



Research Evaluation of Matific Mathematics Learning Resources

Executive Summary
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Executive Summary

Declining student engagement with mathematics is a major concern for educators and other stakeholders in education. Many people attribute disengagement from mathematics to negative experiences during the school years. These experiences often stem from a lack of curriculum relevance to students' everyday lives and the traditional classroom practices emphasizing drill and practice, and rote learning. Decreased engagement can have a negative impact on students' future opportunities in relation to their ability to make important decisions in everyday life and their ability to access tertiary education and careers requiring high levels of mathematics (Attard, 2013).

The need to incorporate digital technologies into the teaching and learning of mathematics is now an integral aspect of Australian classrooms, with current curriculum documents expressing explicit expectations that digital technologies are incorporated into the teaching and learning of mathematics (Australian Curriculum and Reporting Authority, 2012; Board of Studies New South Wales, 2012). Although there are arguments that suggest the use of digital technologies has potential to transform education (Levin & Wadmany, 2008), to date there has been little research exploring the effectiveness of digital technologies in enhancing student learning and their engagement with mathematics, particularly in the primary classroom (Shin et al., 2012). The types of digital technologies and their affordances may also influence whether or not there is an impact on student learning and engagement.

Given that almost all young people are actively involved in game playing in either a concrete or digital form, it makes sense to expect that the use of digital games in education could assist in increasing student engagement with content such as mathematics, that may otherwise feel irrelevant to students' everyday lives. The use of digital games could also assist in bridging the digital divide between how ICT is used at home and at school, as described by Selwyn, Potter, and Cranmer (2009).

Matific is a range of digital mathematics resources that aim to improve mathematics outcomes through the use of game-based applications. Each application, referred to as an episode, focuses on a specific mathematical concept. Each concept is linked to the mathematics curriculum and presents a series of five questions that provide a gradual increase in challenge.

The Project

The purpose of this research evaluation was to investigate whether and how the use of Matific resources, used within a range of Australian primary school classrooms, can improve student engagement with mathematics and assist students in learning and understanding challenging mathematical concepts.

Methods

The research aimed to address the following questions:

- 1 To what degree do the Matific digital mathematics resources assist primary children to understand and learn difficult mathematics content?
- 2 In what ways do the Matific digital resources influence student engagement with mathematics?

This research utilized case study methodology. Eight primary schools from a range of socio-economic areas were selected, invited and agreed to participate in the project. None of the schools had used Matific prior to their participation in this project. Each of the schools was unique in relation to geographical location, academic performance, student population and cultural makeup. The schools also had differences in the number and amount of access they had to digital devices. Two teachers and their students from each school were invited to participate. It was a requirement that the teachers be working in the same grade or stage. Students and teachers from Grades 1 to 6 participated in the study.

On commencement of the study either one or both, researchers spent one day working with the participating teachers at each school. They were provided with an orientation of the Matific resources and were supported in developing a pre-test once they had selected a topic. The teachers then collaboratively planned a unit of work that incorporated Matific episodes. Five to six students from each class group participated in a focus group discussion to gauge their engagement with mathematics, their perceptions of mathematics teaching and learning, and their views and experiences of using technology during mathematics lessons.

During the second stage of the study, the teachers implemented the unit and students completed a post-test at its conclusion. The researcher/s returned to the school and conducted individual interviews with each participating teacher to discuss their reactions to using Matific. Student focus group discussions were also held to investigate changes in students' perceptions as a result of using Matific. The various units of work were finalized and are published as an appendix to the full report along with copies of the pre- and post-tests.

Project Findings

● Teachers' Perceptions of Matific

The 16 participating teachers in this study used the Matific resources in a variety of different ways. This resulted in a diversity of opinions about the resources and varying levels of success in terms of student achievement and engagement.

● Differentiated Learning

The teachers who did set Matific as homework found it to be successful and highly engaging for their students, although there were, as would be expected, some students who did not have access to either the internet or a device. In one school this was addressed by allowing access to the school's computers before school and during breaks. Despite not setting Matific for homework, several of the teachers found that their students used Matific at home because they found it so engaging.

● Student Voice

Many of the discussions around the use of Matific related to either an alignment with or a mismatch between teachers' intentions, beliefs and knowledge of their students, their students' experiences of Matific, their beliefs about learning, and their abilities. For example, the teachers at one school used all the data they had available to ensure students were allocated appropriately leveled Matific episodes and they promoted discussion with and amongst students. They adjusted and adapted their teaching and students' learning experiences according to their students' reactions to the resources. Conversely, in classrooms where students were not provided with reflection opportunities, the teachers appeared to be unaware of what their students thought about using the Matific resources and whether their students felt the resources were assisting them to learn. This was evident in more than one of the schools in this project.

● Integration into Teaching Practice

A significant variable across the case studies was the way the teachers integrated the Matific resources into their teaching practices. Those teachers who enthusiastically took advantage of all of Matific's functionality appeared to have made more significant changes to their practices when compared to those who did not. The teachers who only accessed a minimum of Matific's affordances really did not adapt their practices. Rather, Matific appeared to be an 'add-on' to existing teaching and learning activities.

All of the teachers in the project stated that would be willing to continue the use of Matific and spoke favorably about Matific in comparison to other digital resources they had used in the past.

Learning from Matific

One of the most significant outcomes emerging from the qualitative data gathered from students is that Matific assisted learning. Students from across all eight case studies talked about how the Matific episodes helped them learn mathematics and were able to talk about the mathematics they had learned, rather than focusing on the actual game-related aspects of the episodes.

● Size and Structure of Matific Episodes

The size and structure of the Matific episodes was one factor that contributed to student learning. The students were able to focus on very specific mathematical concepts and skills, and this focus was able to be maintained because each episode consisted of only five questions. The students also noted that they were unable to 'cheat' when repeating episodes as the questions were different with each attempt.

● Scaffolding Learning

The element of Matific that was most commonly attributed to assisting students' learning was the careful scaffolding built into each of the episodes. The assistance provided when answers were incorrect helped the students to build an understanding of the mathematical concepts while also building their confidence.

● Pre- and Post-Test Data

The quantitative data gathered from pre- and post-tests indicate that the overall Improvement Index for all schools is 34%. This means that students on an average improved by 34% of the available marks. This confirms and aligns with students' perceptions that learning took place. However, it is not possible to claim whether or how much the use of Matific influenced this outcome as students would be expected to show some growth when exposed to teaching, regardless of what resources are used.

Engagement and Matific

It is clear from the data gathered from students and their teachers that engagement with mathematics improved as a result of using Matific. It is important to acknowledge that the majority of teachers in this project had not regularly used digital technologies in their teaching of mathematics, so the sudden introduction of a resource such as Matific would have had a novelty effect on the students involved, and this would have had some influence on their engagement.

● Feedback and Rewards

An important point of difference between Matific and other digital resources the participating students had used in the past was the fact that rather than simply state when an answer was incorrect, Matific provided assistance that promoted the development of conceptual understanding. This was an outstanding feature that students felt was beneficial to their engagement and their learning. Tied in with the instant feedback provided by Matific was its reward system. This feature was considered to be extremely engaging for almost all of the focus group students across the eight schools. The most significant benefit of the reward system was that it provided intrinsic motivation for students to continue working hard. The simple 'super awesome' statement promoted perseverance amongst almost all of the students, a characteristic that is important in mathematics learning, particularly in the area of problem-solving.

● Matific is Fun

An outstanding feature of the Matific resources, according to the students, is that it is fun to use. The change from seeing mathematics as something to be tolerated or endured to something that is fun indicates that there was high affective engagement. It should be noted that the word 'fun' did not simply equate to the game aspect of the resources. Rather, the data indicate that the students found it was fun because they felt they were learning.

● Challenges

Minor challenges were experienced by some of the teachers and students in this study:

- None of the schools in this study had access to a 1:1 device program.
- Several of the teachers in this study found it was difficult to use Matific on an iPad, but this was because the actual iPad app had not been downloaded and it was a challenge to get apps downloaded in a timely manner.
- Some teachers did not feel comfortable setting Matific episodes for homework because they were aware that not all students had access to the Internet, computers or tablets.



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