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USING MOBILE TECHNOLOGY TO ENCOURAGE MATHEMATICAL COMMUNICATION IN MĀORI-MEDIUM PĀNGARAU CLASSROOMS

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Abstract

Māori-medium pāngarau classrooms occupy a unique space within the mathematics education landscape. The language of instruction is an endangered minority language and many teachers and learners in Māori-medium pāngarau classrooms are second language (L2) learners of te reo Māori. Mobile technology could be used in Māori-medium pāngarau classrooms to address some of the linguistic challenges. This think piece explores the benefits of using mobile technology to capture multiple representations of pāngarau concepts as a way of encouraging mathematical communication in te reo Māori.

Keywords

Digital technology; Māori-medium; mathematical communication; Pāngarau; indigenous mathematics education

There is growing interest and use of digital technology to support Māori-medium teaching and learning programmes, including pāngarau/mathematics. However, there is a paucity of literature that addresses the unique language learning challenges of the Māori-medium pāngarau/mathematics context in Aotearoa/New Zealand (Allen, 2015; Christensen, 2004a; Meaney, Trinick, & Fairhall, 2012; Trinick, 2015). There are even fewer studies that examine digital technology usage that supports the acquisition of mathematics and of Māori language (Tiakiwai & Tiakiwai, 2010).

A considerable body of research argues that the explicit teaching of mathematical language can simultaneously support the acquisition of mathematical knowledge (Dowker, Bala, & Lloyd, 2008; Hunter, 2005; Pimm, 1987; Pitvorec, Willey, & Khisty, 2011; Schleppegrell, 2007). It is argued that in order to understand mathematics, students must understand the language of mathematics (Usiskin, 2012). This presents challenges for Māori-medium pāngarau classrooms, a unique space within the wider educational context of mathematics teaching and learning that is impacted on by a range of challenges—linguistic and pedagogical.

Many students and teachers in Māori-medium pāngarau classrooms are second language (L2) learners of te reo Māori. The language of instruction is not only a second language (L2) for many teachers and learners but also an endangered indigenous minority language with associated socio-political challenges. Using digital technology in the pāngarau classroom to encourage mathematical communication could provide opportunities for the simultaneous acquisition of pāngarau language and pāngarau/mathematics content/concepts.

Software applications (apps) that allow students to capture their communications using multiple representations and share these with others are sometimes referred to as Show and Tell apps (Williamson-Leadley & Ingram, 2013). These types of apps have a whiteboard feature that students can either draw on or type into, the ability to capture or upload images and the ability to record audio or video explanations. Show and Tell apps, sometimes called screencasting apps,[i] can be thought of as digital modelling books. The students and teacher can use the Show and Tell app to capture examples and explanations of the strategies or solution methods they are using to solve problems. These models can then be saved and revisited as many times as necessary to consolidate the learning or to question and correct any misconceptions that are evident (Allen, 2015). In this way, Show and Tell apps

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[i] A list of screencasting apps is available here: http://edtechteacher.org/apps/screencast/

provide an example of how mobile technology can be used to support pāngarau language use and conceptual development of pāngarau/mathematics understanding within a classroom that teaches mathematics in an L2.

Show and Tell apps differ from Drill and Practice apps that have preloaded problems for students to solve in order to collect points or badges and move onto more difficult problems or levels. While the Drill and Practice apps can be useful for reinforcing basic facts or providing independent practice, they usually don't provide an opportunity for students to record their learning, to reflect on the problems they are solving and to share their learning with others. In some cases, students can merely guess the answer. If the app has a time limit or students are racing each other, multiple guesses can be faster than actually working through the problem. Drill and Practice apps can serve a purpose as independent practice or reinforcement but they may not provide a true picture of students' conceptual understanding or provide opportunities for language development.

Show and Tell apps can provide opportunities for students to express their ideas creatively and to promote recursive and reflective learning (Scott, 2006). Multiple representations of concepts and ideas that have been captured using Show and Tell apps can be revisited, altered and form the basis of new learning. In Māori-medium pāngarau classrooms, using multiple representations to communicate pāngarau ideas, could ease some of the linguistic challenges faced by pāngarau students and teachers, particularly those who are second language learners of te reo Māori (Trinick, 2015; Allen, 2015). However, the benefits listed here can only be realised if Māori-medium teachers have access to robust and appropriate professional learning and development opportunities that exemplify the benefits of using digital technology with the appropriate apps (Tiakiwai & Tiakiwai, 2010).

The use of Show and Tell apps to capture multiple representations of mathematical thinking can provide opportunities to assess the students' mathematical understanding and pāngarau language use. Encouraging students to construct and capture their own story problems using Show and Tell apps can allow students to explore pāngarau language and connect pāngarau concepts to real life situations (Allen, 2015). When students capture diagrams, equations and written explanations of their solution methods alongside their audio or video explanations, they can explain their thinking through creating multimedia presentations. The Show and Tell app captures and externalises their thoughts through writing, the use of screen capture and audio and/or video recordings. This provides insight into students' thought processes and problem-solving strategies (Peltenburg, Van den Heuvel-Panhuizen, & Doig, 2009). In this way, students and teachers can refer back to the recorded presentations and use them as the subject of reflection and mathematical discussion (Allen, 2015; Meaney, Trinick, & Fairhall, 2012; Pimm, 1987). The students' responses, questions and problems can also be used to shape the core lesson content (Fraivillig, Murphy, & Fuson, 1999). Making presentations available to whānau through an online catalogue can also encourage communication between home and school.

The student work sample presented in Figure 1 below was collected as part of a study conducted by a pāngarau facilitator in a Māori-medium primary school.[ii] The facilitator worked with a group of seven Year 4–5 students for three hours per week over a period of 15 weeks. During the course of the study, students constructed pakitau (story problems) and used a range of mathematical representations to explain their solution methods. The students used My Mediasite Personal Capture software,[iii] to video record explanations of their story problems and solution methods. The software allowed the students to combine static images and video explanations. The students captured diagrams, equations and written explanations of their solution methods alongside their video explanations. The My Mediasite Personal Capture software packaged the static images and video recordings together so that they could be viewed simultaneously.

This student work sample shows an image that the student took of their workbook. The transcript is taken from the video recording the student made of themselves explaining their pakitau (story

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[ii] For further details of the study see: Allen, P. (2015). Te reo pāngarau: Communicating mathematically in Māori-medium classrooms (Master's thesis, University of Auckland, New Zealand). Retrieved from: http://hdl.handle.net/2292/26542

[iii] For further information on My Mediasite Personal Capture software see: http://www.sonicfoundry.com/mediasite/capture/mymediasite/

problem) and their solution method. In this case, the work sample shows slight differences between the written/oral explanations and the drawn/written diagram and equation.
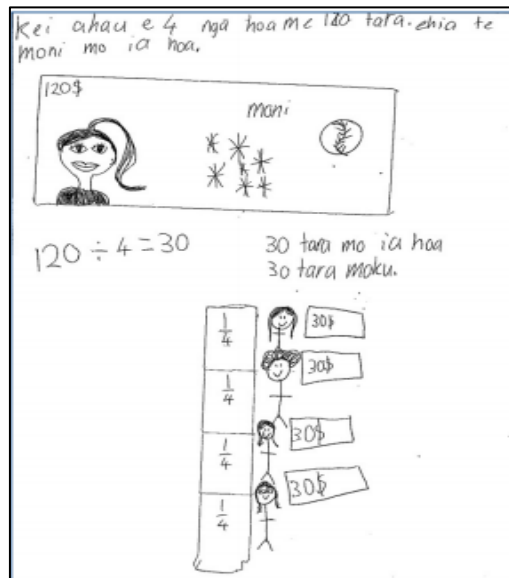

Figure 1:   Student work sample (Allen 2015, p. 76).

Transcript Accompanying Figure 1:

> Student: Kei ahau e whā ngā hoa me tahi rau [rua] tekau tāra. E hia te moni mō ia hoa? (tah) … Toru tekau tāra mō ia hoa. Toru tekau tāra mōku.

> English translation: I have four friends and one hundred and twenty dollars. How much money would each friend receive? Thirty dollars for each friend. Thirty dollars for me. (Allen, 2015, p. 77)

The diagram and equation clearly show that $120 is divided equally amongst four people. However, the story problem in the written and oral explanation seems to imply that the money was shared amongst five people, the four friends and the student herself. While the diagram and equation could be considered self-contained (Cummins, 2000; Gibbons 2002) and mathematically accurate, the ambiguity in the context of the story problem provided an opportunity for further group discussion and reflection around language use. The student was offered the opportunity to recraft her oral explanation and recapture this.

In the work sample above, the student utilises a story problem, diagrams, symbols and words to explain their thinking. Māori-medium students who are second language learners of te reo Māori may require multiple modes of communication in order to explain their mathematical thinking clearly (Allen, 2015). In order to take advantage of opportunities for explicit teaching of pāngarau concepts and pāngarau language through the use of multiple representations, pāngarau teachers need to be confident in their ability to model the specialised language of the pāngarau register (Trinick, 2015; Christensen, 2004b; Meaney et al., 2012). In order to integrate mobile technology into this type of learning, pāngarau teachers also need confidence in selecting and using mobile technology and apps that are appropriate to the needs of their learners and particularly the learning needs of Māori-medium learners. This raises implications for the design of initial teacher education and professional learning that is appropriate for the linguistic challenges of the Māori-medium pāngarau classroom and highlights potential areas for further research.

References

Allen, P. (2015). Te reo pāngarau: Communicating mathematically in Māori-medium classrooms (Master's thesis, University of Auckland, New Zealand). Retrieved from http://hdl.handle.net/2292/26542

Christensen, I. (2004a). *Exploring issues in mathematics education: An evaluation of Te Poutama Tau 2003*. Wellington, New Zealand: Ministry of Education.

Christensen, I. (2004b). Te reo pāngarau: Learning and teaching mathematics in Māori. *Language acquisition research: Papers presented at a Ministry of Education Forum held in 2003* (pp. 117–126). Wellington, New Zealand: Ministry of Education. Retrieved from http://www.educationcounts.govt.nz/__data/assets/pdf_file/0011/6986/language-acquisition.pdf

Cummins, J. (2000). *Language, power and pedagogy: Bilingual children in the crossfire*. Sydney, Australia: Multilingual Matters.

Dowker, A., Bala, S., & Lloyd, D. (2008). Linguistic influences on mathematical development: How important is the transparency of the counting system? *Philosophical Psychology, 21(4),* 523–538. https://doi.org/10.1080/09515080802285511

Fraivillig, J., Murphy, L., & Fuson, K. (1999). Advancing children's mathematical thinking in everyday mathematics classrooms. *Journal for Research in Mathematics Education*, *30*(2), 148–170. https://doi.org/10.2307/749608

Gibbons, P. (2002). *Scaffolding language scaffolding learning: Teaching second language learners in the mainstream classroom*. Portsmouth, NH: Heinemann.

Hunter, R. (2005). Reforming communication in the classroom: One teacher's journey of change. In P. Clarkson, A. Downton, D. Gronn, M. Horne, A. McDonough, R. Pierce & A.E Roche (Eds.), *Building connections: Research, theory and practice. Proceedings of the Annual Conference of the Mathematics Education Research Group of Australasia* (pp. 451–458). Retrieved from http://www.merga.net.au/documents/RP492005.pdf

Meaney, T., Trinick, T., & Fairhall, U. (2012). *Collaborating to meet language challenges in indigenous mathematics classrooms*. Dordrecht, Netherlands: Springer Science+Business Media. https://doi.org/10.1007/978-94-007-1994-1

Peltenburg, M., Van den Heuvel-Panhuizen, V., & Doig, B. (2009). Mathematical power of special-needs pupils: An ICT-based dynamic assessment format to reveal weak pupils' learning potential. *British Journal of Educational Technology, 40*(2), 273–284. https://doi.org/10.1111/j.1467-8535.2008.00917.x

Pimm, D. (1987). *Speaking mathematically: Communication in mathematics classrooms*. New York, NY: Routledge & K. Paul.

Pitvorec, K., Willey, C., & Khisty, L. L. (2011). Toward a framework of principles for ensuring effective mathematics instruction for bilingual learners through curricula. In B. Atweh, M. Graven, W. Secada & P.Valero (Eds.), *Mapping equity and quality in mathematics education* (pp. 407–421). Dordrecht, Netherlands: Springer Science+Business Media.

Schleppegrell, M. (2007). The linguistic challenges of mathematics teaching and learning: A research review. *Reading & Writing Quarterly: Overcoming Learning Difficulties*, *23*(2), 139–159. https://doi.org/10.1080/10573560601158461

Scott, T. (2006). Watch out for the W/HOLE! Student multimedia projects and culturally based education. *Canadian Journal of Native Education*, *29*(1), 43–57.

Tiakiwai, S., & Tiakiwai, H. (2010). *A literature review focused on virtual learning environments (VLEs) and e-learning in the context of te reo Māori and kaupapa Māori education*. Wellington, New Zealand: Ministry of Education.

Trinick, A. (2015). *Te reo tātai: The development of a mathematics register for Māori-medium schooling* (EdD thesis, University of Waikato, Hamilton, New Zealand). Retrieved from http://hdl.handle.net/10289/9593

Usiskin, Z. (2012). What does it mean to understand some mathematics. In S. J. Cho (Ed.), *Proceeding of the 12th International Congress on Mathematical Education.* Retrieved from http://www.amesa.org.za/AMESA2013/Files/P01.pdf

Williamson-Leadley, S., & Ingram, N. (2013). Show and tell: Using iPads for assessment in mathematics. *Computers in New Zealand Schools: Learning, teaching, technology*, *25*(1–3), 117–137.