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explore the use of mobile technologies as part of our digital repertoire for teaching mathematics. If you are thinking mobile technologies means calculators then this article will provide food for thought!

Mathematics on the move: Using mobile technologies to support student learning (Part 2)

Continuing our series of articles on teaching mathematics with technology, this edition furthers our exploration of the use of a range of mobile technologies to enhance teachers' practices in the primary mathematics classroom. In Part 1 of this article, we explored the use of the iPod Touch and iPad. In Part 2, we explore GPS devices and a range of other hand-held devices.

GPS and pedometers

Global positioning system (GPS) devices can be used as mobile tools to enhance mathematics learning and engage students in real-world mathematics. Students can access GPS devices through other mobile devices such as iPods and iPads, or through devices designed specifically for students such as the Geomate Jnr. A GPS device can provide information on the following:

- your position on a map;
- distance travelled;
- length of time you have been travelling;
- length of time before you reach your destination;
- current speed.

Primary school students can use a GPS device to conduct mathematical investigations that cross several mathematics content strands and other curriculum areas. One particular use of the devices that is particularly engaging for primary students (and adults) is geocaching. Geocaching is an outdoor treasure hunt that uses GPS devices to locate hidden containers. Players join a geocaching website and are able to log their 'finds'—and even hide their own treasures for others to find.

On a more basic level, the humble pedometer offers students opportunities to investigate measurement concepts that highlight the relevance of mathematics in their lives. For example, students could wear the pedometers for one day and calculate the total distance covered by the class. Students could compare the length of their strides compared to the stride of an adult. What would be the difference in the distance covered? If I (the teacher) took 10 000 steps over the weekend, how far did I walk? The possibilities are endless!

Interaction of mobile and online technologies

Many online technologies available to teachers and students in primary mathematics classrooms can be accessed free of charge. Mobile technologies that can be used alongside online technologies, and although not free, are often less expensive than laptop computers and more accessible to students (Kissane, 2007).

Primary mathematics classrooms provide ideal opportunities for overlapping mobile and online technologies. Hand-held digital cameras can work well when combined with the use of online live webcams, such as the Earthcam that is located in Time Square, New York (see Figure 1). By using digital cameras to capture local images and videos of locations at various times of the day, a set of resources can be collated to use for comparison of time periods, darkness and light, and shadow lengths, with the images and videos viewed on international webcams that operate at key locations around the globe. Investigations into distances between locations, reasons for different synchronous seasons and time periods across the world can be explored. Other reliable and interesting webcams include:

- Earthcam Trafalgar Square, London: http://www.earthcam.com/uk/england/london/index.php?cam=trafalgarsq
- Polar Bear Cam, San Diego Zoo: http://www.sandiegozoo.org/polarcam/index.html
- Beach Cam, North Bondi RSL: http://www.northbondirsl.com.au/cam.html

Figure 1. Live webcam in Times Square, New York: www.earthcam.com/usa/newyork/timessquare. Image courtesy of EarthCam.com.

Giving children access to live webcams provides many opportunities to make mathematical comparisons between measurements made in various global locations including weather, distance between cities and countries, current time and population. Some of the most interesting classroom lessons using webcams are those in which student-generated questions are used to drive the mathematics concepts that form the basis of classroom activities.

In addition to using online sites, such as webcams, with hand-held mobile technology, such as digital still and video cameras, the interactivity of online polling sites can also be used to advantage in mathematics teaching when used hand-in-hand with mobile phones, iPads and laptop computers. Although not all children will have access to mobile phones, Internet-connected iPads and laptops can be shared among groups of children with the same effect. Online questions can be set up in just a few minutes, without the need to log in, by teachers or students on online polling sites such as Poll Everywhere (www.polleverywhere.com; see Figure 2). These sites make ideal place setters for collecting data from mathematics activities that take place outside the walls of the classroom. Mobile phones and tablet computers can be used to submit data to the online polls. For example, children collecting data about the most common location of litter in the playground, can submit their gathered data to the online polling site by using the text messaging function on a mobile phone or by entering data into an internet-connected iPad or laptop computer. Results are instant and the interactivity of the data being received demonstrates the dynamic nature of data collection and the big-picture nature of data collation (see Figure 2).

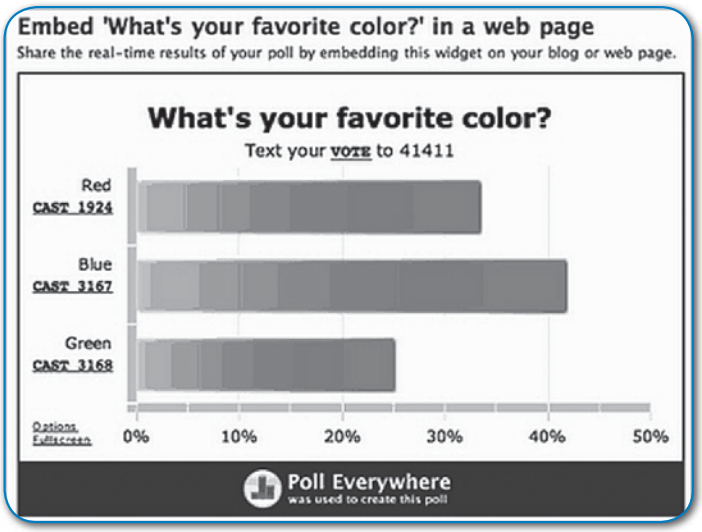

Figure 2. A survey built using the online poll site Poll Everywhere: www.polleverywhere.com.

Hand-held measuring and recording devices

When planning mathematics lessons for inside or outside the classroom, primary school teachers can make great use of hand-held technological measuring devices. Hand-held infra-red thermometers are ideal for predicting and measuring activities where children investigate the temperature of various locations and objects in the classroom or school playground. The point and click functionality of these devices makes them very versatile for use in a range of locations. Many of these devices are now made with built-in USB interfaces that connect directly with laptop and tablet computers. Data gathered during these activities can be displayed in spreadsheet charts on individual computers or on interactive whiteboards for full class access.

Another multipurpose hand-held piece of technology that is very adaptable to the indoor or outdoor mathematics classroom is the hand-held digital sound recorder. Not only can sound recorders be used to record mathematical data and observations during practical mathematics activities, these devices are also ideal for assessment purposes in which children's ideas about mathematical problems and concepts are recorded. Although a picture can tell a thousand-word story, a child's narration about how they reached a particular result in a mathematics problem or how they completed a measurement activity can save their teacher hours of wondering about a child's unusual responses to mathematics activities. As well as recording children's responses to mathematical questions and problems, hand-held sound recorders are also ideal devices to record children's questions that can be used to launch future mathematics lessons and investigations.

Lastly, hand-held digital scanners can be a welcome addition to a mathematics classroom set of resources. They are helpful for both

Figure 3. Hand-held measuring devices: infra-red thermometers, sound recorders and scanners

teachers' administrative use (assessment work samples, tracking student progress) and for children to use during their mathematics investigations. Not only can they be operated within range of electrical outlets, their battery operation ensures they can also be used on excursions and visits to other locations within the school. Scanners enable children to capture images of large and small objects in digital format for later mathematical analysis, manipulation and calculations.

Conclusion

Whether located indoors, outdoors or in the virtual world, the modern mathematics classroom would be much better equipped to respond to children's mathematical questions and learning needs by incorporating a range of hand-held and screen-based mobile technologies. While these mobile tools can be used by both children and teachers, it is vital for teachers to model the use of these technologies (Graham, 2009). Rather than confining the range of resources used in mathematics teaching to objects that have been traditionally found only on classroom shelves, mobile technologies provide the advantage of transfer—children can see the use of authentic mobile technologies being used both at home and at school. The link between everyday mathematics and classroom mathematics can be drawn closer through the use of appropriately selected mobile technologies. Incorporating mobile technology into our mathematics classrooms ensures that students are more equipped for the future and that teachers are more equipped with coping with future curriculum change (Kissane, 2009)—something that we are all aware of as the Australian Curriculum looms.

References

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