Enhancing teaching and learning of primary mathematics through the use of apps

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TEACHING & LEARNING RESEARCH INITIATIVE
NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

Introduction

The project focused on the effective use of mathematics apps with mobile devices. Researchers worked with twelve practising teachers in two schools to evaluate how apps were used as a mediating tool to support individual learning needs and enhance students' conceptual understanding of primary mathematics. In particular, we explored how pedagogy, afforded through the use of apps can, not only enhance, engage, and empower students in learning mathematics, but also support their conceptual understanding. Our intention was to investigate the teachers' selection and use of apps to meet the learning needs of individual students. The TPACK model (Mishrar & Koehler, 2006) was used to identify teaching practices and the ways these practices were transformed through reflection and evaluation. We did not intend to measure teachers' TPACK but to use the model as a lens for teachers' co-reflection and exploration of their use of apps in their mathematics teaching. We aimed to investigate how the teachers' pedagogy was influenced by, and in turn influenced, their focus on students' learning in specific mathematics ideas.

Research Questions

1. What decisions are made by teachers in the selection and use of apps to mediate learning in primary mathematics?
2. How might the Niess (2012) TPACK continuum support teachers in relating technology to pedagogical content knowledge that will further advance the teaching of mathematics in their classrooms?
3. How is student learning impacted by teacher use of the TPACK continuum to guide their use of apps?
4. How does reflecting upon the impact of app usage on students' learning help teachers support individual students' conceptual learning?

What we did

The research design was aligned with teacher and researcher co-inquiry whereby the university researchers and practising teachers worked as co-inquirers and co-learners (Hennessy, 2014), with an emphasis on collaborative knowledge building.

We collected data from:

- interviews with teachers and students;
- video material and transcripts;
- field notes and reflections;
- teacher and student online case-studies/blogs; and
- student classroom mathematics assessment.

Evaluations of the teachers were used to identify four emerging themes related to students' learning:

- Affordances: how opportunities and constraints have the potential for influencing relationships between the user and the artefact, in this case the app (Brown, 2005).
- Socio-technological assemblages: how social and technical elements interact in ways that influence, and in turn are influenced by, the learning.
- Collaboration: how apps enable peer interaction and negotiation of mathematical ideas.
- Personalisation and Differentiation: how students' individual needs are met through the potential of apps to change contexts (Looi, Wong, & Song, 2013) and facilitate students creating their own representations.

We worked with the teachers to co-construct a framework based on Niess' (2102) TPACK continuum in relation to these four themes. While each theme has a different emphasis, teachers' comments and reflections on the framework indicated inter-relationships between the four themes.

Key Findings

- The teachers' pedagogy was of greater importance than just the quality of the app in relation to student engagement and learning.
- Teachers' planning processes and how they managed the use of apps within their mathematics programmes varied depending on their students' age and the teachers' experiences.
- Teachers viewed an app as one of many tools that were available to them from a range of pedagogical media. Teachers and students often used an assemblage of different pedagogical media.
- Quantitative data and teacher qualitative judgements suggested the use of apps had a positive impact on learning.
- Teacher and student responses indicated that the use of apps was motivational and enhanced engagement.
- Affordances of the apps had the potential to enable social interaction, personalisation and engagement with mathematical ideas.
- Students articulating and explaining their mathematical thinking, in conjunction with the manipulation of images and writing, suggested a new learning experience that might enhance mathematical understanding.
- Teachers' reflections on the TPACK continuum in relation to problem solving and collaboration suggested a shift in pedagogy. Nevertheless, teachers made deliberate choices in selecting apps based on intended learning and student needs that were not necessarily reflected in the continuum.

Implications

- The TPACK continuum in the resulting framework could be used to focus on themes for self-reflection, evaluation and discussion rather than as a model for practice. Focus on the themes could support teachers to effectively incorporate apps in their planning and practice.
- Self-reflection could support teachers in recognising the potential of apps within socio-technological assemblages in order to support students' communication and collaboration, and interaction with mathematical ideas.
- Schools could develop a culture of teachers exploring apps and sharing pedagogical approaches for using apps.
- Teachers could be supported in planning for the use of apps in order to meet individual learning needs in a way that empowers students to make appropriate choices.
- Schools using BYOD need to consider management of collaborative activities with regards to the sharing of devices and equal access to apps.
- Further investigation is needed into the ways that mathematics conceptual understanding develops through the use of apps.

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