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PERSONALISED LEARNING WITH MOBILE TECHNOLOGIES IN MATHEMATICS: AN EXPLORATION OF CLASSROOM PRACTICE

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Abstract

Personalised learning is generally understood to be of benefit to students' learning. In addition, the flexible nature of mobile technologies (MTs) and the variety of available apps are seen to respond to the needs of individual students, and hence have the potential to support personalised learning. This paper reports on an aspect of a larger research project that investigated the use of mobile technologies in primary mathematics classrooms. Personalised learning was determined as one theme that emanated from the teachers' and students' use of MTs, and this paper aims to investigate how personalised learning was evidenced within the practice of three teachers. Video data of classroom practice were used to analyse the use of MTs within the theme of personalised learning. Four pathways to personalised learning emerged, enabling a more practical understanding of different types of personalisation afforded by MTs.

Keywords

Personalised learning; mobile technologies; primary mathematics

Introduction

Research into the use of mobile technologies (MTs) and their impact on classroom practice is still in early stages. The touch screen of MTs have affordances that differ from those of desktop or even laptop computers (Wang, Towey, & Jong, 2016), and so have the potential to change learning environments and also to enhance students' learning "… in ways that were previously not possible …" (Clark & Luckin, 2013, p. 2). MTs are tools that enable customisation easily, and so would seem to provide opportunities for students and teachers to personalise learning. To personalise something suggests that there is an opportunity to change that something, or add to it, so that it belongs to, or comes from, a particular person. In this regard, personalised learning is seen as learning that is personally relevant.

MTs may have the potential for such personalised learning experiences, but how are they used in classroom settings? In this paper, our aim is to examine ways that MTs have been used to personalise learning experiences in primary mathematics classrooms. This paper presents data from part of a larger project into the use of iPads and other MTs in primary mathematics classrooms. In particular, we investigate how MTs enabled personalised learning in the practice of three teachers with students from age seven to eleven. Data from video recordings of classroom practice are used to illustrate some ways that MTs supported personalised learning experiences.

The purpose of the study presented in this paper is not to claim that personalised learning with MTs increases achievement in mathematics but to explore the use of MTs in personalising learning. This purpose is twofold. The first is that, while personalised learning is being emphasised in policies (e.g., Ministry of Education, 2007), there is a large amount of confusion regarding what personalised learning is (Prain et al., 2013) and the authors wish to find some clarity. Determining some practical examples is seen to support this clarity. The second purpose is that many schools are purchasing MTs, with one of their motivations being to enable personalised learning, but there is limited knowledge about how this can be done. This paper seeks to find some clarity and to present some illustrations to support our knowledge of how MTs can be used for personalised learning.

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Page 77–84

Personalised learning—a fuzzy concept

Despite the prevalence of personalised learning, there is no consistent use of the term in classroom practice (OECD, 2006). Whilst personalised learning suggests that the learning is made distinct and relevant to a student, this could happen in many ways, and hence can mean many things. Prain et al. (2013) noted that there has been a general vagueness regarding the distinctive features of personalised learning. Furthermore, current understandings of personalised learning in research literature are often conflicting in relation to who is tailoring the learning. On the one hand, An and Reigeluth (2011) suggested that personalised learning involves teachers paying close attention to individual student's knowledge and skills to provide personalised experiences and support in learning. In contrast to this, Leadbetter (2005) proposed that personalised learning should focus on motivating students to become engaged in their own learning by allowing them to make choices, and hence, empowering them to make decisions. In this latter interpretation, the focus is not on the choices as much as it is on the motivation and self-regulation of learning. These two views of personalised learning present a contrast in relation to the teacher or the student tailoring the learning.

Other understandings have noted that personalised learning relates to the structured activities students engage in with scaffolding from their teachers, such as "… modelling, guidance in goal-setting and timely feedback" (Waldrip et al., 2014, p. 357). Tomlinson (2009) used the term differentiation to describe this sort of concept, but also to draw on the notion of student choice. She concluded that teaching should be concerned with not only content mastery but also student efficacy and ownership of learning, hence making links between the different views.

These different and contrasting views serve to make personalised learning a 'fuzzy concept'. This lack of clarity also means that there is a lack of practical knowledge about how personalised learning can be implemented in classrooms. In this study a broad stance is taken in viewing personalised learning as the employment of learning tasks, tools and environments to enable and encourage learning that is personally meaningful through acknowledging and catering for individual differences, and hence providing opportunities for student ownership of learning. A key theme is that personalised learning experiences enable the tailoring of learning to a student's wants, preferences and needs. There is a sense of controllability and personal value that could increase motivation of the learning task and perceived self-efficacy.

MTs and personalised learning

MTs have been identified as having the potential to enhance personalised learning due to two main characteristics: the mobility of the devices, and their ability to continually change contexts (Looi, Wong, & Song, 2013). The feature of mobility suggests that MTs can be used anytime and anywhere. While computers have a fixed location, with a limited number of individuals being able to access it at one time, the size and touch screen feature of MTs allow for flexibility in how and when they are used. This mobility, when used in the classroom setting, enables students to work in any location, specifically those that were not accessible using technology before, such as sprawled on the floor or curled up in a beanbag. This mobility can extend beyond the classroom with the ability for the user to change location seamlessly, between school, home and further afield, such as on field trips (Calder & Campbell, 2016). Furthermore, while MTs allow for the typical social sharing that other computers offer, they also enable another more personal form of sharing. Looi et al. (2009) noted how with MTs, students have the ability to swivel and show another what they are working on, thus allowing students to not only make choices regarding where they are working, but also who they may wish to work with.

The other feature of MTs is their ability to change contexts by customisation through features on the screens or use of various apps. As with the students in Robinson and Sebba's (2010) study, certain apps can enable features to be altered, such as font and colour, hence allowing for customisation easily. Another way in which different contexts are created is through the ability of apps to shape experiences to meet specific needs. There are specific apps designed to meet various learning stages and steps, meaning that the selection of apps can be personalised to students' needs (Clark & Luckin, 2013). Furthermore, some apps provide specialised features that enable specific learning and instruction within the app. This means that not only can the choice of apps be personalised, but also what happens within them, enabling interaction with the MT to be personalised to a student's specific learning needs (Calder & Campbell, 2016; O'Malley et al., 2013).

As discussed, several studies have suggested that MTs have the potential to be customised to suit a variety of situations and interests, hence they have the potential to personalise learning through customisation and through mobility. With this literature in mind, this paper seeks to explore the classroom practice of three teachers; how they and their students used the potential of MTs to personalise learning within the context of mathematics in primary classrooms. In particular, we ask in what ways these teachers used MTs to personalise learning in their mathematics classrooms, and if these different ways can help to further clarify key ideas related to personalised learning.

The study

The data were collected as part of a two-year research project investigating how apps were used in mathematics education at two New Zealand primary schools. In this paper we focus on the first year of the project, when the researchers collaborated with three teachers experienced in using MTs in their classroom programmes. Two of the teachers taught their class of Year 5 and 6 students co-operatively in a large, purpose-built modern learning environment. Every child had access to an iPad that the school provided. The third teacher had a class of Year 4 students in a modern classroom space with an adjoining hallway space that was available as a learning space. In this classroom the students were asked to provide their own device and a selection of apps (BYOD).

An interpretive research methodology was used, based on a belief that human reality is multi-layered and complex (Cohen, Manion, & Morrison, 2011). Qualitative data were collected using a range of methods, but for this paper, we focus on the data from video recordings of classroom practice. Regular mathematics lessons were videoed four times during the year to gain an overview of the teaching throughout the year. Video clips were viewed and discussed by the research team at regular meetings with the teachers through the year. Personalised learning was one of the themes identified and subsequent analysis revealed four different types of personalisation when using iPads in mathematics learning. These different elements of personalised learning will be explored in the next section.

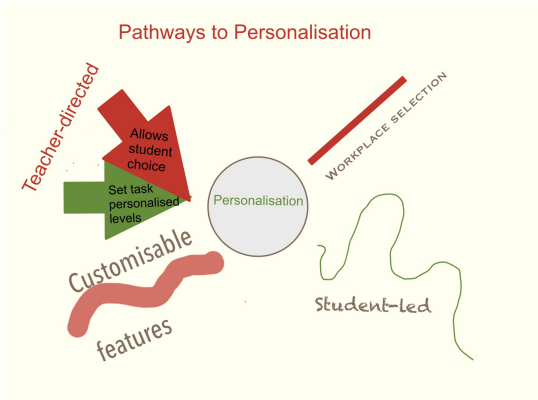

Figure 1: Pathways to personalised learning diagram.

Examples of personalised learning

In analysing the data, four pathways for personalised learning emerged: teacher-directed, customisable features, workplace selection, and student-led learning. These four pathways are shown in Figure 1. Data that illustrate each of these pathways are presented.

Teacher-directed

Classroom video data showed how the teacher from the Year 4 BYOD classroom identified the specific learning needs of a group of students and used this information to create digital worksheets that were imported into the MT. In this case, the learning related to place value: rounding numbers, identifying the column value of digits, and ordering numbers (Figure 2). Students worked on digital worksheets assigned in relation to their particular learning needs for the week. Later in the year, data from video material for the same teacher showed how the teacher identified the specific learning

needs of an individual student, in this case recall of number facts, and had used this information to create a list of specific apps to target each student's needs (Figure 3). Each student used this list to choose the order to work on the different apps.

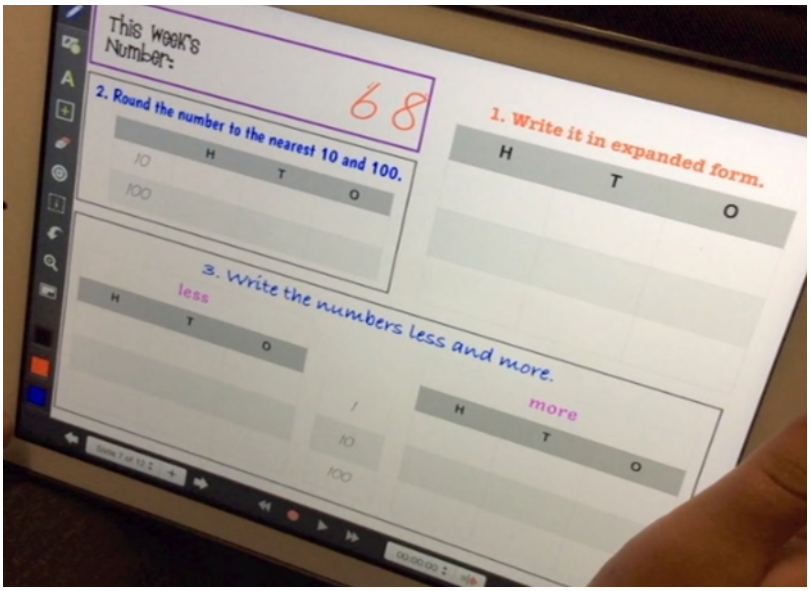

Figure 2: Teacher directed digital worksheet on place value.

These examples show how learning was personalised through the teachers' control and direction by providing students with learning according to their needs, as assessed by the teacher. They also show a shift in the way the teacher directed the learning in allowing students to start to make some decisions themselves in choosing the order to use the apps.

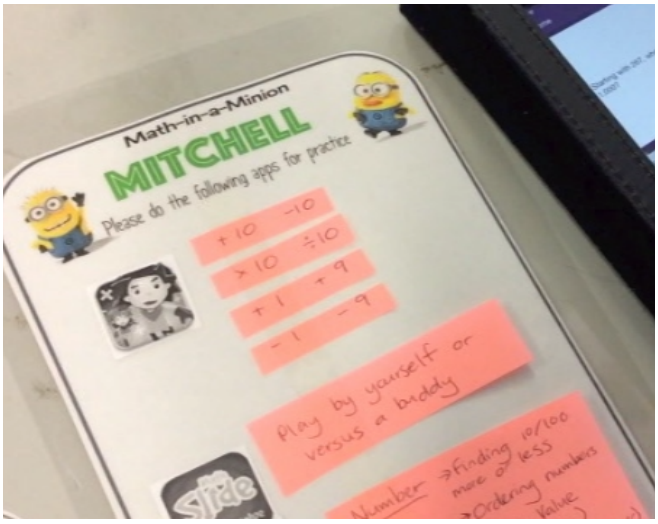

Figure 3: Teacher directed list of apps related to number facts.

Customisable features

In the classroom video data from all three teachers, students were seen to use customisable features, such as font, colour, images and the recording function to take ownership of their learning in using images that made connections for them personally. For example, as shown in Figure 4, one student scrolled through pictures of dogs to select one that she preferred to use for a division problem.

Figure 4: **Choosing a preferred image of a dog to solve a division problem.**

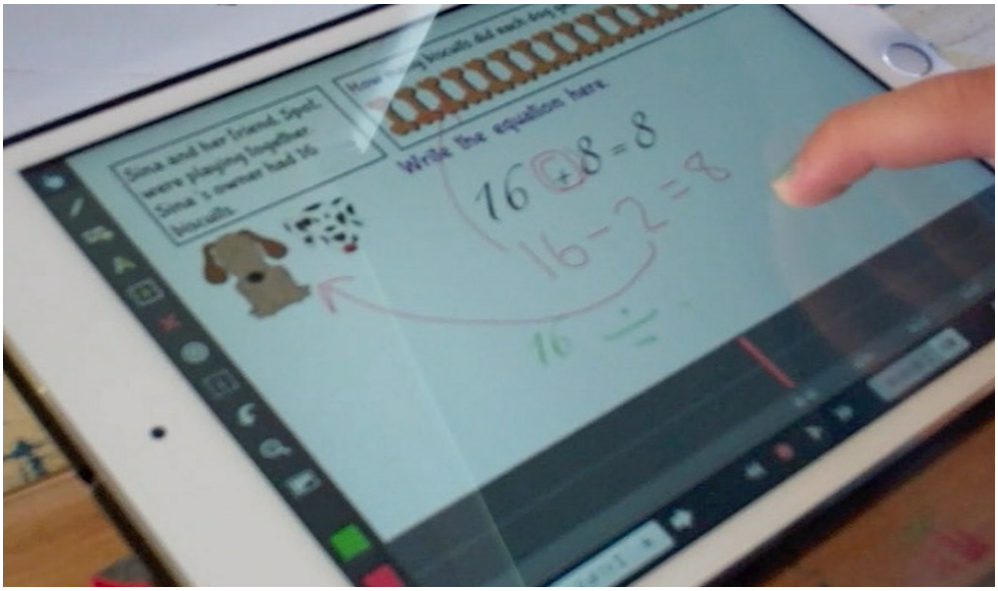

Figure 5: **Choosing the format to present her solution to the division problem.**

Another student was observed formatting her recording of the division problem 16÷2=8 using different fonts and colours (Figure 5).

These examples show how the customisable features of MTs allowed the students to make choices regarding how they presented their learning and thus making the mathematics personal and relevant to them.

Workspace selection

Both classroom spaces had adapted workspaces to account for the flexible use of MTs. Students were encouraged to choose to work in spaces that they preferred (Figure 6).

Figure 6: A variety of spaces to work.

In the Year 4 BYOD classroom, the teacher assigned the students a task on the iPad and told them that they were able to complete this task in whatever location within the classroom they felt most comfortable and able to concentrate, with options such as on bench seats, desks both high and low, the floor and beanbags.

The mobility of iPads also enabled transitions between collaborative and individual work, to suit personal preferences and needs. In another video clip from the Year 5/6 classrooms, a group of students decided to go to a quieter spot to record their learning as a video presentation. These examples illustrate how this pathway enables students to make choices about where to sit, including being able to choose to sit next to someone and collaborate, or to sit and work alone, or to find a space more conducive to completing the task.

Student-led learning

Some video data showed how the teacher had created an environment which allowed students to have an element of control over what they learn, how they learn it and how they present it. In one example from the Year 5/6 classrooms, students were asked to explore a mathematics calculation strategy with a 'buddy', creating their own video to explain how their selected strategy worked, and for which problems it would be most effective. Students were observed exploring various strategies, such as equal addition and reversibility. They recorded their strategies in a multitude of ways, such as the use of whiteboards, calculators and discussions, before creating their own video recording on their iPads.

Figure 7: Exploring and comparing calculation strategies.

These examples show how the student-led pathway is an intentional teacher-created environment that empowers students to have a say in what they learn, along with how they record and present their learning. Such an environment encourages self-regulated learning.

Discussion

The examples of video data were intended to illustrate personalised learning through the different pathways in order to help clarify the fuzziness. As such, these pathways relate to the different views of personalisation as presented in the current literature. The teacher-directed model is akin to An and Reigeluth's (2011) concept of personalised learning, wherein the teacher creates personalised learning experiences based on their understanding of students' knowledge and skills. In this pathway teachers used the change in context feature of MTs to choose apps and tasks within apps, to suit specific learning needs (Clark & Luckin, 2013; O'Malley et al., 2013). However, this pathway is limited in the way it represents ideas of personalised learning that relate to student choice or self-regulated learning.

In the customisable features pathway, the opportunity to select fonts and images may provide for some student ownership in making the mathematics personally relevant, and hence encourage engagement and interest in their work. This engagement has been seen as a crucial element in learning (Attard, 2011). As such, the use of the change of context feature becomes one that suggests personalisation in relation to preferences and ownership. Similarly, the workplace selection pathway allowed for individual preferences in both place and collaboration. In this case, it is the mobility feature that is enabling preference and ownership.

The student-led learning pathway strongly aligns with Leadbetter's (2005) concept of personalised learning as a teacher-created environment in which students are empowered to make decisions and to self-regulate their learning. This pathway reflects the potential of MTs and the various apps for personal choice and contrasts strongly with the teacher-directed pathway, where the teachers make most of the choices.

Whilst there is a sense that the student-led pathway best fits the key elements of personalised learning as defined for this study, all the pathways are seen to have their own benefits. The teacher-directed pathway can help to enhance learning in key areas related to learning objectives, something that is not guaranteed when students make choices regarding their own learning. The student-led pathway empowers students in decision-making about what to learn, something no other pathway offers. From these findings, a further question emerges: Can all these pathways be used to enhance the personalisation of students' learning?

As this was an examination of particular contexts with only three teachers, it is not possible to be confident that these findings would be generalizable to a broader context. It would be valuable for more research on the implementation of personalised learning with MTs, and the encouragement of teachers to create learning environments that support personalised learning through the different pathways. Teachers could use the pathways to understand which form of personalisation they wish to achieve in specific situations. This paper should also serve to provoke teachers in thinking about how they can empower students to lead their own learning, whether through the customisation of features or the selection of learning tasks.

Conclusion

This paper identified four different pathways to personalised learning using MTs: teacher-directed, customisable features, workplace selection, and student-led. Whilst different, each focused on creating an environment that allowed for learning tailored to the needs and preferences of students. As such, the illustrations provided here suggest that personalised learning is not something that happens just one way, and that there are synergies between the different pathways. A key element was how the teachers made decisions to optimise the students' engagement and to meet individual needs, whether this was through teacher-direction, customisation features, work places, or student-led learning. Whilst MTs have the potential to enable personalised learning, it is through the practice of the teacher and the physical classroom setting that this potential can be realised.

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