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Altered Geometry: A New Angle on Teacher Technophobia

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Abstract

We analyze teacher technophobia using an activity systems framework and contend that technophobic teachers make the mistake of confusing and collapsing the tool into the object thereby figuratively altering the geometry of the classic activity system triangle. Three case studies of technophobic teachers are reviewed and compared with observations of a teacher described as exemplary but whose practice exhibited technophobic characteristics. The teachers in this paper shared four mental models, that is, (a) teacher as expert, (b) student as inexpert, (c) ICT as being restricted to productivity applications, and (d) schooling as the achievement of purposeful outcomes. We conclude that teachers with technophobic characteristics act logically in terms of their worldview but that this leaves them with either no or limited processes to enact change and no clear view as to where they are heading.

Altered Geometry: A New Angle on Teacher Technophobia

What the world looks like depends on where you stand to view it. In this paper, we argue that those teachers who cannot 'see' how technology can be used in meaningful ways in their classrooms are seeing a world in which tools and outcomes are conflated into one. Their view is one which sees an incomplete world and leaves them with either no or limited processes to enact change. For the analysis in this paper, as in our previous work (Lloyd & Albion, 2005) on teacher technophobia, we adopted the approach of mapping Australian teachers' perceptions to an activity systems framework (Engestrom, 1987), which allowed a formalizing of the "complex set of connections between individuals, technology, and the social, political and material environments" within a school (Granger, Morbey, Lotherington, Owston, & Wideman, 2002, p. 480). We here consider the experiences of four primary school teachers – three who could be classified as technophobic with the fourth, while being described by her principal as exemplary, curiously exhibited similar practice to the technophobic teachers.

Background

If we accept Bailey's (2000) description of teachers as the "rank and file implementers of change" (p. 112) and Marcinkiewicz's (1993) notion of the need for "a reconciliation between teachers and computers" (p. 234), it is a simple step to the hypothesis that, if our schools have not adopted and integrated technologies at the expected rate or have not achieved systemic goals, then it is teachers, particularly reluctant teachers, who are to blame. Adding to the growing body

of research into teacher resistance to technology in education (Granger et al., 2002; Hodas, 1993; Maslen, 1995), our concern in this paper is with those teachers who are usually labeled as being resistant users or, at worst, as being "technophobe, or too traditional in their teaching style, or reluctant to adopt change" (Watson, 2001, p. 253). We are also concerned with those teachers who are erroneously labelled as exemplary by school administrations and others but whose practice exhibits similarly constrained characteristics.

We agree that, to understand what is or is not happening with ICT in classrooms, we "need to examine the life of practicing teachers and develop resources that address reasons and excuses, real or imagined, for [the] slower adoption of ICT " (Backhouse, 2003, paragraph 1). Through this paper, we question what has become a somewhat simplistic placement of blame on individuals and, to a lesser extent, the according of higher status to individuals who, irrespective of constrained teaching and learning outcomes, are using ICT in their classrooms.

We are particularly interested in the creation of the technophobic teacher as an identity category and believe teacher technophobia to be a complex matter worthy of closer scrutiny. Rather than pathologize this as a condition for treatment, this paper takes a closer look at these teachers who are more usually described pejoratively as "middle-aged technophobe[s]" (Maslen, 1995, p. 112) or as lagging behind the early adopters. This review is positioned within an empathetic understanding of teachers' beliefs as a "messy construct" (Pajares, 1992) and we see a teacher's role as being something that is "ambiguous and ill-defined, hedged about with uncertainty, inconsistency and tension" (Nias, 1999, p. 237). We will adopt the terms technophobe and technophobic in this paper in a descriptive rather than derogatory sense.

A number of developmental schemas have been devised to describe teachers' adoption and curricular integration of ICT (see, for example, Dwyer, 1995; Hall & Hord, 1987; King,

2002; Mevarech, 1997). Each extant schema suggests a progression from an embryonic stage, which Mevarech (1997) referred to as "survival" and others called "awareness" (Hall & Hord, 1987), to a final stage typified by reinvention or creative application. All schemas show an increasing transparency and a shift towards using technology in ways that support broader pedagogical goals. The metaphor of a journey is frequently adopted to describe this development and, in likening ICT adoption to a "journey of transformation," King (2002) described the first step as one characterized by fear, uncertainty, disorientation and self-examination. The teacher identified by her principal as exemplary but whose practice was constrained could be categorized as having begun the journey but is, to continue the metaphor, travelling without a map or without a guide to lead by example.

The technophobic teachers described in this paper have consciously or unconsciously resolved not to begin the personal journey of change implicit in the extant developmental schema. It could, however, be argued that they have not done so because they simply do not want to and seem impervious to attempts to cajole or coerce them to do so. They may, arguably more simply, not believe that they have a problem and would not describe themselves as technophobic. It is external agencies that have created their condition and which offer solutions to individuals who may not wish to be 'saved' or 'cured' or do not understand or accept that such action is needed. They perceive little or no disequilibrium in their practice and therefore are not seeking to restore their balance. The prescription by system authorities and growing social pressure to make use of technologies in their classrooms is an external rather than internal motivator.

The behaviors of the technophobe teachers described in this paper confirm the contention that to adopt and integrate technology in the classroom "is complex and involves the head and the heart, the personal and the professional" (Day & Roberts-Holmes, 1998, p. 29). Consonant

with this observation, Zhao and Frank (2003) found that, among the key predictors of the use of technology in the classroom, the most significant in measures of teacher predisposition were (a) perceived compatibility (with existing values), (b) past experiences and needs, (c) perceived complexity, and (d) perceived relative advantage (relative to the technology or practice being replaced). These are fundamentally affective and unique to individuals, thus confirming the suggested engagement of both "head and heart." All four teachers in this review believed that their path was true, and in fact, each acted logically in terms of their worldview. The problem as addressed in this paper is that their view of the world is incomplete or skewed.

Method

In order to argue the case for its model of a conflated activity system as a possible cause for teacher technophobia or constrained practice, this paper revisits three case studies from two previous research projects (Lloyd & McRobbie, 2005; Lloyd & Yelland, 2003) both concerned with the adoption and integration of ICT in the classroom. Each of the reviewed case studies (to be referred to as Teachers A, B and C) were individuals identified as technophobes. A fourth case study of Teacher D, regarded by her school as an exemplary ICT-using teacher, has been added to argue that technophobic characteristics are more prevalent than would be notionally presumed. Observations of Teacher D's practice have been drawn from field studies conducted in 2005. Interview data and field notes relating to these subjects were assessed in terms of Activity Systems Theory (Engestrom, 1987) and, through this process, have revealed new insights into the beliefs and perceptions of teachers. The activity system represents the 'world' allowing us to reinterpret the worldview of those discussed in this paper.

Subjects

Teachers A, B and C were primary (Years 1-7) school teachers who were categorized as technophobes due to their limited experience with, and restricted adoption of, ICT in the classroom. Each was of a similar age (50-55 years) and each was a career teacher having begun teaching around age 20. Each had worked within the state educational system since graduation (with some breaks related to family rearing for the females) and all had been at their current school for a lengthy period (each in excess of 12 years). All were thought to be "good" teachers and were respected within the school and local community. Each presented as a warm, caring, dedicated but somewhat “old-fashioned” teacher. Each was articulate and empathetic and clearly had a good rapport with their students.

Teacher D was also a primary school teacher (Year 6) but being in her mid-30s was younger than Teachers A, B and C, and interestingly, one of the youngest teachers in her school. She shared the characteristics of competence and dedication with the technophobic teachers but was considered to be a leader in ICT use in her school and had been nominated by her principal for a state award. Her age and engagement with ICT marked her as a digital native. The technophobic Teachers A, B, and C, by corollary, could be cast in the role of digital immigrants. Teacher D was observed delivering a lesson in which her students were to use PowerPoint® to build a board for a simple board game tenuously linked to their current studies in Science. The lesson began with each student sitting at a separate computer following the teacher’s instructions. The steps to be followed were being projected onto a screen at the front of the room. The demonstration ended with the teacher showing the students a few finished examples. They were then instructed to wait until she had checked their work and shown each individual how to color

the squares on the game board. They were to sit in their places and raise their hand when all the shapes were in place or if they needed to ask for assistance.

Table 1 provides additional details related to the case study characteristics and current schooling responsibilities.

Insert Table 1 about here

The employing schools (respectively referred to as Schools A, B, C and D) were very different in the culture of innovation and collegiality they displayed. They similarly differed in the emotional and technical support offered to teachers, particularly beginning and reluctant teachers. The most positive was School C where vibrant leadership saw highly innovative practices being adopted in the design of learning spaces and in the encouragement given to students to manage their own learning (assisted by technology). Schools A, B and D were more conservative with School B having some isolated instances of teachers adopting isolated elements of innovative practice in their own classrooms. Further to this, little was shared in these schools and there was little discernible leadership or evidence of collaboration among teachers.

Data analysis

The data for this paper, as previously noted, were taken from interview transcripts and field notes from two previous studies (Lloyd & McRobbie, 2005; Lloyd & Yelland, 2003) and from field observations which included Teacher D's lesson. These data were mapped against an activity systems framework (Engestrom, 1987), which proved effective in providing us with new insights into the technophobe and teachers with constrained practice. Activity Systems Theory is of particular use in analyzing interactions within workplaces (activity systems) where a common

goal is shared but in which individuals hold differing contributory roles. The "activity" within the activity system is the carrying out of socially-formulated, goal-directed actions with the help of mediating tools (Wertsch, 1981). In the analysis in this paper, the activity is teaching and the activity system is a classroom or the teacher's individual practice.

The components of an activity system are subject, rules, tools, community, division of labor, and object, which has a direct link to the outcome or over-arching goal. The operations and interactions, that is, the activity of the activity system, are viewed from the perception of the subject and, in most instances, subjects' responses are recorded in turn as multiple case studies. The analysis of an activity system emerges from the mediation of one component by another and the multiple relations within the triangular representation of activity (See Figure 1).

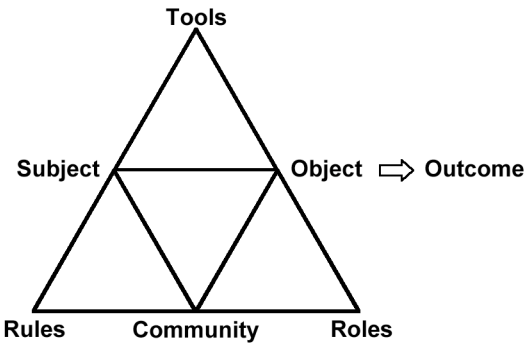

Figure 1: An Activity System (Engestrom, 1987)

Findings

The findings of our analysis will be grouped under a discussion of the components of an activity system. Our emphasis is on the subject component as this is where we offer a deep analysis of the mental models and critical commonalities of the four teachers. Our key argument is that an error the teachers in this study have made, in terms of an activity system, is in mistaking the tool for the object and collapsing these components into one thus altering the geometry of the activity system—both literally and figuratively.

Subject

In an activity system, the "subject" is the individual or group whose agency is chosen as the point of view in the analysis. It is important to reiterate that these teachers were neither inexperienced nor incompetent and all were highly regarded in their school communities. Relating to the conservative functions of schooling, all shared a mental model of:

1. *a teacher as expert*. Teacher A reported her discomfiture to her principal "that the children knew what to do and she did not" (Lloyd & Yelland, 2003, p. 90). As an indication of perceived complexity, Teacher B (in interview) offered "before I do anything with the kids, I have to be confident that, if something goes wrong, there's a chance I can fix it. If I don't have that confidence, then I don't put myself in that position." Teacher D demonstrated her expertise by instructing the students to defer all requests for assistance to her. She did not encourage or seemingly allow any peer tutoring or collaboration.
2. *a student as inexpert*. Teacher B was alarmed at the freedom and independence given to students in other schools asking "Isn't this expensive stuff? I'm just blown away by [teachers] just letting them use it!" Teacher C believed that his Year 3 students lacked the reading and comprehension skills needed to use the Internet and forcefully added, "Let's face it! The way these kids use computers, they're likely to end up with it crashing." Teacher A hinted at the potential for malicious damage in speaking disparagingly of "the type of child in my class." Teacher D's students were cast in the binary role of "inexpert" in default of her assuming the role of "expert." They could not show or share any of their own expertise in the teacher-led activity they had been given.

3. *ICT as being restricted to a desktop computer and simple peripherals* (such as keyboard, mouse and printer). Teacher B explained that her students did "a lot of word processing. … cut and paste … changing fonts … getting the capital letter there." Teacher C spoke of word processing and basic file management. No specialist educational software was used in Teacher A, B or C's classroom. No students were involved in image processing as there was no use of any paint, drawing, animation or presentation programs. Neither were they involved in the construction or use of either open or closed information systems. Teacher C could not accept that there was anything unique to ICT processes arguing that "the only thing I think that's unique to a computer is [that] it's faster" and "it is a convenience product." Each technophobic teacher was dismissive of students' ICT experiences outside of the classroom (particularly of computer games and the notion of playing). Teacher D had a broader repertoire of ICT skills but her students stayed within a closed environment of proprietary software applications and solving 'problems' in a predefined manner. There was no "playfulness" or the opportunity to interact with the software "without having to produce immediate products or results" (Agarwal & Prasad, 1997, cited in Zhao & Frank, 2003, p. 835). For all, ICT was about productivity rather than cognitive process.
4. *schooling as being the achievement of purposeful outcomes*. As a measure of perceived compatibility, Teacher B offered that "they don't get games in my room. It's purpose stuff" derisively adding that "my teaching partner does games" (with "games" here being mathematics software applications). Similarly, Teacher C expressed concern about students uncritically copying and pasting digital content but this was unlikely in his class as his students were word processing simple documents such as invitations and letters.

> Teacher A's students had to prepare emails as handwritten texts before they could be word-processed and then pasted into an email client. ICT did not fit what these technophobic teachers held to be the normative and conservative functions of schooling (Hodas, 1993) or as anything other than an adjunct to existing non-digital processes. Teacher D's students' behavior did not change from the classroom to the computer laboratory. They raised their hands to ask the teacher a question and did not move from their seats or offer support to their peers. The teachers' sequenced instruction was followed without question and students' prior knowledge was seemingly ignored.

Despite external appearances to the contrary, we argue that Teacher D was embodying technophobic characteristics by maintaining the conservative functions of schooling. The class observed was one in which she was firmly in charge and what was presented as guided practice was instructivist in nature. This teacher-centered behavior is consistent with the findings of Cuban, Kirkpatrick and Peck (2001) in high-tech schools in California where there were no open-ended problems to be solved and little creative input from students in the classes observed. Teacher D behaved in a similar way – she was the expert and the students had to continuously ask permission to act. Measured against the interdependent attributes of meaningful learning described by Jonassen, Peck and Wilson (1996), Teacher D's activity could be said to be intentional (in its achievement of specific goals) and active (in students' physical engagement) but was not constructive, authentic or cooperative.

Critical commonalities emerged amongst the technophobic teachers that were not, however, observed in the Teacher D's practices. These commonalities, related to, and were arguably generated by, their mental models of teachers, students, ICT and schooling. These were that they:

1. *were threatened and defensive* and appeared, in differing degrees, to see questions about their practice as personal. The issue was elided into one of identity (as noted in Jonscher, 2000; Turkle, 1996).
2. *were "digitally homeless"* with Teacher A overtly technophobic (having been previously reported as evidencing a physiological and "genuinely neurotic reaction to technology" (Lloyd & Yelland, 2003, p. 88)), Teacher B using only word processing and email in supervised spaces such as her husband's office and school, and Teacher C not seeing any use for computing in his work practices or home activities. None had a computer at home.
3. *did not believe that ICT is a necessary component of education*. Teacher C offered two spurious arguments against the use of ICT. These were that ICT in schools (a) cannot be vocationally sound as students will be taking jobs that "haven't been invented yet," and (b) not effective in meeting student needs, asking "Why do these kids need to know how to use a computer? If they don't have one at home, it's pointless, a waste of time because they won't get enough time on the target here at school."
4. *were not familiar with the notion of a connected or technology-rich classroom* with Teacher B offering that she "would not know what it looked like." This is despite her having recently returned from a 3-day intensive practicum in a technology-rich school where she made classroom observations and there being instances of innovative practice in her own school.
5. *were dismissive of constructivist practices and/or discovery learning*, particularly in comparison with instructivist practice or a focus on operational skills. This is significant

in light of the research evidence that effective ICT adoption is associated with constructivist pedagogy (Becker, 2001). Teacher B offered that:

> … I was just blown away with … [the idea that you should] just sort of 'throw them in the deep end and it will be all right' and I'm thinking 'Gee! What about your keyboarding skills?' You're turning the thing on, you're turning it off, you're saving your work because if the kids can't save their work. It was a waste of time them sitting there, not total waste, they would have picked up some skills hopefully, but they've got nothing to show for it at the end of the time."

6. *held the view that technology was outside what was done in their classroom* with Teacher C aligning it to other specialist teaching areas such as Music or Physical Education, which are taught by specialist teachers in designated areas, that is, not the general classroom. Technology was "othered."
7. *felt an abiding sense of compulsion and subsequent resentment* about having to use ICT in their classrooms (see Bailey, 2000). Teacher C offered, in also alluding to a lack of curriculum guidance, that "the Department [is] simply telling us here are the computers, use them in your classroom, you figure out how to use them and you figure out what the kids will do."
8. *used a perceived lack of support as a scapegoat* with Teacher A accusing the ICT Coordinator of deliberately withholding information and stockpiling resources and Teacher B complaining of delays in receiving technical support.
9. *had not lacked opportunity*. Teacher B spoke of a Commodore 64 laboratory (of 14 machines) once being in the school and she listed various past and ongoing school-based support initiatives. Teachers B and C were known to have participated in an intensive

practicum just prior to interview and Teacher A attended the same introductory sessions as her students. The School B Principal was conducting 1:1 skills training sessions with Teacher B on a regular (weekly) basis. This may, however, have been counter-productive, as such training has been shown to have little or no effect in transferring to actual implementation in the classroom (Browne & Ritchie, 1991) or in engendering technological pedagogical content knowledge (TPCK) (Mishra & Koehler, 2006).

10. *rationalized their lack of involvement with ICT* with each offering the plausible excuses recurrent in the literature (see Davis & Eslinger, 2001; Granger et al., 2002). The defenses raised by the subjects in this review included:
    - a lack of practical models to follow—with Teacher B offering that "until you see it actually working, it's still a mind block."
    - equity issues—with Teacher B offering that "if I can't find a way for every child to access something, then it tends to be [offered to] no child."
    - issues of technical reliability—with Teacher B referring to computers as "frustrating things" and expressing annoyance at "when the damn things don't work … they're 'down' as often as they are 'up'" and Teacher C referring to the computers in his room as "6 year old stuff that's on its last legs."
    - preference for/defense of print over digital resources—with Teacher B saying "I'd rather read a book. You can read a book anywhere. You can take a book out fishing, you know" and Teacher C advocating the need for print literacy to be taught before digital literacy.

- a lack of time—Teacher C argued that teachers were mostly concerned with "survival, getting through the day, getting through the term, what is the next big stress point" and did not have time to come to terms with integrating ICT in the curriculum.
- no curriculum guidance—Teacher C, in alluding to the carrot/stick analogy of reward and punishment, argued that:

> No. No. ICT … is all sticks. … they didn't say exactly what they wanted the children to be able to know and do. … Here are the computers, use them … okay if that's the outcome, most teachers could tick with a big tick with confidence [that they] were using them. And then, they 'Oh No No! We want you to -.' Where is that written - we want you to do this with your kids, it's not there!

- the lack of physical space in traditional classrooms.

There was an interesting irony in Teacher B's final aside that her arguments were "all cop outs." Teacher C off-handedly offered his intention to make more use of ICT, particularly digital cameras, but vaguely qualified this as "I haven't done it yet," "it's in the back of my head," and "I should be using them." These self-deprecating comments lacked conviction particularly when compared with his strongly-worded complaint that the school did not have a scope and sequence document and that the state system had failed to provide him with clearly stated goals and directions. The literature on accommodation and assimilation includes the tenet that accommodation does not occur until all avenues of assimilation have been exhausted. The richness, range and vehemence of the defenses would seem to support the notion that these individuals may have been unconsciously looking for ways to assimilate the curricular use of

ICT in their classrooms. It is equally likely to be the manifestation (through rationalization, scapegoating and projection) of a psychological defense mechanism.

It would have been simple to dismiss Teachers A, B and C as the previously cited "middle-aged technophobes" (Maslen, 1995) and attribute their reluctance to their age but they seemed more unaware and unconcerned than showing any irrationality or fear. Any link to age was deemed to be coincidental (as in Oliver, 1994) and our own observations have shown that reluctance and age are not interdependent variables. Interestingly, none of the technophobic teachers used their age or impending retirement as an excuse for their lack of use of ICT in their classrooms. In fact, apart from the inconsequential defenses offered, no real excuse or apology was given as each maintained the illusion that they were meeting student needs and system demands. This is consonant with the view that there is an "insular culture of self-congratulation that attempts to reassure them [teachers] that they are competent and selfless professionals, that their social and institutional function is to develop the very best qualities in the children they serve" (Hodas, 1993, paragraph 36).

Rules

The "rules" in an activity system refer to the explicit and implicit regulations, norms and conventions that constrain its actions and interactions. In the cases presented in this paper, rules include those imposed by the state system (particularly regarding Internet use) and the school community (regarding computer access). Such rules serve to limit what have been described as the situationally constrained choices available to teachers (Cuban, 1986).

The "rules" seemingly of greatest concern to technophobic teachers were those relating to their own competence. The increasing systemic demand for certification of competence was perturbing to these teachers because it called their professional worth into question. For these

respected teachers, this was affronting. Because they did not believe that ICT was integral to education, the demand for compliance seemed unreasonable. This was a circular argument, which served to support the previously raised notion that they did not see that they had a problem or a disease that needed to be cured. It was the world that had gone mad and the system that had let them down.

Tools

"Tools" in an activity system are perceived as mediating between subjects and object. In the case of integration of ICT in the classroom, the tools are the technologies (ICT) through and with which students learn. Each of the technophobic teachers saw ICT as the object of study rather than as a tool supporting study of another object. When asked what the students were learning when they used the school's computers, Teacher B offered that "they're just learning how to manipulate text." Teacher C said that his students were learning "keyboarding." Teacher D, demonstrated a similar view of operational skill as pre-eminent over the cognitive demands of the task. In her students' building of the game board, there was a pre-occupation with the functions of the teacher-selected software application. The ICT was the object of activity rather than representing a process or mindtool (Jonassen, 1996). For Teacher B, the tool/object was quite specifically the functions within Microsoft Word. For Teacher D, the tool/object was the selection, arrangement and coloring of autoshapes in PowerPoint®.

The contention of teachers mistaking the tool as the object might help to explain the change in the behaviors and beliefs of teachers in the Cognitively Guided Instruction (CGI) project where, over a period of four years, teachers moved from "demonstrating procedures and telling children how to think to … [a practice] that stresses helping children develop their mathematical knowledge through creating learning environments, posing problems, questioning

children about their problem solutions and using children's thinking to guide instructional decisions" (Putnam & Borko, 2000, p. 7). The former is a tool and the latter is an object. To establish the distinction between them and to convert it into real practice took sustained effort over time (through workshops, mentoring, and opportunities for observation and reflection). This process and identification of distinction has patently not occurred spontaneously within the practice of the Teachers A, B and C, the three technophobic teachers discussed in this paper. Despite her use of ICT in the classroom, neither had this process been realised within Teacher D's practice as her classroom was also one in which the teacher talked and the students listened and the students emulated her actions. She was teaching new things in old ways perhaps replicating how she herself had been taught.

Community

The activity system "community" is made up of parents, students and systemic authorities who represent the implicit and explicit pressures to use ICT in teaching. Teacher B thought that the state system employer (through its mandatory teacher requirements) was saying "Give me the clouds. Obviously the department has to come up with an ideal. It's an ideal. It's not practical." It is significant that one of the technophobic teachers, Teacher C was in a school where truly transformative work was being conducted and yet he remained unaffected by this example. Teacher D was the exemplar in her school – she had no other models to follow and no one to act as peer mentor. It is a cautionary tale to remind us that what teachers see, from the isolation of their own classrooms, is different from what is seen by the outside observer. These instances represent the understanding that there is often a greater difference between classrooms than there is between schools.

Division of Labor

A "division of labor" can refer to both a horizontal division of tasks among the members of the community and a vertical division of power and status. It refers here to the roles and responsibilities of individuals within each school particularly in relation to ICT integration.

The technophobic teachers (Teachers A, B and C) had all taken advantage of others to meet system expectations without engaging personally with the technology. Teacher A was the most ingenious in that she set up student peer teaching routines to enable students to take part in a researcher-led telecommunications project. The students were unaware of her technophobia. Teacher B relied on a teaching partner and, as noted, Teacher C sent his students to a specialist class conducted by the school's teacher aide and system technician. Teacher C revealed only a passing understanding of what the students were experiencing in their specialist lessons, adding, as an afterthought the comment that "Oh they've actually started the Net down there with them." In each instance, the responsibility was 'othered' but students were not denied access to ICT thus reconfirming for these teachers that, despite their own beliefs, they were meeting systemic goals. Although their strategies ostensibly allowed these teachers to meet their responsibilities related to ICT, the model of ICT use presented to students was poor and the experiences were narrow and non-authentic. The students did not see their teachers engaging with technology and could therefore relegate it to the status of an optional or add-on activity. The distancing of the teacher and the ICT was obvious in Teacher C's inclusion of the terms "down there" and "with them" emphasizing both a physical and human distance.

In Teacher D's case, the division of labor was really one concerning the focus of leadership and decision-making in the classroom. The activity observed was patently teacher-led with the students allowed to make only superficial decisions about shape and colour selection.

Ertmer (2005) contended that low-level technology uses generally tend to be associated with teacher-centered practice while high-level uses tend to be associated with student-centered or constructivist practices. Following this, it could be argued that it was Teacher D's teaching practice itself, the "tool" of pedagogy rather than of operational skill or technological fluency that stood to prevent her making more meaningful use of ICT in her classroom. She was, in direct contrast to Teachers A, B and C, presenting a positive role model to students in her hands-on engagement with the technology and in devising activities for students that had a curricular and temporal link with other classroom activities.

Object

An "object" is the 'raw material' or 'problem space' at which the activity is directed and which is transformed into outcomes with the help of physical and symbolic, external and internal mediating tools. We concluded that the four teachers we were reviewing were unilaterally mistaking the tool for the object, thereby reducing the problem space to be the technology itself. This had the consequences of:

(a) leaving the "tools" component of the activity system effectively void, giving them no cognitive processes to meet changing system needs and downgrading the object to one of skill set attainment; and/or,

(b) misaligning the "object" so that there was a gap between what was being done and the achievement of broader educational goals or the "outcome."

This misapprehension is fundamental and critical and, we feel, lies at the heart of the issue of apparent teacher resistance and teacher under-use/misuse of technologies in the classroom. The collapsed tools-object entity is also self-fulfilling and does not foster the achievement of broader outcomes. With its identification in Teacher D's classroom, it would also

seem to mark a critical place between belief and practice, a gap between 'talking the talk' and 'walking the walk.' Despite Teacher D's heightened operational competence, confidence in classroom management and avowed adoption of ICT in her practice, there was still an emphasis on ICT as an object of study for its productivity potential rather than as cognitive tool with the potential to enhance learning across a wider sphere.

Outcome

Within the aggregated activity system of a school, the shared outcome is the achievement of learning and personal goals perhaps as specified in a school's mission statement or a student's individual education plan. Within a state or federal education system, the outcome is the broad achievement of prescribed benchmarks or the holistic achievement of a literate and informed society. In this review, the outcome is (a) intended, such as the demonstrated attainment of curricular objectives, and (b) unintended, as in the modeling of ICT as peripheral to learning and an object of study in its own right removed from other student activities.

When asked how she would like to see ICT used in her classroom, Teacher B candidly responded, "I honestly don't know. I don't know what would work. I really don't." Her school Principal's 1:1 skills sessions were not providing her with the technological pedagogical content knowledge she desperately needed. The interview with Teacher C was intriguing as he said that it represented the only real conversation he had ever had about the purpose of ICT in the classroom. Early in the interview, he had offered that the outcome was:

> Yes, yes well it's keyboarding. It would be good if we had a good program for keyboarding … and actually teach the kids how to type from Year 1. I could see that would be the most, or one of the most, important things that we could do. 'Cause otherwise they're just here henpecking, you know. It takes so much time but, yeah, they

> type, save to the group file and print if it's a program and that's basically it. It's not very elaborate but it's about all we've got time for.

For the technophobes, the outcome was simple. It was defined by their own limitations and restricted experience of computing. It was all about text – there were no images, no interactive simulations, no telecommunications, no information systems. The outcome was typing. The tool was typing. For Teacher D, the tool and object were similarly compacted. The geometry of the activity system had been altered and because of this, the outcome was constrained.

Conclusion

Together the components of an activity system form a dynamic of action achieved through their combinative interactions. In the cases presented in this paper, we have noted that activity systems become dysfunctional when components are misapprehended or poorly understood. Being unable to progress or change may have more to do with a problem of perception of roles rather than technophobia or other neurotic reactions.

What we observed as common to the four teachers was that they appeared to make the fundamental error of confusing the tool with the object. Each thought that what they were doing (or having done on their behalf) was teaching the students how to use a computer. This sentence ends too soon. By this we mean that they needed to go on to say that they "were teaching the students to use a computer to achieve specific desired learning outcomes." For the technophobes, the computer, because of their own limited experience and narrow perceptions, became a typewriter and an end rather than a means to an end. For the teacher said to be exemplary, learning to use a computer was predominantly about operational rather than cognitive processes. An allusion to Maslow's hammer and nail analogy comes to mind. If a computer is seen to be only a productivity tool, then this constrains and contains how it is used in a classroom.

Guskey (1986) argued that belief follows behavior. But the problem for these technophobic teachers was that because the behavior was at such a low level and their own immersion was at best peripheral, there was little ground for belief, particularly in the transformative power of ICT. As a corollary to the Guskey tenet, there was little chance of a change in belief when the teachers had not incorporated ICT into their own lives or set of social practices. There was arguably no pedagogical use of ICT in the technophobes' classrooms because there was no belief, and there was no belief because there was no (worthwhile) use. Teacher D was seen in a transitional stage where behavior had superficially changed but perhaps beliefs had not. It could be conjectured that the generative and interdependent nature of this process would see a resolution of this over time.

One of the characteristics of the effective or expert use of tools is transparency, that quality that allows the user to concentrate on the task rather than the tool itself. Familiarity breeds fluency and, with this, a change of focus becomes possible. A reverse geometry is effected in that something that begins as an object when it is new and unfamiliar can be morphed into a tool as its familiarity makes it virtually invisible. Relating this to ICT use in the classroom, Ertmer (2005) suggested that the predominance of low-level uses may be due simply to the fact that low-level use precedes high-level use and that not enough time has passed for high-level uses to emerge, and similarly, insufficient time has passed for teaching approaches to change. Teacher D was, as noted, said to be exemplary by (and in comparison to) her peers but still displayed shared mental models with the technophobic teachers described in this study. Perhaps her models will change over time – belief will follow practice – as she continues to use ICT with her students. Teachers A, B and C may not change as their beliefs are too entrenched and too closely aligned with their sense of personal worth and identity.

For the technophobic teachers, the mental model of ICT had fixed around a closed use rather than encompassing more transformative or authentic models. It was self-fulfilling and had its own inertia. It was founded in an older paradigm that described integration as being teaching about computing rather than teaching with or through or effecting any school change or reform. The computer was the object of instruction not merely the medium. Their mental models had closed on an understanding of computing as equating to business or productivity applications confined to typing and where the only input device was a keyboard. The tool had become the object, removing process from the activity system and thereby adversely affecting other possible interactions. The model had also closed on the technophobe teachers' concept of themselves and their unshaken belief in their dedication and service to their students.

What the technophobes were (or were not) doing makes perfect sense when you come to understand their worldview and see the angles from which they view their activity systems and when you understand their logical flaw in collapsing tool into object leaving them with few processes to enact change, and no clear view as to where they are heading. As digital immigrants rather than natives, ICT is an object of their personal learning, it may loom large enough in their vision to obscure the use of ICT as a tool for learning. This trick of perspective makes it easy for them to confuse the tool with the object in their classroom activity systems. The solution may be to shift their angle of view by offering them experiences that can provide new ground upon which to stand and from which the confusion of tool and object is less likely. Both the problem and its solution may be a matter of altered geometry.

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Table 1

Details of subjects

Identifier	Gender	School location	Level of Schooling Taught	Data Source
Teacher A	Female	Urban	Upper Primary (Year 7)	Lloyd & Yelland (2003)
Teacher B	Female	Regional Town	Early-Middle Years (Year 3-4)	Lloyd & McRobbie (2005)
Teacher C	Male	Rural Town	Early Years (Year 3)	Lloyd & McRobbie (2005)
Teacher D	Female	Metropolitan	Upper Primary (Year 6)	Field observation (August, 2005)