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Teachers' beliefs about first-and second-order barriers to ICT integration: preliminary findings from a South African study

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Teachers' Beliefs about First- and Second-Order Barriers to ICT Integration: Preliminary Findings from a South African Study

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Abstract: Teachers' beliefs have been shown to play a critical role in their decision to utilize technology in their classrooms, but few studies have examined those beliefs among South African teachers. This paper reports preliminary findings from a qualitative study of Cape Town secondary school teachers that analyzed their belief statements in order to establish their perceptions of first and second order barriers to technology integration. Preliminary findings suggest that a variety of socio-cultural factors impact on teachers' beliefs and pedagogic practices pertaining to technology use. These factors may inhibit South African teachers from adopting more student-centered pedagogies that foster technology integration. Implications for future research are also discussed.

Introduction

The aim of this study is to examine the interaction of teachers' beliefs and aspects of their surrounding culture and context in relation to ICT integration and pedagogy. In their two-year study of a teacher laptop computer program, Windschitl and Sahl (2002) concluded that models of technology use that emphasize ICT skills, "…underestimate the powerful influences of…teachers' beliefs about learners and learning, which are mediated by the specific character of the school community" (p.203). In other words, it is necessary to not only attend to teachers' belief systems, but to situate those beliefs within the community where teachers work. We consider the argument that community cultural and societal factors will impact teacher beliefs and practice, and that these factors need to be accounted for in technology-related teacher development.

In South Africa, the investigation of how these relationships operate has just begun. In the emerging economy of the country first-order barriers can be stark. Second order barriers to ICT integration are, however, equally as critical. We argue that the severity of first-order barriers in the South African contexts may mask the complexity of second order barriers, particularly the impact of community and culture. This is particularly problematic in that there has traditionally been significant investment of technology in South African schools that goes unutilized, and may not be the support truly needed in the schools. We explore the issue of teacher beliefs and community through a theoretical analysis of four teacher interviews, conducted at two Cape Town schools, based on Ertmer's (1999) concept of first and second order barriers to ICT integration. First-order barriers refer to the logistical obstacles that are extrinsic to the teacher, such as computer provisioning and technical support. Second order barriers are intrinsic to the teacher, and include beliefs about technology and teaching. This approach provides a way to identify teachers' conceptions of ICT access, beliefs about integration, and pedagogy. While the barriers are well accepted in the literature, the relationship between first-order and second-order barriers remains complicated. Findings from this study will provide a preliminary examination of the deeper issues around technology integration in South African schools, and preliminary recommendations for supporting future technology-related teacher training and development.

Background

A shift to student-centered pedagogies that embrace technology is severely limited not only by access, but also by teachers' beliefs about their role in instruction. If we are to address second-order barriers to ICT integration, we need to better understand how teachers' beliefs are shaped by the school, community, and socio-cultural context.

South African Teachers and Schools

The discussion section that follows presents research in the context of South Africa and offers some insights into barriers to technology integration. Some barriers are intrinsic to the teacher, and in South Africa these intrinsic factors are further complicated by the nation's unique historical and cultural dynamic. The 2005 Report of the Ministerial Committee on Teacher Education baldly states that the nation does "not have enough well qualified and committed teachers…" (SADOE, 2005 p.40). In 2005, 38% of teachers held a qualification of REQV 13, the equivalent of a three-year diploma. Another 9% possessed no diploma whatsoever (UNESCO, 2010). Although recent policy initiatives hope to improve teachers' professional development, currently it is not systematically addressed. Moreover, there is no provision in the legislation to re-certify educators once they are registered by the South African Council for Educators.

Many professionals, particularly those from disadvantaged backgrounds, carry out their assigned duties without the requisite content or pedagogic knowledge. As Brodie (2002) reports, several studies of Further Diploma in Education students by Alder and colleagues in the late 1990s concluded that South African teachers:

> …who are taking up forms without substance are in fact struggling with other, more basic aspects of their teaching. They struggle to provide continuity between lessons, and within lessons between different tasks. They struggle to determine appropriate levels of tasks. They do not assign and monitor homework, and they struggle to match lesson plans with purposes. (p.557)

This is the nature of many teachers in South Africa.

South African schools have changed little since the end of apartheid in 1994. While the transition to a non-racial school system in the 1990s occurred with little conflict, the fact remains, as Jansen (2004) states, "For a long time to come, the majority of black learners will receive their formal education within the confines of all-black schools" (p.127). Race and class inequities of apartheid-era African and Colored[1] schools remain entrenched (Soudien, 2007). These contextual factors impact on teachers' first- and second-order barriers to technology integration in a number of ways. In the following section, we outline some of these barriers and their possible relation to context.

First-Order Barriers

While barriers to teachers' ICT use, in general, are fairly well studied in the developed world (Jones, 2004) and in technology-rich environments in non-Western settings (Schoepp, 2005; Strigel, Ariunaa, & Enkhjargal, 2008; Tondeur, Hermans, van Braak, & Valcke, 2008), only a few studies have examined barriers in South African schools. The first-order barriers identified by researchers working in South African schools (Wilson-Strydom, Thomson, & Hodgkinson-Williams, 2005; Fanni, Rega, Van Zyl, Tardini, & Cantoni, 2010; Chigona & Chigona, 2010) include:

- low technical capabilities
- limited access to computer labs created by strict timetables and high student-computer ratios
- inadequate technical support
- school policies

The most notable research in South Africa is the Second International Technology in Education Study (SITES 2006). The SITES 2006 study included responses from 666 math teachers and 622 science teachers across the country (see Howie & Blignaut, 2009). Data was also drawn from principals' and technology coordinators' self-reporting about first-order barriers relating to computer and Internet availability, as well teacher ICT training. Nationally, South Africa struggles to overcome first-order barriers. The following few key findings, as reported by Howie & Blignaut (2009) illustrate the challenges:

- 62% of schools surveyed did not have access to computers
- Of the 38% of schools that did have computers, more than 60% had Internet access
- Compared to the international average, very few South African teachers has access to technical support

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[1] The racial categories of the apartheid-era government are still employed by both government and civil society in contemporary South Africa, and we retain those descriptors to distinguish teacher populations. In fact, one of the authors was interrupted while writing this article by a 2011 Census taker and asked to identify his race.

While this data is useful for planning policy to support ICT provisioning and support, the study did not specifically examine second-order barriers.

Despite the national picture painted above, two provinces, Gauteng and the Western Cape, have implemented systemic projects to provide computers labs to schools through the provincial departments of education. As a result of the Western Cape Education Department's Khanya Project, for example, 76% of schools in the Western Cape were equipped with computer labs by 2007 (Isaacs, 2007). By the March of 2012, it is expected that all schools in the Western Cape will have a computer lab installed (Khanya, 2011). Even in the areas where computer access has been provided, anecdotal evidence and research show that many teachers struggle to integrate technology regularly (Miller, Naidoo, and Van Belle, 2006). There have not been significant studies examining second-order barriers may be impacting on the use of technology in these schools.

Teacher Beliefs as a Critical Second-Order Barrier

Regardless of previous training, teachers' belief in their personal capacity to teach effectively with computers may be a crucial determinant of whether or not they use ICT. Teachers' attitudes and beliefs about technology have been shown to influence the use of ICT in their classrooms (Marcinkiewicz, 1993). Teachers' beliefs, particularly those about pedagogy, tend to reflect their practices (Angers & Machtmes, 2005). In their extensive review of research on pedagogies for the use of ICT, Webb and Cox (2004) also note that "teachers' beliefs about teaching and learning were linked to what they did in the classroom and choices they made in selecting how to integrate ICT into their teaching" (2004).

In relation to second-order barriers, the SITES 2006 researchers found that South African teachers' use of ICT remains "persistently low" and that "teachers' preference for traditional learning has thwarted the development of students' 21st century skills" (Blignaut, Els, & Howie, 2010, p. 566). Ford and Botha (2010) confirm this finding by summarizing the reasons for the failure of ICT projects in South African education:

- A lack of ICT literacy amongst teachers and limited access to technology training.
- An inability to incorporate ICT due to inadequate or unreliable infrastructure.
- Structured forms of teaching "with little or no scope for lateral thinking."

This last item highlights the need to examine second-order barriers in South African schools. In the following section we outline how we have begun to explore this idea.

Methodology

The preliminary data analysis focused on four high school teachers, two from each school. The four interviews were selected as illustrative cases to demonstrate the interaction between first- and second-order barriers in the context of a typical working-class South African school. Both school communities face socio-economic challenges such as high poverty, crime, domestic violence, alcohol and drug abuse, as well as impacts from HIV/AIDS. The poor infrastructure, and the undersized and overcrowded classrooms of the schools in this study reflect this reality.

Sibiya High School[2] is situated in an African township. It is a designated "no-fee" school, which enables local impoverished students to attend, but severely restricts its resources. One of the Sibaya interviewees, Palesa, teaches accounting and manages the computer lab. Her colleague, Lindani, teaches Mathematics. By contrast, Klipspringer High School serves a Colored suburb. It charges parents a moderate fee that provides it with some additional resources, such as extra teaching posts. At Klipspringer, both teachers interviewed serve on the school management team. Reza is the head of the Mathematics department. Nadia is acting head of the English department.

To examine teachers' beliefs about using ICT in teaching, the project employed a mixed-method survey design, conducted in two phases. This analysis includes only data from Phase 2: in-depth, semi-structured interviews that sought data on teachers' ICT knowledge, their use of ICT in teaching, perceptions of risk associated with ICT use in teaching, as well as their beliefs about school and provincial educational culture. The interview schedules were based on previously validated tools used to examine teachers' beliefs about ICT integration in schools (see Howard, in press; Howard and Careller, 2011).

Interviews were analyzed using thematic codes (Flick, 2009), based up on Ertmer's description of first and second order barriers (Ertmer, 1999). During the first coding pass transcripts were analyzed for perceptions about

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[2] Pseudonyms have been used for names of schools and teachers.

technology integration in general. On the second pass, transcripts were coded for comments about first- and second-order barriers related to technology integration. The following are the findings from this analysis and the resulting discussion.

Findings

In regard to general technology access at the two schools, both had computer labs, and in the case of Klipspringer a brand new laptop lab had been installed three months prior to our visit. Both schools had Internet access and each had seven interactive whiteboards. While both schools were situated in high-poverty areas, Sibiya was more directly impacted by crime. Due to the high incidence of cable theft, for example, the national telecommunications company refused to service the school's phone lines, and Sibiya relied on a satellite link for Internet service. In the past year, data projectors were also stolen from several IWB-equipped classrooms.

In addition to these contextual factors, the following first and second-order barriers have been extracted from the teachers' comments about their school, subject area and ICT.

Examples of First-Order Barriers

The most salient first-order barriers reported by the teachers were:
- computer viruses
- insufficient time to develop technology skills and knowledge

Computer viruses were the most common first-order barrier to ICT use mentioned by teachers at both schools. Teachers' technical capacity, as well as the challenge of regularly connecting to the Internet to download updates, prevented them from utilizing freely available virus protection software.

At Sibiya High School, teachers had no workroom or other dedicated space to access computers. Teachers here relied on the computer lab, or they borrowed one of the school's shared teacher laptops. Lindani mentioned his reluctance to share his personal computer because "when I share I find out now my laptop has viruses and it is giving problems to open it to find certain documents are wiped out." In a resource challenged environment, this reluctance to share hardware makes it less likely that Lindani will also share his practical technology knowledge with his colleagues.

At the better-resourced Klipspringer High School, teachers had access to an educator computer center, where memory sticks transferred viruses from teachers' home computers to the school's network. Nadia, who reported having three computers at home, refused to use the educator center's computers:

> And the technology is sometimes faulty. And it's very frustrating. I prefer to do everything that I need to do at home so that I come prepared to school and I don't waste time trying to get a computer to work here or finding that your flash is consumed with viruses or short cuts...

Computer lab viruses were also seen as a barrier to using ICT with students. As one participant explained:

> Reza: The major problem we have in the computer lab is the excessive viruses on the lab. And we don't have expertise to fix that, that problem. Because sometimes when you fix it, after say a week or two, it clogs up again… You load something on the computer after say, two weeks or three weeks it either jams up something. You have a technician in then they tell us that it's either a virus that's a new virus, etcetera, or we just do the best on how to deal with the virus. It tends to be expensive at the end. And you lose… you lose stuff over there.
>
> Int: Oh okay. So this, because of that, you're less likely to go the lab?
>
> Reza: Yes

Reza's belief about computer viruses is clearly based on experience. But this belief becomes generalized to other situations. Despite the fact that the school had a new, virus-free Apple MacBook lab for four months, Reza had not taken his students to use those computers.

These Cape Town teachers echo the common refrain of teachers around the world that there isn't enough time to learn technology. When asked what prevented her from learning more about technology, Nadia provided a typical response:

> I'm a language teacher, and if you've been in this school you know that the language teachers have absolutely no extra time. We have no time. If there are, for example, workshops that we have to be over a weekend… weekends are precious – marking, prepping, you have at least, I would say, twice as many

assessment as any of the other learning areas. So any time for us is very precious. Schools have in-house jokes about languages, that you never finish marking. It's so true.

Nadia also mentioned that she could not attend afterschool training sessions because she taught an "extra class" for Grade 11s in the afternoon. Because it severely restricts potential professional development activities, this perceived need for extra classes in the South African context is something that deserves further study.

By contrast, Palesa believed that technology could save her time. She appreciated the technical affordance offered by the interactive whiteboard (IWB), that of being able to save a lesson for later use:

I only went for one lesson about how to use the interactive whiteboard. I thought maybe it's easier like you have to plan your lessons…and then you don't have to write them again or do much editing, you just leave it on the laptop…

Palesa's belief that the IWB saves time made her interested in having one for her own use. When asked if she would like to have an IWB to teach accounting, she brightly replied, "Yeah, I would love to." When further questioned about whether an IWB is needed for teaching computer skills in the lab, she responded:

It's not all that … not all that necessary for me. I think there … the most important thing that maybe I need to use in the computer lab… is to use the projector.

Her beliefs about the affordances of the technology influenced her desire to teach accounting with an IWB, and enabled her to make the evaluative judgment that, in a resource-poor context, the IWB is not an essential tool.

Examples of Second-Order Barriers

The most common second-order barriers expressed by the teachers were beliefs about:
- the role of the teacher
- the need for classroom control
- the value of ICT in teaching and learning

The first two items are closely linked to the socio-cultural position of the teacher in South African society.

In his analysis of post-apartheid South African, von Holdt (2010) counts "face" among one of the five key features of state bureaucracy:

This situation – the conquest of sovereignty and the simultaneous constraining of sovereignty by the persisting powers of the ex-colonial forces within society and beyond its borders – elevates the importance of authority, reputation and 'face' in the state. (p. 250)

This concept of "face" complicates and seems to limit teachers' ICT use. When asked if she would Google information for her teaching, Palesa responded, "It's best not to do it while I'm teaching." When asked to elaborate on the reason why, she explained that:

…if learners see that you don't know something and then you try and maybe to explain it in another way they won't have that confidence in you. So it's better to say, "not now I'll give you the answer tomorrow." Or maybe just to try to find something to cover up. Because once they see that you don't know something, you know learners, they will think that maybe you don't know even everything that you are going to teach them, they will lose confidence in you.

The role of teacher as expert was a consistent theme among teachers. Despite his position as a department head, Reza expressed concern that students would perceive a deficit in a teacher who cannot confidently operate technology:

Because kids will know…because if you enter their class, and you're not actually clued up as to what you're doing there…you know the content of the subject but you're not clued up as to how to operate on the system, etc. And that makes a teacher look scared. Even with all the knowledge that you have, you stand there and click buttons.

This belief that technology might create a chink in the armor of the teacher's authority is also revealed in comments regarding classroom management.

Teachers' who were reluctant to use the computer lab often expressed a concern about managing students in that "risky" environment. At several points in the interview, Nadia expressed concerns about taking her children to the computer lab:

> Too many risks… and also in a computer lab you can't really check as effectively as you can see them in a class… In our classes, because of the numbers, you need to be able to control effectively. So that… that is problematic. I don't think you'll have forty-three or forty-five computers in the lab necessarily.

> And to take a class down there would just be a nightmare for me. I'd be more worried about if something were to go wrong down there with technology, with the principal is always telling us we have to be so careful and things get broken. Then it's not a really attractive place to be for me. It's too much of a responsibility. I can control them in class, in my classroom.

> I weigh up what, what, will I use this? Am I going to take my children into the lab? Am I going to take responsibility for all of, anything that can go wrong, and will go wrong there? And I say to myself, 'No!'

Despite reporting that she regularly used a computer at home, Nadia's statements demonstrate strong beliefs about classroom management challenges in a computer lab that prevent her from even considering using the computer lab for teaching.

It is interesting to note, however, that late in the interview Nadia expressed a desire to try new things with her grade eight students:

> I know there are certain programs. For example, when the kids go in and um…they need to go into the lab but also to do something like, news reading. To make it fun. Like, reading as pretending to be a newsreader and reading the text off a screen. Like that. And people can rate you how, how well you are presenting the news and things like that.

While she may not have a clear picture of the technologies she would use, Nadia believed there might be value in students using a computer lab. She had some notion of a pedagogical approach, but her beliefs about classroom control and management prevented her from expanding her teaching methods.

Nadia's fears of the computer lab contrasted starkly with Palesa's, whose experience of students in the computer lab was completely positive:

> Okay like, the other thing I only saw, I only went for one lesson about how to use the interactive whiteboard. I thought maybe it's easier like you have to plan your lessons…and then you don't have write them again or do much editing, you just leave it on the laptop…

Palesa's colleague Lindani found the computer lab to be safe enough to take groups of children whom he did not even teach. "In my free period I take the grade 8s to the computer lab," he explained, and then added his disappointment that his mathematics and science colleagues did not do the same:

> It concerns me when our… the majority of our teachers especially those that are doing maths and science who are a little bit shy or are not comfortable using the latest technologies… They need to link their teaching with technology.

The contrast between Palesa and Lindani, who work at a less resourced school with less reliable computer hardware, and Nadia and Reza, whose school has more functional computer resources, is intriguing. Do Nadia and Reza allow perceptions of first-order barriers to color their beliefs about ICT use? This is a critical question for further study.

Discussion

Interactions Between Barriers

It is well documented that first-order barriers to ICT use do not prevent teachers from adopting ICT into their regular teaching practice. As the SITES 2006 report found, "there was no correlation between the level of ICT access (student-computer ratio) and the percentage of teachers reporting having used ICT in their teaching" (Law, Pelgrum, & Plomp, 2008, p. 2). Instead, those findings suggest that pedagogical ICT competence is the most important predictor of ICT integration (Ibid, p.3). In South Africa, as noted above, the need to save 'face,' is one cultural dimension that may impact on teachers' pedagogy, their conception of the teachers' role and beliefs about power and control in relation to their students. Research has shown that 'authority' is quite strong in South African culture and schools. In his international comparison of work place values, Hofstede (2001) notes that white South Africans "have a need for strict authority of hierarchical superiors" (p. 216). Our initial findings suggest that South African teachers' desire for control may be a key factor in their decision about whether to put themselves in the 'risky' position of taking learners into the computer lab.

Webb and Cox (2004) refer to a number of factors related to control, including how teachers organize their classrooms, how the structure learning activities, and how much autonomy they give students. These socio-cultural

factors impact on teachers' beliefs, thus furthering existing second-order barriers. When teachers are unsure of first-order barriers, such as how to use technology or unsure of the class behavior, they may feel the potential for loss of 'face'. Moreover, it is thought that ICT is used more effectively when used in conjunction with student-centered pedagogies (Becker & Ravitz, 1999). Student-centered practices change the role of the teacher in the classroom, and thus change the related power and control over the classroom. Teachers who are more invested in a didactic approach that reinforces their position of authority may chose not to attempt pedagogies that promote the role of students and challenge the status quo. These socio-cultural factors suggest that South African teachers, like Nadia, will not be easily swayed towards student-centered approaches.

Need for Further Study

In analyzing our data, one of the challenges we faced was clarifying the relationship between beliefs about ICT and teachers' specific pedagogic practices. The next step in this research would be to examine teachers' practices in relation to their beliefs. Do viruses, in fact, cause teachers to believe that it is not worth taking students to the computer lab, or do their beliefs that the computer lab will not function properly reinforce a belief that computers are not valuable for teaching and learning? The messiness of this distinction between first and second-order barriers deserves greater attention, as well as examination though teacher observation and discussion of their actual practices.

In referring to the range of available affordances offered by ICT, Cox and Webb note that "changes to teachers' beliefs and values are needed in order for their pedagogical reasoning to lead to planning of appropriate learning opportunities to use these affordances" (2004). If we accept this premise, then it stands to reason that a deeper understanding of those beliefs and how they operate in the South African context will enable inservice providers to create more effective intervention strategies. Moreover, understanding the commonalities of belief patterns might suggest effective professional development strategies across a range of South African teachers and provide a basis for making international comparisons.

ICT integration in South African government schools is not widespread. In an economically constrained context, government and non-governmental organization (NGO) decisions about teacher professional development should be guided by research about teachers' beliefs and pedagogic practices. This study represents an attempt to establish a preliminary understanding of how teachers' beliefs impact their perceptions and use of ICT for teaching in the South African context, and how those perceptions enable or discourage teachers to engage in ICT integration. This exploratory data set shows us patterns and trends in an under-researched population of teachers. The findings point to the need for refined instruments and analytic approaches to address the broader cultural and social dimensions of context. Future research should be conducted across a variety of settings to confirm or disconfirm these findings, and to deepen our understanding of why teachers still experience barriers to ICT integration.

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