I can locate it!

Teaching location with the assistance of digital technologies

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An exploration about how the use of digital devices such as fitness trackers, robotic toys and handheld mobile devices may be used by teachers to enhance student learning in geometric reasoning.

How can we effectively use fitness trackers, robotic toys and handheld mobile devices to teach the outcome ACMMG023, 'Give and follow directions to familiar locations' to Year 1 students? This article will provide you with specific examples that encompass current pedagogy and practice to discuss the benefits of using mobile devices within a primary mathematics classroom.

The Association of Mathematics Teacher Educators (AMTE) views technology as an essential component in the teaching and learning of mathematics (AMTE, 2006). In a world where digital technologies drive what we do and how we live, it is important to remember that it is not the technology itself that transforms our learning environment, rather its potential to enhance existing classroom practices. For mobile devices to play a significant role in our learning environment, we as educators, need to think explicitly about why we are using the digital technology and how it is going to enrich the students' learning experiences (The Australian Association of Mathematics Teachers, 2014). Therefore, it is fair to say that as educators we have a duty of care to ensure that we are providing quality experiences for our students, which encompass digital technology and its benefits to education (AMTE, 2006; Attard & Northcote, 2011; Day, 2014). However, this in itself is not an easy task to accomplish with the exhaustive range of apps, devices and accessories available for educational use.

Technology has the potential to push education exponentially, where the students are able to connect curriculum content to local and global real-world experiences (Day, 2014). The current generation of students has technology embedded into their everyday experiences. (Henry, 2015; Samuelsson, 2007, as cited in Attard & Northcote, 2011). Therefore, if technology is such an integral part of our lives, how can we ensure that this is reflected in our teaching and learning environments?

Fitness trackers

Utilising fitness trackers in the teaching and learning of mathematics allows for learning to occur through real-world experiences. The use of fitness trackers in the classroom allows the students to see the potential for mathematics in everyday experiences and the use of mathematics to enhance our quality of life (Attard & Northcote, 2011). Attard (2014) states that students are engaged through learning that is contextual and relevant and when technology is used to complement the learning that is taking place. In other words, technology is used to complete tasks that were not accessible to students previously, therefore bringing the learning to life through its use.

With more than half of Australia's population utilising a fitness tracker daily (Ricco, 2016), using this device in the classroom would be highly motivating to students due to its current status in society. Besides thier health benefits, fitness trackers have the potential to calculate, measure and record statistics, location and measurements for use within the classroom, as shown in Figure 1.

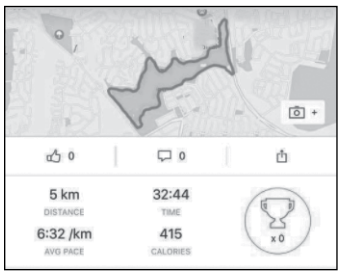

Figure 1. Image of fitness tracker data.

The data provided by fitness trackers offer students the opportunity to engage in tasks that require the implementation of the Proficiency Strands of the F–10 *Australian Curriculum: Mathematics*; understanding,

fluency, problem-solving and reasoning, whilst refining their current level of knowledge and understandings (Australian Curriculum, Assessment and Reporting Authority, 2015; Guerrero, 2014). An example of this can be seen through the potential for this data to be used with Year 1 students to record their movements within the playground (ACMMG023) and the number of steps taken (ACMNA012, ACMNA013) during a 30-minute period (ACMMG020). The students can then take this data back to the classroom where they can interpret, discuss, compare and analyse the data (ACMSP263). This provides students with a meaningful and contextual learning experience, whilst developing a student's personal and social capabilities (ACARA, 2015).

The use of technology in the example above is highly warranted as it allows the students to collect accurate data for analysis at a later stage. If the students were asked to complete this task during class time then the complexity of classroom and technological management may obstruct the quality of the mathematics taking place (Guerrero, 2014; Koehler & Mishra, 2009). If the students use their fitness trackers to obtain this data during their playtime it provides the provision for student-directed learning and makes them accountable for their learning throughout the entire day (Booker, Bond, Sparrow & Hurst, 2010).

The map obtained from the fitness tracker data can be used by the students to create a recount of their events during lunchtime, which will provide them with the opportunity to demonstrate the mathematical language of right, left and turn (ACMMG023, ACELY1661). The recount could then be shared with their peers to retrace their steps to see if they have travelled to the same destination (ACMMG023).The peers could then provide the original author with feedback on their directions, which will allow for reflection and refinement of the task (ACMMG023, ACELY1662). This provides assessment opportunities and cross-curricular links through the activities that can be implemented from the data collected. The recount activity also encourages self-reflection and peer-evaluation, which is essential for the development of a positive mindset towards a student's mathematical knowledge and abilities (Wiliam, 2011).

Bee-Bots

Bee-Bots are small, user-friendly programmable robots that can be used to explore many facets of mathematics. The body contains seven large buttons that are pressed to move the robot in four directions: up, down, left and right. It is their simplicity in design and utility that makes them ideal to use in a Year 1 classroom (Highfield, 2010). The students can program up to 40 moves into the robot before pressing the 'Go' button. The robot then begins to move using the directions that the students have entered. Each movement is 20cm in length; therefore if the student presses the forward button twice, Bee-Bot will move forward 40cm (Attard, 2012). Bee-Bots allow the students to implement their knowledge of directionality and positional referencing, which is required for the mathematical concept of location, to obtain instantaneous feedback through the movement of the robot (Attard, 2012). For example, if the students require the robot to move forward and turn left to navigate inside an object, they need to estimate how many moves the robot will require to reach the point at which it will need to turn (ACMMG019).This requires the students to self-reflect on their attempts to program the robot and self-evaluate to finalise the path and movements the Bee-Bot will need to take to reach its intended destination. As the students engage in the process of modifying the instructions, they are actively constructing their learning (Booker, et al., 2010).

The robotic devices also encourage collaboration and communication amongst the students, which will provide them with the opportunity to see how their mathematical knowledge can be applied in various contexts (Sparrow & Hurst, 2010). In the example noted, as the students are relishing their achievements in moving the robot close to the target, they are also discussing how to ensure that their next attempt will meet their intended outcome. The rich conversations that occur amongst the students as they problem-solve, moves students beyond simply acquiring knowledge by allowing them to fortify their understandings through their learning experiences (Joyce, 2011; Koehler and Mishra, 2009).

The open-ended nature of programming the robotic device allows all students, regardless of their current level of knowledge and understanding of location, to participate in the learning experiences (Highfield, 2010). The application of multiple pathways when reaching a destination intrinsically motivates the students through its engaging design. It also promotes a deeper understanding of the content through the practical application of knowledge and skills (Piggott, 2011).

The example describes the utility of a Bee-Bot in its simplest form, as the complexity of the task can be altered in many ways to cater for the diversity of needs and abilities in a classroom. This can be achieved through altering the complexity of the instructions provided to students, such as move the Bee-Bot through a tunnel and stop it next to the bookshelf, as shown in Figure 2. This multi-step request requires students to navigate through obstacles (ACMMG023) and estimate how many movements (ACMMG019) are required by the robot to achieve the desired result. The activity could also be extended to require the students to build a track to drive the robot on, which will encourage further refinement in their implementation of their measurement and geometry knowledge (ACMMG019), therefore, demonstrating how mathematical knowledge is integrated and how it can be utilised in different contexts (Attard, 2014).

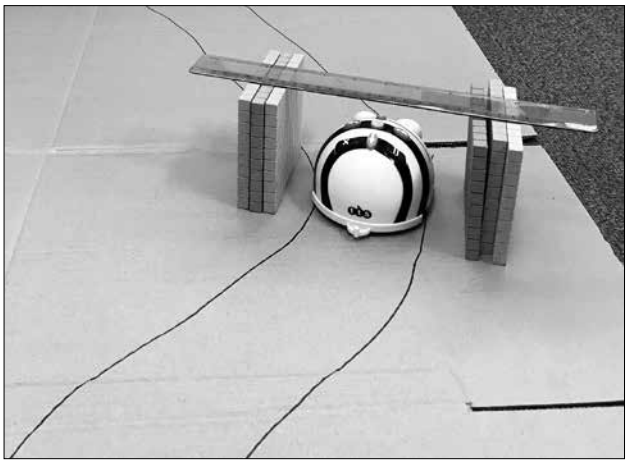

Figure 2. Year 1 students navigating Bee-Bot around and through an obstacle.

The toy lends itself to being a potential distraction, however, it is how the technology it is utilised that guides the breadth and depth of the learning that can occur (Attard, 2012; Attard & Northcote, 2011; Henry, 2015). It is always important to think about what explicit instructions the students will require to be able to use the mobile devices, and the prior learning that has taken place to allow the students to reach the point at which they can use their directional and positional knowledge to program the robot. Therefore, for the students to engage in higher-order thinking tasks that require them to reflect, evaluate, reason and problem-solve through the use of robotic toys, it is the pedagogical and classroom management decisions that lead to a quality and engaging learning experience (Attard, 2012; Attard, 2014; Guerrero, 2014; Koehler & Mishra, 2009).

iPads

Meaningful and contextual implementation of handheld mobile devices such as iPads has the potential to enhance the teaching of mathematics in the classroom. iPads allow students to access information, tools and methods of communication that were previously inaccessible to them (Henry, 2015). It is this instantaneous access that makes them a powerful contributor to education and student engagement (Attard, 2014; Henry, 2015). Therefore, it is essential that from the beginning iPads are introduced into the classroom in this manner to allow the students to see how they can potentially enhance their learning (Guerrero, 2014). Herein the problem lies, as to be able to do this successfully, teachers need to understand how to utilise these devices effectively to reflect current educational pedagogy and to have an awareness of what appropriate apps can offer to their learning environment (Attard & Curry, 2012; Guerrero, 2014; Koehler & Mishra, 2009).

Current research into the most versatile apps to use in mathematics classrooms found that the best apps were not originally designed or labelled as specific to educational use (Attard & Northcote, 2011; Day, 2014; Larkin, 2014;). Larkin (2016) found that there were more than 201 000 education apps available for download at any one time. This places another hurdle in the way of teachers when searching for quality apps, as it is not as easy as typing in key words and finding an array of quality apps to use. These factors all lend themselves to the misuse of these devices within the classroom, as teachers wrestle with the lack of allocated time for planning and preparation (Attard & Northcote, 2011; Koehler & Mishra, 2009).

Apps that allow for open-ended discovery through student-led learning (Booker, et al., 2010) include the *Camera app, Explain Everything* and *Show Me Interactive Whiteboard.* These apps do not limit the students in their utility, and allow for the proficiency strands of understanding, fluency, problem-solving and reasoning to be developed. The teacher can use the suggested apps to record the location of an object and the students can follow the directions to find the object (ACMMGO23). The students can record their own journey and later add narration to it to demonstrate their mathematical knowledge of location (ACMMGO23). These apps can also be used to document a student's understandings through the use of a learning journal, which provides the teacher and the student with summative assessment data.

Other apps that can be used to facilitate student learning include *Maps, Map My Walk* and *QR Reader for iPad.* These apps focus on developing a student's skills beyond the parameters of the classroom and a drill and practice activity (Attard & Curry, 2012; Day, 2014; Guerrero, 2014; Leong & Chick, 2011). They can be used to provide the students with a stimulus to record their mathematical understandings of location (ACMMGO23) as they direct their peers to a particular place using *Maps* or *Map My Walk.* When using these apps it would be beneficial to the success of the task, if an example was present for the students to refer to. Once the students are familiar with these apps, they can also be used to describe a particular place; such as a local park or provide a tour of the local area and its features (ACMMGO23). The teacher and students can use the *QR Reader* app to place positional cues in the classroom or around the playground to direct others to a particular location (ACMMGO23). This activity can be further developed through the use of informal measurement cues along with the positional language, such as "Move 20 steps to the left" (ACMMGO23, ACMMG019). Therefore, it is fair to say with adequate planning, preparation and pedagogical knowledge, mobile devices such as iPads can play a pivotal role in the teaching and learning of location (ACMMGO23) (Attard & Curry, 2012; Guerrero, 2014; Koehler & Mishra, 2009).

Conclusion

The daily pedagogical decisions that a teacher makes in regards to digital technology used in the classroom severely impacts upon the global and real-world experiences to which students are exposed (Day, 2014). It is best practice for teachers to plan quality learning experiences for their students that encompass the opportunities and facilitation of learning that technology can provide (AAMT, 2014; AMTE, 2006).

For all of this to come together, teachers must think about how they are using the digital technologies in their learning environment, whether their classroom practices are reflecting current educational pedagogy, and whether they have had access to quality professional development to make informed decisions about what constitutes appropriate digital technology use within the classroom (Attard & Curry, 2012; Koehler & Mishra, 2009). Without this understanding, time-poor teachers are faced with the burden of self-education, which can lead to superficial utility of these devices within the classroom (Attard & Curry, 2012).

Year 1 Australian Curriculum content descriptors referred to within the body of the article

- **ACMMG019** Measure and compare the lengths and capacities of pairs of objects using uniform informal units.
- **ACMMG020** Tell time to the half-hour.
- **ACMMG023** Give and follow directions to familiar locations.
- **ACMNA012** Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero.
- **ACMNA013** Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line.
- **ACMSP263** Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays.
- **ACELY1661** Create short imaginative and informative texts that show emerging use of appropriate text structure, sentence-level grammar, word choice, spelling, punctuation and appropriate multimodal elements, for example illustrations and diagrams.
- **ACELY1662** Re-read students' own texts and discuss possible changes to improve meaning, spelling and punctuation.

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