EXPLORING SOCIAL EQUITY ASPECTS IN INTEGRATING TECHNOLOGY IN PRIMARY MATHEMATICS EDUCATION

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ABSTRACT

This research focus on aspects of equity related to the introduction of using technology in classrooms. Technology has the potential to support mathematics pedagogy with visual representations and offer modelling and simulation facilities, increasing the creativity of the learning and teaching processes (Kaput, Ness, & Hoyles, 2008; Stoilescu 2008). Introducing technology in mathematics is not always helpful. Sometimes it improves the instruction and equity and sometimes it increase inequity and the earning knowledge gap. For instance, by introducing ICT in classrooms, mathematics pedagogy is changed, as the devices involved can be used to explain, to test, and to give feedback to students. This is because ICT offers an environment that allows a dynamic context and lets instruction become more engaging and interactive. As well, technology could be used in non-creative ways in which students are only kept busy so that the knowledge accumulated is at minimum. This qualitative research study will select four exemplary teachers to discuss ways of improving technology in classrooms. Situations where introducing technology in mathematics classrooms will be discusses to see their relevance and whether they are helpful and fair or not.

KEYWORDS

Computer Technology in Classrooms; Equity and Technology, Mathematics and Technology, Teacher Education.

1. INTRODUCTION

There is increasing concern in Australia (Atweh, 2011; Valero & Zevenbergen, 2004) and internationally (Apple, 1992; Ernest, 2002) over questions of equity involved in integrating ICT into mathematics education. This project will investigate dimensions of equity (gender, ethnicity, socio-economic status, ability) involved in integrating ICT in primary mathematics education of four caring teachers from two Greater Western Sydney (GWS) primary schools using qualitative research (case studies) methodologies, in order to identify challenges as well as the productive potential of diverse contexts. There are two major aims to this study. The first is to investigate primary teachers' views on the importance of using digital technologies in mathematics education in relation to social equity. The second is to explore the equity challenges when implementing ICT technologies in mathematics classrooms in multicultural, low socioeconomic status schools in Greater Western Sydney. Through interviews, observations in classrooms and documentary analysis the project will: 1)- Analyze teachers' views of integrating technology in mathematics education to reveal their challenges and professional needs;2) Document existing ways of using digital technologies in mathematics education classrooms in a multicultural school with low economics status to identify strategies and potential;3) Identify how gender, ethnicity, low SES, ability intersects with patterns of integrating technology in primary school contexts;4) Identify systemic aspects and structures, including policies, pedagogies and practices that shape processes of inclusion.

2. BODY OF PAPER

The significance of bringing relevant pedagogy into classrooms has been appraised by numerous researchers (Ladson-Billings, 1995; Apple 1992), and its principles were largely accepted by educators to help them guide in achieving an adequate balance between wellbeing and knowledge for all of participants of the

educational processes. However there are numerous barriers in implementing effective pedagogies in mathematics education as this area of education was traditionally oriented toward intellectual elite. As Ernest (2004) put it: "Many people have come to feel that mathematics is cold, hard, uncaring, impersonal, rule-driven, fixed and stereotypically masculine. Evidently, there is a strong parallel between the absolutist conception of mathematics, the negative popular view of mathematics, and separated values" (para. 38). . Presently, due to the increasing number of years of schooling, mathematics education no longer targets just the intellectual elite. In addition, the quantity and complexity of mathematical problems have increased in real life and in practical settings. At the same time, technological needs in everyday life have grown exponentially. However, there are few studies that focus on the equity aspects of integrating ICT in mathematics classrooms.

Technology has the potential to support mathematics pedagogy with visual representations and offer modelling and simulation facilities, increasing the creativity of the learning and teaching processes (Kaput, Ness, & Hoyles, 2008; Stoilescu 2008, under review). By introducing ICT in classrooms, mathematics pedagogy is changed, as the devices involved can be used to explain, to test, and to give feedback to students. This is because ICT offers an environment that allows a dynamic context and lets instruction become more engaging and interactive (Kaput, Hoyles, & Noss, 2008).

In terms of socio-economic status and pedagogy Kaput et al. (2008) asserted that "changes in representational infrastructure are intimately linked to learnability and to the democratization of the intellectual power" (p. 713). Introducing technology in mathematics education becomes essential to include students from diverse backgrounds. Several studies revealed the importance of equity in mathematics education (Gutstein, 2006) and that there is a need to mentor mathematics teachers support integrating ICT in an equitable way (Gates & Jorgensen 2009). The integration of technology in studying mathematics reveals important multiple facets of equity to access and instructions (Atweh, 2011; Forgasz, 2009; Stoilescu, 2009): curriculum, teacher professional development, educational policies, textbooks, and ICT tools. In the last years, various aspects of equity in curricula, textbooks, and technologies in mathematics classrooms were explored (Gutstein, 2006; Herbel-Eisenmann, 2007; Tutak, Bondy, & Adams, 2011). However, the number of studies exploring aspects of equity in integrating technology in mathematics education remains very low, as this topic requires adequate expertise and attitude in all three main research areas: mathematics education, social justice, and educational technology.

Actual practices of equity of integrating ICT in mathematics classrooms have received mixed reviews. On the one hand, researchers saw integrating technology as an opportunity to make mathematics more accessible for various social categories of students (Kaput, Hegedus & Lesh., 2007; Aggarwal, 2011). On the other hand, studies have shown that ICT can also amplify social pre-existing inequities (Apple, 1992; Gates & Jorgensen. 2009) in mathematics classrooms. By way of example, researchers found that often teachers from poor neighbourhood schools are not adequately trained and are often marginalized because they are minorities themselves (Atweh, 2011). Becker and Ravitz (2001) revealed that the quality and the nature of instruction received by educational technology are affected by students' socioeconomic status. In mathematics instruction, classrooms from poor schools received ICT instruction more as drill-and-practice, and not as a way to improve higher-order thinking skills. In addition, technology was introduced only in a perfunctory way, without adequately adapting ICT to specific class requirements. Other studies showed that ICT in poor communities was often obsolete or adequate educational software was missing from these schools (Becker & Ravitz, 2001).On the contrary, some research shows that often, in affluent schools, ICT used in classrooms has resourceful roles and is creatively used by educators and students. For instance, Jorgensen, Gates and Roper (2013) explained that, in affluent neighbourhoods, students experience and engage in mathematical activities with habits that had already been shaped during their early socialisation in their families, and this shapes the way they act and value experiences in schools.

Maintaining a façade of objectivity and equity may have a negative impact on teachers' productivity, causing many conflicts or disappointments; impacts on teachers' abilities to interact effectively with students, colleagues, and administration; and decrease the probability to see teachers' desire or ability to stay in a particular school or in teaching, more generally. A major challenge in using ICT in mathematics classrooms is the limited availability of the software and hardware equipment, as the updates require consistent financial commitments. As Jorgensen, Gates and Roper (2013) pointed out, in mathematics classrooms "it is therefore important to consider not only the concepts but also the medium of instruction. In many disadvantaged communities, the clash between the culture of school and the culture of learners contributes significantly to the failure to experience success of many learners" (p. 8).

2.1 Method & Techniques

This study is a qualitative study, and, in particular, multiple case studies (Merriam, 1998). Data will be collected from observations in classrooms, document analysis, and interviews. The case studies involve four teachers from two primary schools. The main criteria for selecting the schools and the teachers are that they represent a community with ethnic diversity and low socio economic status from the Greater Western Sydney The other important criteria of selecting the teachers are: persistent involvement in school community, being viewed by community as exemplary teachers, experience in teaching in primary schools, positive view toward using technology in classrooms, frequent use of technology in mathematics.

Observations will be collected for a period of approximately two months, at least five hours per week for each teacher. Observations will be done in the classrooms. The role of the technology in place will be discussed. As well, how the technology is used in classrooms will be noticed and how the students and the teachers' interact through ICT and appreciate it. Field notes from observations about the integration of ICT in classrooms will be recorded.

In regard to document analysis, initially stage of analysis will be started by considering curricular documents on primary school mathematics, equity policies, and educational technology curricula from the Department of Education and Training from the New South Wales. During this study, teachers' handouts and digital artefacts will be collected in order to acknowledge teachers' ways of designing mathematics curriculum and ways of using technology in teaching mathematics. Also, some students' assignments and projects will be examined. After these documents will be analyzed, individually discussions with teachers will take place for debriefing. The notes about curriculum in primary school and antipoverty policies in place in the New South Wales will be reviewed and compared with the field notes from observations. The differences, similarities and challenges will be noted and discussed.

The CI obtained already references and recommendations to locate the four caring teachers from the two schools. Next, ethics approvals will be obtained. Each teacher will have two individual interviews designed to explore their attitudes and views about the use of technology in classrooms. The interviews will provide data on the teachers' background and previous educational and technological experiences. Teachers will be asked about their overarching reasons for adopting technology in the class, their opinions about their students, their personal reasons for integrating technology in mathematics, the personal motivation that made them choose to teach at that specific school, and their perspectives on the integration of technology in mathematics classrooms. Also, questions about recent events that were observed in classrooms will included, in order to identify how these events were perceived by them and eventually to discuss eventual differences. The teachers will be asked to reflect on what they thought was specific to equity issues in teaching mathematics with technology. They will be asked to reflect on ways their technology in place and teaching practices of integrating technology in classrooms is suitable or not for their students. Teachers will be asked to reflect on what they perceive their students' expectations are and describe difficulties (coming from SES or gender disadvantages) encountered by their students in classrooms when they tried to integrate technology in the mathematics curriculum. Also, they will be asked to reflect on ways their teaching practices could help or deter their students' efforts. These interviews will be semi-structured. The protocol for each interview will be designed to explore experiences, attitudes, and insights of the teachers. At the end, they will be asked about what could be modified in their approaches in order to improve instruction in mathematics. Their views on integrating technology in mathematic classrooms will be described. In addition the CI will discuss with their teachers their ways of providing justice to see how they actually performed in their classrooms in order, eventually, to compare and explain any differences between teachers' appreciations. Follow-up discussion and debriefing will be carried out with each participant. Interviews will be audiotaped. The time and place will be negotiated with the participants at a mutually convenient time using an informal, semi-structural approach. Several key questions will be asked including:

- What is their opinion about the use of technology in mathematics classrooms
- if and how they use technology in mathematics education in their classrooms?
- What is the social role (if they think it has one) of technology in mathematics education? Is technology neutral? (or) Is technology a factor for equality/inequality in promoting progress in mathematics education?

If the technology influences equity of mathematics education in general:

- How do experience the use of technology in equity in their mathematics classes?

- What are examples when the technology helps students (through social equity)?
- What are examples when the technology negatively affects social equity?
- What cases (positive and negative) can they provide about the use of technology in equitable ways in their classrooms?
- How can they influence with their teaching (positive or negative)? What are the limits?

Data will be collected from interviews and observations will be coded and analysed with NVIVO. For credibility and validity, Lincoln and Guba (1985) recommend pursuing the following main aspects: prolonged engagement, persistent observations, structural corroboration, referential adequacy, member check, and triangulations. Prolonged engagement were attempting to overcome possible distortions presented by the researchers' presence and to test their perceptions, biases as well as those of their participants. By extending my presence in the researched classrooms, teachers will become used to my presence and confident that this study was not critical of their teaching approaches and classroom interactions. Persistent observations will be also used to identify pervasive characteristics from atypical ones in order to eliminate from analysis irrelevant aspects, while continuing to observe key aspects of social equity in technology in teaching mathematics. In particular, observations and interpretations between researchers will be checked to see whether these are consistent with participants' intents.

In this research, triangulation processes is very important. Two distinct types of triangulation recommended by Patton (2005) will be used: data triangulation and triangulation through multiple analysts. For data triangulation, the accuracy of the data will be checked by comparing data from different sources (interviews, meetings, field observations, paper and electronic documents) confirmed each other. For multiple analyst triangulation, the CI will discuss the analysis of data and the findings with research assistants, as they will help him analyze the data or will be asked to co-authored some articles and conferences linked with this research. The accuracy of the data will be analyzed as a preliminary step. As with any qualitative research, the process of analysis will be on-going (Bogdan & Biklen, 2003). The transcripts from initial interviews and observations will be collected. The process of coding will be initiated in order to create a set of codes based on concrete findings.

3. CONCLUSION

There is a need to examine the equity aspects of the locations in which the teachers are positioned, in order to see how they are impacted upon by various subjects and how they impact themselves their ICT choices in students' preparations. Consequently, the discourses in which the integration technology in primary mathematics takes place will be explored in terms of mathematical approaches, technological pedagogical discourses, and equity. An analysis of the discourses that operate in relation to teachers' professional experiences will also be undertaken to develop an understanding from the participants' perspectives the degree of visibility and challenges in digital technological issues in in primary mathematics settings. Foucault's (1997) framework will be applied to explore how power shifts is contextually located and how this persuades on the types of power educators have at different moments and contexts. This project is significant and opportune in the context of Australia's concern about decreasing capabilities in mathematics education and the desire to close the gap between results for low SES students (Cobbold, 2010). Ascertaining whether integrating ICT in mathematical education contexts is perceived as more problematic because of the social construction of technology and mathematics in today's educational context, or whether this apparent objectivity renders educators perceptions as totally insignificant and unproblematic, allowing them to be honest and open about their own challenges, views, would provide a significant discussion to research. Furthermore, it will extend in relation to choosing the technology and the adequate ways of using it. Primary teachers in various situations are required to implement adequate strategies to integrate ICT in mathematics education and equity of implementing ICT in classrooms is essential.

In this case, comparisons, contrasts and links could be developed between the experiences of mathematics education, educational technology and social justice aspects. By drawing on the voices of experienced caring primary teachers living and working in a multicultural Australian community, these much needed case studies of professional experiences of primary mathematics educators will be ascertained. The intersection between social justice, pedagogy in primary mathematics and technology is a timely research niche that

offers many opportunities. More exactly, a foundation on which further critical research may be conducted on linking teaching professional development with social justice issues will be provided. This experience will help the CI attempting further research projects, for instance, conducted via an ARC Discovery Early Career Research Award. Further studies would be conducted on a greater scale in different school contexts and using a variety of ICT opportunities in order to understand educators' challenges and support them with adequate information, perspectives and strategies.

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