Research Guided Practice: Student Online Experiences during Mathematics class in the Middle School

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The approaches to new technologies available to schools, teachers and students largely concern computers and engagement. This requires adoption of alternate and new teaching practices to engage students in the teaching and learning process. This research integrates youth voice about the use of technology. A major motivation for this research is to increase understanding of student perceptions about their learning and interactions taking place during mathematics classes utilising ICT. The focal point is student experiences online as it applies to middle school aged youth (12 - 15 years old) and the constructs that inform student online experiences.

The use and impact of technology for teachers is increasing exponentially with increasing availability of hardware and peripherals. Teachers are increasing use of digital technology in the form of web-site development, online textbooks, online blogs, a myriad of resources, and personal computers and iPads for students. Despite this, literature suggests that the perception of use of this technology is viewed differently by youth and the older generation (Beastall, 2008; McGehee & Griffith, 2004). Thus, in the classroom whilst students and teachers may use the same technology, the nature of the communication and interaction with that technology, may be different according to teacher and student beliefs and practices in use of Information Communication Technologies (ICTs) (Beastall, 2008; Prensky, 2010).

The major motivation for this research is to contribute to the understanding of the student experience of being online during mathematics class. It is evident from the literature that researchers have seemingly overlooked the valuable inputs of student perceptions and opinions and classroom practice surrounding students online in the mathematics classroom. This paper records the research experiences of a practising middle-school classroom teacher to provide teachers with more information to enhance teaching mathematics on line. It is based on qualitative data obtained as a component of a larger study for a PhD by Maria Mojica-Casey.

Background

The rapid advances in digital technology have meant the techniques and resources available in mathematics education are undergoing many shifts. With the arrival of each new ICT application, a response on how best to make use of it becomes necessary. The use of ICT in this research refers specifically to the use of computers for accessing, gathering, manipulating or communicating during mathematics lessons online.

The relatively limited resources considering ICT use in mathematics class mostly reflect the teacher perspective (Goos & Bennison, 2008). It is well documented in the

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literature that ICTs in teaching practice, require new and alternative practices. In this respect research of mathematics practices using ICT have concerned

- the characteristics and effectiveness of specific ICT applications and their capacity for enhancing student mathematical understanding (Akpinar, 2010);
- student usability and critiques of reusable learning objects (Freebody, Freebody, McRae & Muspratt, 2006; Haughey, 2005; McGehee & Griffith, 2004);
- the design of interactive student and mathematics class learning environments (Ilomaki, Lakkala &Paavola, 2006);
- the use of blogs for learning mathematics (Pyon, 2008).

Furthermore research suggests that the practices designed for the use of ICT in the classroom contribute to the efficacy of the resource. For instance, Freebody et al. (2006) evaluate the efficacy of the use of digital technologies in educational settings and explore possible improvements in creative and effective uses. They state,

> Students' comments have significance for developers and for teachers using digital learning objects (LOs) in their classrooms. (p.14)

Their findings reveal students do not see reusable learning objects (RLO's) as tools as their teachers might, but as spaces for "facilitating interaction and engagement." Freebody et al. posit student expectations for interaction and engagement must also be met with the teacher's role of incorporating learning objects in the classroom practices by understanding the potential of ICT-based learning. It follows that teacher understanding of student perceptions of the use of ICT can impact upon the design of learning environments and participation structures with ICT. More recent research includes Loong, Doig, and Groves (2010) who found that fifty-precent of the students surveyed use computer software and Internet at home for mathematics.

The foregoing overview of contemporary mathematics education and practices intimates a need for classroom research that would guide teaching practices. This research used voices of middle years students about teaching and learning practices that could impact on their mathematics learning.

The Study

The general aim of this research was to explore student experiences online in a mathematics classroom in a middle school setting. The specific aims of the research were:

- to examine the opinions and perceptions of middle school students using mathematics RLOs, blogs and online textbooks; and
- to obtain student voice about their own, as well as teacher involvement in mathematics lessons using ICT.

These specific aims were addressed by exploring answers to the research questions.

Research Question 1: What particular aspects can influence student online experiences during mathematics class?

Research Question 2: How do students communicate amongst themselves and with their teacher when online during mathematics class?

There are two key points of this study that support the aim and foster answering these questions: firstly the use of student ideas as data and secondly, the use of ICTs that are readily available Australia-wide. It has been established that youth are able to provide credible data. (Appleton, Hunt, Thrupp, & Heldsinger, 2006; Attard, 2010; Thrupp, 2008). One of the key findings by Attard (2010) in soliciting student views on mathematics teaching and learning during the transition from primary to secondary school, included

differences in pedagogy related to ICT use. The aforementioned research utilized focus group discussions in order to gather student voice on the topic.

Methodology

The larger study used mixed methods methodology as a means of securing an in-depth understanding of the phenomenon in question, that is, in-depth perception of online experiences by students during mathematics class. However, the research reported in this paper only concerns the qualitative results. Table 1 outlines the alignment of the qualitative data collection sources and data to be collected relating to the RQs addressed in this research. It can be seen from the table that triangulation of the results is possible through use of opinionnaires, posts to mathematics blogs, and focus group data.

Table 1
Summary of Data Collection Sources and Methods

RQs addressed	Data source/ method	Data collected
RQ 1 & RQ 2	Student Mathematics Opinionnaire (SMO)	Open-ended comments about student opinion of: their online experiences using mathematics-blogs, mathematics reusable learning objects and textbooks online.
RQ1 & RQ2	Posts to mathematics blogs	Samples of communication by students amongst themselves and with their teacher whilst posting comments on pages of the mathematics blogs.
RQ1 & RQ2	Focus groups	Student reflections about: • data uncovered in the opinionnaires; • their experiences using blogs, reusable learning objects and textbooks online; • their interaction with their teacher during class.

Research Design

Two rounds of data collection incorporated the different online contexts that were explored to answer the research question. It was decided to use two rounds of data collection in order to incorporate the different online contexts in use at the school. The round 1 online context was interactive and included the use of RLOs and mathematics blogs. The round 2 data collection online context was read-only and included the students' textbook online.

Data Source

Three data collections provided a variety of settings with a mix of purposes. Student Mathematics Opinionnaire (SMO) was a survey that provided data reflecting student perceptions and opinions regarding their experiences during online mathematics lessons. The posts to blogs were obtained to provide real samples of student use of the online context. Focus groups provided conversational, reflective data about student experiences online and results from the other data sources.

The survey instrument, SMO comprised open-ended questions. It was designed to ascertain/identify the dominant themes and attitudes of students related to the topic. The commentary provided by students was compared to those made in posts to the online mathematics blogs to identify whether any repetition of themes, ideas or patterns existed between the two, related to student experiences as they are described in the RQs.

These posts by the students to the online mathematics blogs provided unique and personal expression by students and were used as a source of data to provide a real world example of student online communication and interaction during mathematics class. Posts to mathematics blogs captured surface impressions of the students' perceptions and opinions of mathematics. All posts were archived and analysed for descriptions, identification of trends and interrelationships as they relate to each of the research questions.

Focus group data provided the opportunity for students to share their ideas, experiences, and attitudes as well as consider those of their peers. This freedom of expression enabled the participants to comment on, from personal experience, the topic of going online to do mathematics during class time. It was intended that students could discuss perceptions about experiences during mathematics class in an online context, the roles of mathematics learning objects, blogs, textbooks and other digital mathematics related media. In addition consideration in the discussion was to be given to how their usage of computers during class time affects the student-student and student-teacher relationship.

Participants

The sample comprised 79 students out of 121 students enrolled at an urban school. The focus group was a representative subgroup because it consisted of middle school students. It comprised a mix of males and females, who had participated in the other data collection instruments, and were using ICT in mathematics class.

Data Analysis

SMO survey data, focus groups and posts to mathematics blogs were analysed using *NVivo* 10 software. Analysis consisted of comparing the qualitative data collection instruments and sources to identify themes, from which constructs were established. Constructs were a conceptualisation of details within data. Review of the literature and consideration of data obtained from each of the data collection instruments and data sources were used to analyse and verify the data within this research. The processes undertaken for the analysis of SMO data commenced by informal thematic coding of ideas uncovered in the literature review, followed by formal coding using *NVivo* 10. Confirmation of constructs uncovered in informal coding was achieved through cross checking in the data coding process of the software. *NVivo,* enabled the researcher to start small and build up a picture of the coded data collected in rounds 1 and 2, assisting interpretation of the data and answering of the research questions. *NVivo* also helped in sorting and identifying relative occurrences between and of constructs and the relationships in data that may otherwise have been overlooked.

Results

Analysis of the data resulted in the identification of seven constructs. The constructs are ordered according to prevalence in the analysis as follows: *usefulness, empowerment, teacher interaction, sociability, differentiated learning, visual aspects,* and *youth culture.* Within the group of constructs, there is a clear distinction between the first two constructs and the latter five constructs. Defining of the first two constructs (*usefulness* and *empowerment*) occurred in 56% of the data. The most significant aspect dominating student

online experiences during mathematics class was the construct of *usefulness*, comprising over 36% of the data coded.

Each construct was defined from the responses of participants. Those definitions are now presented followed by examples of direct quotes from data that gave rise to the definition.

Usefulness is defined as convenience and practicality in the use of computers during mathematics lessons online. Examples of comments about *usefulness* of computers during online experiences include:

> On computers you know if you are right or wrong straight away. No books to carry makes your bag lighter. There's a calculator on the computer. You can use spellcheck so you don't loose communication marks. Your work will be neater. You can use the zoom to zoom in on what you want. Computers are easy to use and work better.

The computer is:

> easier, harder, better, helpful, useful and saves time…

Samples of negative responses related to *usefulness* include:

> This link is loading too slow. The blog wasn't very helpful. I think the blog is a waste of time because it gives you the questions but doesn't really tell you how to answer anything. Finally someone is giving hints instead of answers. I don't think this is faster because you still gotta read the instructions do the work and do the working out somewhere. Bad keyboards are a problem. Flat batteries are a problem but not as likely as people forgetting their pens.

Empowerment is defined by participant responses indicating that the online experiences during mathematics class provided a feeling of control or of freedom to work and experiences of independence and self-confidence as they used the ICT during class. A typical example is:

> We are more in control of our learning. When you do things independently you get more confidence to do it by yourself. You can use the Internet for more information while you wait for the teacher. You can forget what the teacher says but on the computer it is always there for you. Online there is more information. Online you can get more understanding. Online gives you more choices. You can work it out yourself instead of having to ask a question in the first place.

Computers provide:

> More independence. More examples. More know how. Is helpful…Through the school year you can learn a lot more and do a lot more.

Teacher interaction describes teacher presence to assist learning, offer support and or add input during online mathematics lessons. Student responses cited the input of the teacher as necessary in supporting learning and understanding of mathematics during online lessons.

> Teachers get kind of distracted themselves because they are working with you. We want the teacher around so they can come to you when you want them. It is a bit easier if you have the teacher right there beside you. The way the teacher does it is probably going to be the easiest way of remembering it. In a regular class the teacher tells you to stop talking and look at them. Teachers act different in lessons using ICT because the focus is off of them. The teachers are more lenient they are more relaxed.

Sociability was defined as greater autonomy with fellow students to communicate amongst them, friendliness of their teacher and having fun or emphasising camaraderie when using computers to learn mathematics.

> While we were on the computer I said, Let's do our homework and we did it. Using computers in the maths lessons helps us learn in a fun way. Time passes quicker. The lesson is interesting. The lesson is cool.

A comment that suggested anti-*sociability* included:

> When you're on the computer you're kind of locked into it without socialising with anyone.

Differentiated learning is the opportunity provided by ICTs to work at a pace consistent with their mathematical abilities; comments include:

> I'm a visual person and doing maths online is a lot of visual. I find I work better on computers. I can concentrate better on the computer. Computers extend my understanding. More of a variety. Figuring out the answer by yourself. Using the computer is more fun than just copying what the teacher tells us to write. I do better work now. It is too hard by myself. On computers you are going as fast or slow as you want to. When the teacher is going slower/faster than you, you can learn however you need. If some people are slow in your class it gets annoying and you look out the windows.

Visual aspects refers to the 'look' of online learning during mathematics class.

> It is better than a teacher doing it all on the board. I like the bright colours. Our textbook colours are faded. You can read the instruction over again. The pictures and diagrams are more clear. I like the zoom. Diagrams on the computer are easier to follow than the textbook. My textbook is full of graffiti and is worn out. It is easier to follow the pronumerals when they are the same colour. The computer holds my focus. You're locked into the computer screen better than when looking at a hard copy of the textbook.

Youth Culture is adoption of ICT for and by young people or when participants critiqued adult usage or participation. For example, comments by students referring to the limitations of a teacher or parent when using ICT or comparing their time spent or abilities to that of adults using computers. Responses indicating students felt the online context was particular to his or her self or to youth culture in general, as in:

> We get to learn how we want. Lets students use something they know how to use. We get to do what we enjoy and are used to doing, Teachers have their own way and if you don't understand their way you kind of suck. They (adults) don't use it as much. We learn how to do it easier. Mum's on a computer eight hours a day and still she comes home and says, 'How do you do this?' like on MSWord they don't know what the buttons do. Computers make it a less old-fashioned classroom. We try more stuff and new stuff on computers. Computers belong to young people. We are like the technology age so we like it.

Figure 1 illustrates the relative prominence in the data of the seven constructs previously described. The numbers on the vertical axis represent percentage coding within the data.

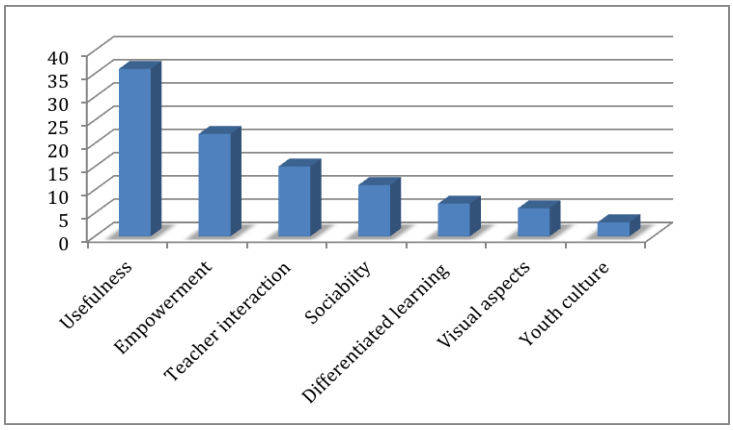

Figure 1. The relative prominence of constructs in data.

The graph in Figure 1 places the constructs in ascending order highlighting the importance of individual constructs within the data. The findings provide aspects for consideration in design for learning in mathematics and more specifically, in designing for students using ICT during mathematics class from their perspective.

Implications

Early stages of the analysis indicate that the research could identify aspects that influence student online experiences during mathematics class and perceived relationships amongst students and with teachers when online during mathematics class. The following statements capture the key understandings that have their origins in the findings.

1. Students are pragmatic about ICT usage in classroom learning.
2. Students value control in their learning environment.
3. Students recognise that ICT use with teacher presence adds value to their learning of mathematics.
4. Students recognise the difference in the nature of teacher-student interactions in an online environment and the capacity for teachers to interact with different students in different ways.
5. Students enjoy social aspects of ICT use during class time.
6. Students recognise the capacity for ICT use to assist with their different learning needs as well as those of their peers.
7. Students feel the visual aspects provided by computers to do maths improves understanding, clarity and focus for some students.
8. Students perceive computer usage during maths lessons to align more to current youth culture when compared to traditional classroom learning.

It is necessary to consider the meaning of these statements for teachers and their design of mathematics class and mathematics learning environments. The implications of the findings are as follows.

- Students are capable of having input into design of and the usefulness to themselves of online mathematics class environments.
- Students perceived use of ICT in mathematics class is based on its empowerment of learning.
- Students describe interactions between themselves and their teachers during class using ICT to be different to that of their traditional class experiences. They feel the teacher's role is one of advocacy and support for their learning.

- Student opinion is that social characteristics in lessons using ICT differ greatly from the traditional classroom, with the former being a more relaxed environment.
- Students recognize and value the wide range of interactions taking place using ICT that focus learning for themselves and their peers. Students also enjoy working in different ways.
- Students claim the visual aspects of a digital copy of their textbook enabled better and longer focus than that provided when using the hard copy text.
- Students view lessons utilising ICT to be modern and youth orientated.

Conclusion

This research has used youth voice to provide guidance for teacher practice with regard to online learning in mathematics in middle schooling. It is evident from this research that the role of classroom mathematics teacher is expanding with ICT use. Furthermore, it is evident that youth can discuss aspects of using ICT during mathematics lessons and they have much to contribute in the dialogue about the nature of mathematics learning. Given the need to motivate learners to participate in and enjoy mathematics, these implications are timely.

References

Akpinar, Y. (2008). *Improving children's learning of science and mathematics through contextualized learning objects.* Retrieved from: http://webcache.googleusercontent.com/search?q=cache:x-ofnw0KgIkJ:ietc2008.home.anadolu.edu.tr/ietc2008/231.doc+Improving+chlidren"s+learning+of+science+and+mathematics+through+contextualized+learning+objects&cd=1&hl=en&ct=clnk&gl=au.

Appleton, K., Hunt, J., Thrupp, R., & Heldsinger, D. (2006). *Information communication technologies uptake and usage by primary-aged students*. Queensland: Central Queensland University.

Attard, C. (2010). Students' experiences of mathematics during the transition from primary to secondary school. In L. Sparrow, B. Kissane & C. Hurst (Eds.), *Shaping the future of mathematics education*. (Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia.) Freemantle: MERGA.

Beastall, L. (2008). Enchanting a disenchanted child: Revolutionizing the means of education using information and communication technology and e-learning. *British Journal of Sociology of Education*, *27*(1), 97–110.

Freebody, P., Freebody, K., McRae, D., & Muspratt, S. (2006). New curricular ways with new technologies: The Le@rning Federation"s learning objects arrive in classrooms. *Professional Educator*, *5*(2), 14–17.

Goos, M., & Bennison, A. (2008). Surveying the technology landscape; teachers' use of technology in secondary mathematics classrooms. *Mathematics Education Research Journal*, *20*(3), 102-130.

Haughey, M. (2005). Evaluating learning objects for schools. *E-Journal of Instructional Science and Technology, 8*(1) Retrieved from http://ascilite.org.au/ajet/e-jist/docs/vol8_no1/fullpapers/eval_learnobjects_school.htm

IIomaki, L., Lakkala, M., & Paavola, S. (2006). Case studies of learning objects used in school settings. *Learning, Media and Technology*, 31(3), 249-267.

Loong, E., Doig, B., & Groves, S. (2010). Students' and teachers' use of ICT in primary mathematics. *2010: Proceedings of the 47th Annual Conference of the Mathematical Association of Victoria*, pp. 99-106, Mathematical Association of Victoria, Melbourne, Vic.

McGehee, J., & Griffith, L. (2004). Technology enhances student learning across the curriculum. *Mathematics Teaching in the Middle School*, *9*(6), 344-349.

Pyon, S. (2008). Why math blogs? *Teaching Children Mathematics*, *14*(6), 331.

Prensky, M. (2010). *Teaching digital natives; Partnering for real learning.* London: Sage.

Thrupp, R. (2008). *Social groups and information communication technologies: Exploring primary-aged learners' identities.* Rockhampton: CQUniversity.