving Empirical Progressions

An alternative set of learning progressions, the *Collaborative problem-solving empirical progressions* (Hesse et al., 2015), were also reviewed. A product of the Assessment and Teaching of 21<sup>st</sup> Century Skills (ATC21S) project, this set of progressions assists with unpacking the social dimensions required for effective collaborative problem-solving. Importantly, these are distinct from the SWANs social processes learning progression in that they were not designed specifically for students with disabilities. The Collaborative problem-solving empirical progressions (Hesse et al., 2015) provide a series of sequencing skills in terms of sophistication and how individual skills can be used in conjunction with other skills (Hesse et al., 2015). An illustration of the dimensions of the *Collaborative problem-solving empirical progressions* is shown below in Figure 7, with the social dimensions that are the focus of this report highlighted in blue.

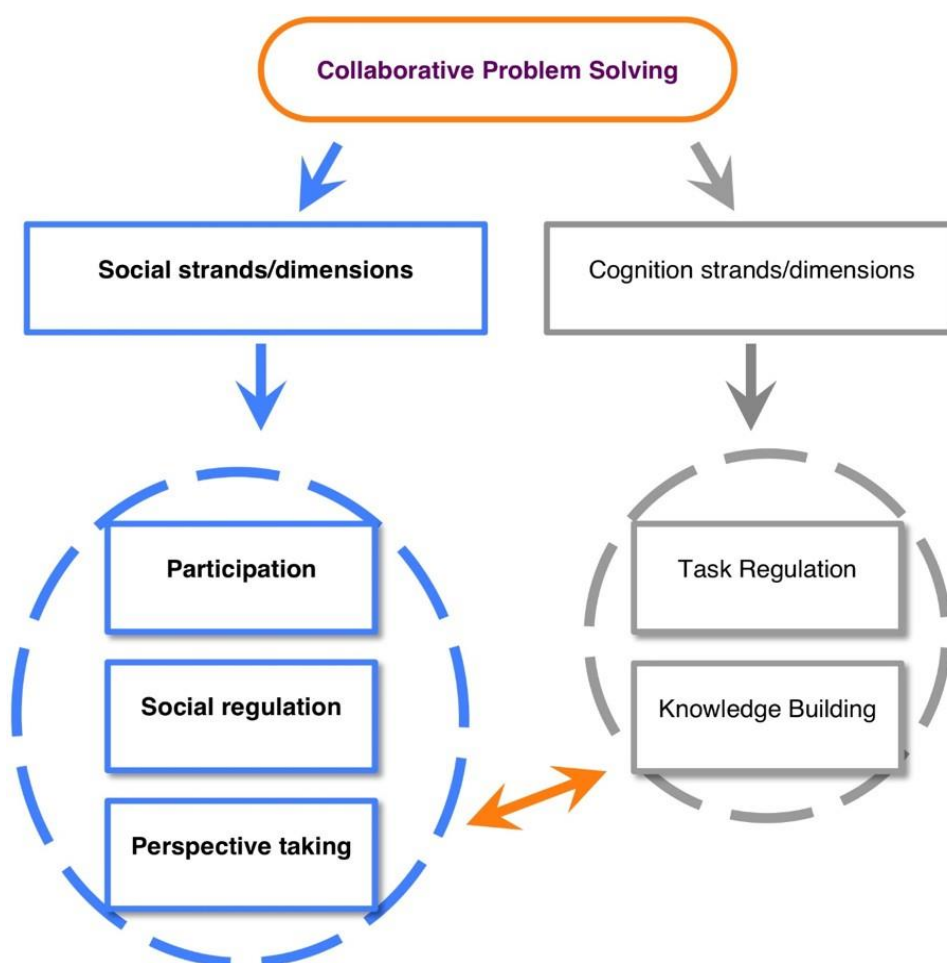


Figure 7. Organisation of social and cognitive skills within the Collaborative problem-solving empirical progressions. Adapted from Griffin, Murray, Care, Thomas and Perri (2010).

The social skills sub-elements of the Collaborative problem-solving empirical progressions are presented on the following page in Table 11. Like the *SWANs social processes learning progression*, a hierarchy of increasingly sophisticated performance is presented for each of the three social dimensions. In this case the level of sophistication increases from the bottom to the top.

Table 11. The social dimensions of the Collaborative problem-solving empirical progressions (Hesse et al., 2015).

Level	Participation	Perspective-taking	Social regulation
F – Cooperation & shared goals		<ul style="list-style-type: none"> <li>🔍 The student can tailor communication with their partner based on their awareness of their partner’s understanding from the start of the task.</li> <li>🔍 The student incorporates the contributions from their partner to suggest new solution paths or modify incorrect ones.</li> <li>🔍 They use solutions provided by their partner and work more collaboratively through the problem-solving process.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student assumes group responsibility for the success of the task.</li> <li>🔍 They can manage conflicts with partners successfully, resolving differences before proceeding on a possible solution path.</li> <li>🔍 The student is able to evaluate their overall performance in the task.</li> <li>🔍 They are also able to evaluate the strengths and/or weaknesses of their partner based on their performance during the task.</li> </ul>
E – Appreciated & valued partnership	<ul style="list-style-type: none"> <li>🔍 The student is able to actively participate in unfamiliar tasks.</li> <li>🔍 The student initiates and promotes interaction with their partner often before entering their own answer.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student acknowledges and responds to contributions from their partner but does not make changes to their original plan.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student attempts to resolve differences in understanding with their partner but resolution of differences is not reached.</li> <li>🔍 The student is able to comment on their partner’s performance during the task.</li> </ul>
D – Mutual commitment	<ul style="list-style-type: none"> <li>🔍 The student perseveres to solve the task by repeating attempts and/or multiple strategies.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student modifies communication with their partner to improve common understanding and share resources and information.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student comments on or shares information with their partner regarding their own performance while attempting the task.</li> <li>🔍 The student is aware of their partner’s performance on the task.</li> </ul>
C – Awareness of partnership	<ul style="list-style-type: none"> <li>🔍 The student demonstrates effort towards solving the problem.</li> <li>🔍 The student discusses the task with their partner by responding to communication cues and requests.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student makes contributions to their partners understanding.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 They have a common understanding with their partners in regard to the problem.</li> <li>🔍 The student reports to their partner regarding their own activities on the task.</li> </ul>
B – Supported working	<ul style="list-style-type: none"> <li>🔍 The student actively participates in the task when it is familiar.</li> <li>🔍 Interaction between partners occurs more frequently but it is limited to only when it is necessary for completing the task.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student is not overtly responsive to their partner, often taking a long time to respond or not responding at all and tends to ignore their partners contributions.</li> </ul>	<ul style="list-style-type: none"> <li>🔍 The student still works largely independently taking responsibility for their own actions during the task.</li> <li>🔍 The student is aware of their own level of performance during the task.</li> </ul>
A – Independent working	<ul style="list-style-type: none"> <li>🔍 The student commences the task independently focusing on the instructions provided.</li> <li>🔍 Interaction with their partner is limited to the beginning of a task and only in those situations where the instructions are clear.</li> </ul>		

Based on the findings of this study we recommend that:

- School systems and teachers become familiar with and implement assessment practices using the *Collaborative problem-solving empirical progressions*. The full progressions, including the cognitive dimensions, are available from Hesse et al. (2015).
- We also suggest that school systems consider the use of video-based assessment to capture instances of collaboration between individuals. As shown in this study, video allows teachers repeated viewings of interactions to allow for a more evidence-informed assessment using such progressions.

## 9.0 Future directions for research

This report analysed three case study lessons in different settings. While this provided some indication of how M:EE is being used by teachers in these schools, larger scale research is required to make any definitive judgment as to the impact it is having on broader academic and social learning. Despite the inability of this research project to provide a quantifiable measure of impact, the individual instances of academic and social learning that were captured provide a sense of cautious optimism. While M: EE can create the conditions for collaborative learning, all three participating teachers recognised that they have a vital role in digital games-based learning. Future research should focus on optimising the role of teachers in leading digital games-based learning.

Future research projects that this study indicates would have merit include:

- Research identifying how best to develop teachers understanding of digital games-based pedagogies beyond understanding the rules and mechanics of M: EE. There is a definite need for the development of a local learning community for teachers who are experienced in using M:EE as a tool for learning and teaching.
- Research that builds upon the High Impact Teaching Strategies by identifying their optimal use during lessons utilising M: EE. From this research an exemplar video bank of teachers implementing High Impact Teaching Strategies in Minecraft could be created for facilitating professional development.
- A large scale local randomised control trial is required to fully validate M: EE as a teaching and learning tool in Victorian classrooms. At the time of writing this report there was very limited comparative research that suggests the contexts in which M: EE can definitely be judged as preferable to other learning and teaching interventions.

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