British Journal of Educational Technology *Vol 47 No 3 2016* 554–572
doi:10.1111/bjet.12454

Teachers pedagogical change framework: a diagnostic tool for changing teachers' uses of emerging technologies

Isabel Tarling and Dick Ng'ambi

Isabel Tarling is a researcher at the University of Cape Town's Educational Technology Inquiry Lab (ETILAB). Her research interest include individual and organisational change, educational technologies and teachers practices. Dick Ng'ambi is an associate professor at the School of Education, and a project director of the ETILAB. His research interest is in scaling innovative practices of teaching with emerging technologies for wider education impact. Address for correspondence to: Dick Ng'ambi, School of Education, Private bag X3, Rondebosch, Cape Town 7700, South Africa. Email: dick.ngambi@uct.ac.za

Abstract

One of the challenges facing education systems in general and the South African education system in particular is how to understand ways that teachers change from nonusers of technologies to becoming transformative teachers with technology. Despite numerous initiatives, not limited to training, workshops and so forth, to bring about sustained and wide-spread teacher change, transmission/delivery-based pedagogies and chalk-and-talk methods continue to dominate. While policy directives and professional development programmes aim to effect change in teachers' practice, they tend to fail to create sustainable change in teachers' practice of using emerging technologies (ETs). This paper reports on a study that sought to understand how teachers change their pedagogy of teaching with ETs. Using a Design-Based Research approach, the paper reports on the teachers' pedagogical change framework (Teaching Change Frame -TCF) as a diagnostic tool for locating and mapping how teachers' change. The TCF maps teachers' existing pedagogies and ET uses, and designs a pathway of a change process to effect the desired change. The TCF was tested and refined using data from 325 teachers drawn from rural, resource-constrained schools, urban, well-resourced schools and from preservice teaching students in a decontextualized environment. Following three iterations it was found that teachers' use of ETs in regulated, restrictive ways correlate with transmission pedagogies, unregulated, dispersed ways correlate with transformative pedagogies. The use of TCF not only located teaching pedagogies but also provide different pathways to ensure sustainable change. Findings emphasize the need for teachers to encourage learners to build/create/construct with ETs and for increased interaction in fostering nonregulated dispersed use of ETs.

Introduction

"In my school we have two computer labs. One has about 50 or 60 computers that all work but it is always locked. Nobody ever uses it. On the other side of the school is another computer lab from 'Group X' and they have people who come to work with the kids there every two weeks or so. The teachers send the kids there but they never use our own lab. They just refuse. I am always telling them, 'Come, let me show you how' but they just refuse. They don't want to." (Mrs K, a WCED Trainer attending our program)

Since the fall of apartheid in 1994 South African education has changed significantly to transform what was a fundamentally unequal system. One of the most irrepressible challenges to

Practitioner Notes

What we know

- Education systems in general and the South African system, in particular, are in crisis.
- The South African government has implemented the third curriculum reform in two decades and is directing the use of Emerging Technologies (ET) in schools to transform education in the country.
- Most teachers, trained in teacher-centric ways, make extensive use of transmissions pedagogies themselves.
- Though the ET landscape has changed significantly, there has been little growth in the pedagogical uses of ETs in schools in the past 10 years.
- The changes among teachers to teach with ET have been piecemeal and erratic, and there have been no frameworks to help understand how teachers change in this regard. The lack of a change framework means that while change can be recognized, and celebrated, it cannot be accelerated because it is not fully understood.

GAP

- How do teachers in diverse teaching contexts currently use ETs to support teaching and learning practices?
- What pedagogical assumptions inform different types of uses of ETs?
- How do teachers integrate ET in current pedagogies?
- How can current pedagogical approaches be understood so that potential change to uses of ETs in these practices can be explicit and deliberate?
- What this paper adds/contribution of this paper:
- The paper provides a framework for understanding how teachers change to embrace ETs in their teaching practices.
- It addresses the current gulf in literature on the general lack of empirical evidence that reports on how teachers' pedagogical uses of ETs shift across rural and urban, resource-rich or resource-constrained contexts.
- It provides a diagnosis of teachers' pedagogical approaches across varying South African education contexts.

Implications for practice

The Teaching Change Frame is developed as a diagnostic tool to analyze and describe teachers' existing uses of emerging technologies and the underlying pedagogical orientations. The paper argues that pedagogical orientations influence how educators use ETs for teaching and learning. It therefore follows that diagnosing educators' pedagogical orientation is a critical first step in identifying the required change, designing change drivers, and developing appropriate scaffolding of critical self-reflection and creative thinking skills needed for seamless integration of emerging technologies in teaching practice. This is particularly relevant to the ongoing vocational education of teachers, of teacher trainers and preparation of pre-service teaching students toward transforming education.

education reform has been changing teachers' traditional pedagogic practices to those required for teaching and learning in the 21st century. This led to an increased misalignment between the acquired skills of school-leavers and graduates from institutions of higher learning, and those required by employers. Needless to say, the skills required for employment are changing rapidly while teaching approaches continue to be rooted in 20th Century pedagogies. Coupled with such complex factors as low teacher content knowledge, poor retention rates and subject choices, unequal educational opportunities and insurmountable learning deficits, among a variety of complex factors, leads Spaull (2013) to classify South Africa as having "*the worst education system*"(Spaull, 2013, p. 3) compared with similar education systems of middle-income countries. This was reiterated by national minister of education, Angie Motshekga, when discussing the Matric (final grade) results from 2015. She stated that the continued underachievement of learners is a "*national catastrophe*," adding:

"If one learner fails, that's a challenge. If two fail, that's a problem. But if 25% of a cohort fails, then we must have sleepless nights, as this is akin to a national crisis." (Motshekga in Masondo, 2016*)*

Various measures aim to address this, among which is an increase in the provision of emerging technologies (ETs) including Wi-Fi in schools, policy requirements and training workshops from the national Department of Education (DoE) and provincial departments such as those in the Western Cape and Gauteng. Given the compelling and salient pressure to bring about change, reform efforts in many instances focus on teaching, teacher preparation and teacher training as "*the single most important element of the education system*" (Spaull, 2013, p. 24). While addressing such factors as poorly qualified teachers with low content knowledge, education policies also advocate change across the system, requiring all educators to change and adapt or innovate pedagogical practices that integrate ETs into classroom practice. Training and upskilling/re-qualifying initiatives and professional development programmes support such solutions, and focus among other on curriculum implementation, policy enactment and the integration of ETs to affect change in classrooms. Despite these, teaching practices remain largely unchanged. As in Mrs K's example above, many teachers remain hesitant to use ETs in their pedagogical practices instead preferring "proven" practices even though these consistently reproduce poor learner results and in many instances alienate students from learning.

Although change to teaching and learning is slowly occurring, these changes remain localized to pockets of individual innovators and change drivers (Naidoo & Muthukrishna 2014; Ngassam, Ntawanga, & Eloff, 2013; Spaull, 2013; Vandeyar, 2014). Those individuals who are change drivers, such as Mrs K, often fulfil a guiding informal leadership role (Jameson, 2006; Ng'ambi & Bozalek, 2013), operating in challenging educational contexts sometimes across vast geographic areas, and are frequently dependent on contextual factors and intrinsic motivation to inspire change (Hargreaves, 2009; Jameson, 2006). Commonly located in positions of little authority, they face isolation, animosity from teachers deflecting their frustrations (with ETs for instance) onto them (Ng'ambi & Bozalek, 2013). As in Mrs K's example, they tend to emotionally support their colleagues' change efforts without themselves receiving similar support, and risk burnout as a result. This is compounded by intensified external pressure, both implicitly and explicitly, for schools to change in light of the increased availability of ETs in and outside of school and shrewd marketing campaigns that drive hype-cycles[1] to use ET tools (despite a lack of proven educational value). Whereas anecdotal evidence suggests that in some schools teachers are changing and continuously responding to these pressures, making adjustments, shifting their pedagogies to align curricula, pedagogy, learner needs and ubiquitous technologies, many are not.

Amidst this complexity very little is understood about *how* or *why* some teachers choose to change and others refrain from this. Change, whether internally or externally mandated, is rarely

easy and many find it difficult to change unthought-of practices, beliefs and assumptions, reverting to "*the way things were*" despite their best intentions. We contend that understanding *how* educators change is critical if change is to be sustained. Such an understanding of change will enable more purposeful and effective designs of change policies, programmes and processes, and could profoundly impact the acceleration and spread of system-wide change efforts. By addressing this knowledge gap, we aim to assist teachers and teacher-trainers/practitioners, and pre-service teaching students in formal academic and vocational higher education, in understanding ways of changing internal pedagogical orientations or dispositions that inform (external) practices.

Diagnosing teachers' existing pedagogical practices and orientations within situated contexts, guided by their agendas and priorities, is a critical first step toward changing this. The framework proposed in this paper is both a diagnostic and change design tool, premised on practical activities intended to change teachers' pedagogic orientations. Our assumption is that once change is effected to dispositions, the integration of ETs into practices become relatively easier to achieve. Bourdieu's (1990, 1977, 2000) thinking tools help us to understand how change to core dispositions can inform change to pedagogical practices and beliefs, to potentially (externally) change how things are done. Thus, the development of a teaching change frame as a diagnostic tool sets out by plotting teachers' existing practices and maps these against their pedagogic orientations (dispositions). Using the Teaching Change Frame (TCF), we locate teachers in quadrants reflecting their general pedagogic approach and their appropriation of ET tools in teaching and learning. We also elaborate ways in which the framework may inform understanding of changes to teachers' existing pedagogical approaches and how this could impact on their appropriation of ETs in teaching and learning practices.

Transforming education in South Africa: setting the context

Learner achievement is critically affected by factors involving the school, classroom and home background (Hoadley, 2012). By implication, these same factors affect teachers' practices and achievements including other pressures not limited to curricula, throughput and performance ratings. South Africa's education landscape is one of dramatic diversity and egregious inequality: while some schools lack such basic necessities as running water, flushing toilets or electricity, others are exceptionally well-resourced. These factors may affect both learners and teachers' practices and achievements. Learner-to-teacher ratios, eg., differ substantially across contexts: 55–60 learners or multi-grade classes in one classroom are the norm in many schools compared to resource-rich schools with 15–20 learners per class. These diverse contexts not only influence teachers' pedagogical choices but how they are able to appropriate ETs in their teaching and learning. It may also impact the focus of what needs to change and how change should occur, foregrounding the need for an empathetic, personalized approach and to desist from one-size-fits-all-with-technology approaches. However, as the New Media Consortium Horizon report notes, widespread, sustained teacher change is a 'wicked problem', being most difficult to solve and "*complex to define, . . .* [requiring] *additional data and insights before solutions will be possible*" (Johnson *et al.*, 2015, p. 20).

Attempting to bring about large-scale systemic and organizational transformation, the provincial Western Cape Education Department (WCED) in South Africa, launched an e-Learning and Smart-Schools Strategy (2015) aimed at providing Internet connectivity to schools across the province. At the University of Cape Town (UCT), the Educational Technology Inquiry Lab (ETI-LAB^2) is engaged in ongoing "ICT Integration Sandpit Sessions" for teachers, subject advisors and teacher-trainers in the province. Nationally the Department of Basic Education (DBE) implemented various policy-led initiatives to target classroom practice and increase curriculum coverage and pacing (Hoadley, 2012). The Curriculum and Assessment Policy Statement (CAPS)

was the third major curriculum overhaul in a series of curriculum changes. This national curriculum and assessment policy statement serves as:

> . . .a single, comprehensive, and concise policy document, which has replaced the Subject and Learning Area Statements, Learning Programme Guidelines and the Subject Assessment Guidelines for all the subjects listed in the National Curriculum Statement Grades R-12. (Department of Basic Education, 2012)

CAPS aims to standardizes the content delivered throughout South African schools while the Annual National Assessments (ANAs) measure performance across schools and increases the urgency and pace of coverage. The DBE Action Plan for 2019 prioritizes the provision of ETs to improve, diversify and individualize learning, and encourage innovation (DBE, 2015, p. 18).

CAPS mandates teachers to move beyond transmission-based pedagogies characterized by rote-learning and drill-and-practice activities, toward learner-centric pedagogies that develop higher-order cognitive skills such as identifying and solving problems using critical and creative thinking (1.3.d. General aims of SA curriculum). It also encourages the use of formal and informal testing. Although these pedagogical aims are foregrounded, the document does not prescribe *how* teachers should affect change or adapt existing pedagogical practices. It also does not provide pedagogical guidance for the integration of ETs into teaching and learning, nor consider the appropriation of ETs for assessment purposes. It appears to assume that if teachers are exposed to ETs, they will innovate appropriate pedagogies (Gundy & Berger, 2016) to use ETs in their teaching and learning (and that assessments would be done using pen-and-paper methods). Ironically, while the DBE Action Plan laments the lack of wide-spread changes in teachers' pedagogies and the limited access to ETs among learners (DBE, 2015) it too is mute on addressing change processes and fails explicitly to support pedagogical innovation.

To address this vacuum, a three-step process is suggested: (a) identify teachers' existing pedagogical practices; (b) understand how ETs are currently used in schools; and (c) develop a framework to map and shift existing practices toward transformative pedagogies where ETs are seamlessly integrated.

Theoretical underpinning

Traditionally teachers' professional development initiatives or training programmes provide rational arguments to convince participants of the need to change beliefs and activities, and introduce and/or reinforce alternate methods or skills. Such a framework does not necessarily affect change to core dispositions but is premised on the assumption that if someone sees the need to change and has the tools to change, they will make the change. Once training sessions conclude, anecdotal evidence suggests participants return to "*the way things were*"; like a stretched rubber band returns to its shape after stretching. Bourdieu refers to this as an effect of hysteresis, where the primary conditioning of core dispositions remain more durable than the intended change. He uses this to explain why, despite an individual seeing the need to change, wanting to change, or seeing themselves 'left high and dry' by changing circumstances, they may be unable to effect change (Bourdieu, 1990). In order to address this, one would need to target and effect change to the structuring dispositions of the habitus which suggests a long-term, deliberately designed process.

Changing the pedagogical practices of teachers from transmission to transformative, and from low/no use of ETs to full integration, is not as straightforward as it may appear. As we have argued, the change from a transmission to a transformative pedagogical orientation requires fundamentally altering the role of the teacher in the learning process: changing from the sage-on-the-stage to that of a guide-on-the-side. This role change inherently affects teachers' identity, their position of authority and their perceived levels of control over the learning process. This

change cannot be assumed or taken-for-granted, but needs to be carefully understood and deliberately and empathetically designed. A socio-cultural lens is "*particularly powerful*" to research the introduction of ETs and innovations that accompany this (Somekh, 2007, p. 2). It provides a frame for analysis and interpretation with which to "*go beyond the individual agent when trying to understand the forces that shape human action*" and explicate relationships between "*action, including mental action, and the cultural, institutional, and historical contexts in which these occur*" (Wertsch, 1998, p. 24; see also Somekh, 2007). Bourdieu's work, in particular, breaks with dichotomous notions of theory and practice. Instead, he argues that practical sense and scientific explanation form different aspects of human endeavour (Bourdieu, 2000, 1990; Wacquant & Deyanov, 2002). This argument supports how descriptions of classroom practice are understood and analyzed, and how change to this is conceptualized in this study.

Teaching and learning in South African schools

Classroom practices are part of much greater historic, economic and socio-cultural factors that influence and are in turn influenced by the activities in the classroom. Christie (1998) reminds us that educators operate within social discourses, power relations and informal logics that form the complex texture of schools. Hoadley's (2012) meta-analysis of research in South African primary schools foregrounds the prevalence of transmission-based pedagogies and the dominance of oral discourse, with teachers emphasizing behaviorist practices such as chorusing oral drill sequences or whole-class reading of fragmented sentences or texts from the board. In many instances, the language of teaching and learning differs from learners' home language(s); thus while learning an entirely new language in which to study, learners receive very limited feedback from teachers who focus instead on assessment and on the group rather than the individual. While very few learners access and/or use textbooks or bounded texts individually, fewer still are given the opportunity to move beyond basic literacy in terms of technical decoding of single texts to unpack and synthesize broader concepts towards individual meaning making. Teachers also tend to pitch texts or cognitive tasks well below the standard expected. This results in "*a very low level of cognitive demand in classrooms*," coupled with a slow pace of curriculum coverage and severely eroded instructional time (Hoadley, 2012, p. 196).

Addressing such pedagogical limitations, CAPS encourages problem-solving and critical and creative thinking, including collecting, analyzing, organizing and critically evaluating information and effectively communicating this in various modes (CAPS forward, 1.3.d General Aims). It further promotes evaluation and assessment according to lower, middle and higher order cognitive thinking skills. Although not directly referenced, for the majority of school subjects these cognitive skills refer in language arts to Barrett's 1968 taxonomy (Barrett, 1968) and more generally to Bloom's taxonomy (1956): see Figure 1.

"Knowing" and "comprehending" as lower order knowledge orientations in CAPS corresponds to "remembering" and "understanding" in Bloom's. This includes rote learning, chorusing and drill-and-practice, which Bloom describes as Lower Order Thinking Skills (LOTS) as these emphasize retaining static knowledge. In contrast, pedagogical practices that favor critical thinking skills and problem-solving is encouraged by CAPS and correlates to Bloom's Higher Order Thinking Skills (HOTS). Ideally HOTS actively involves the learner in creating, evaluating and analyzing knowledge. This supports constructivist pedagogies where learning is understood as a creative, active, social experience that leads to meaning making and the construction of different kinds of knowledge (Ng'ambi & Lombe, 2012).

Using Bloom's Revised Taxonomy (Churches, 2008), we mapped teachers' pedagogic approaches on a continuum (see Figure 2. Transmission-based pedagogies focus on the transfer of information from educators to learners, what Freire terms the "banking method" (Freire, 1970).

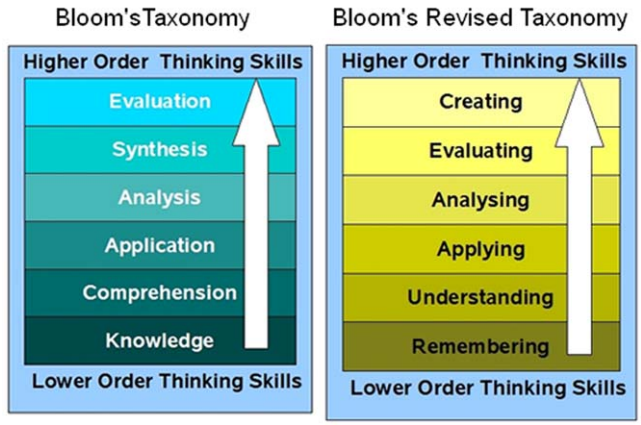

Figure 1: Bloom's Original Taxonomy (left) and Revised Digital Taxonomy (right)—Drawing by a Churches (2008)

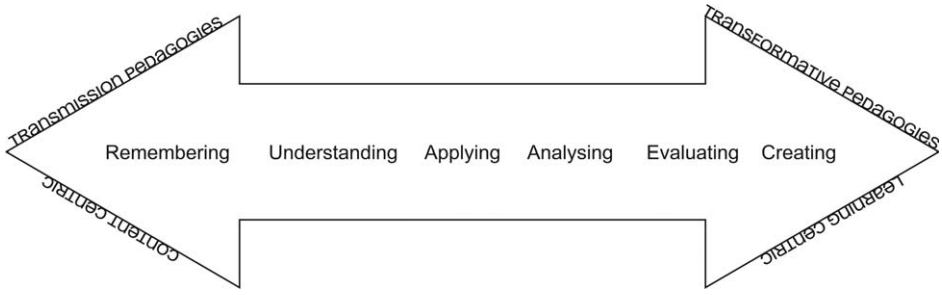

Figure 2: Continuum of Pedagogic Approaches using Bloom's Revised Digital Taxonomy

Information is seen as discreet or limited elements, bits of content that can be remembered and reproduced parrot-fashion, and relationships identified between these. Information or content-centred transmission pedagogies focus on LOTS: remembering, understanding and applying. These are located towards the left of the continuum as supporting "Information Centric" approaches where the teacher's role is that of "sage-on-the-stage," controlling the pace and content to be disseminated and testing the retention of the valued information. This type of pedagogy supports the need for productive manual workers who, Drucker (1999, 2001) notes, could successfully operate production equipment.

The economy and society of the 21st century, however, is based on knowledge, the production of knowledge work and knowledge workers. Knowledge, Drucker (Drucker, 2011, p. 242) notes, "*is information that changes something or somebody – either by becoming grounds for action or by making an individual (or an institution) capable of different and more effective action.*" Pedagogies that conceptualize knowledge in this way orientate learning to be generative and transformative. As a catalyst for change, it leads to action or makes the learner capable of different or more effective action (Drucker, 2001, p. 2). Such transformative pedagogies actively include the learner or student in the analysis, evaluation and creation of knowledge through action, encouraging life-wide and life-long authentic learning. The role of the teacher becomes that of knowledgeable guide-on-the-side who guides students as they learn ***how*** to interact and work with knowledge. These

dynamic, generative pedagogies are thus considered to be "Learning or Knowledge Centric," incorporating HOTS and located towards the right of the continuum.

While this continuum may appear to imply determinism in the sense that transformative pedagogies capture the epitome of learning, while transmission pedagogies fail to achieve this, ie, not our intent. It would be irresponsible to discard such vital skills as remembering and understanding of established knowledge. In keeping with Bloom's original intent, this continuum "*represents the process of learning*" and while learning may start at any point, analysis, for instance, typically requires prior elements and stages, such as understanding and applying (Churches, 2008, p. 5). The continuum represents various pedagogies that can and should be used in different contexts to achieve deep and meaningful learning.

This continuum forms the first part of the diagnostic tool with which to diagnose a teachers' pedagogic practices. A second layer of diagnosis seeks to understand teachers' varying use of ETs for teaching and learning.

The appropriation of emerging technologies in schools

It can safely be said that learners and students no longer learn in the same way their educators did when they attended schools and tertiary institutions (Ng'ambi, 2013). Whether this applies to desktop computers, tablets or mobile phones, uses of ETs have impacted education and will continue to do so. The ubiquitous availability of ETs, the integration of technology into teacher education and increasing use of Bring-Your-Own-Device (BYOD) approaches in schools (Johnson *et al.*, 2015) are transforming not only how and when learners and teachers engage with knowledge, each other, leaders, and others, but also how they learn, their performance and achievement.

Notwithstanding the affordances offered by ETs, when these are initially introduced in classes, they are often treated as an "add-on" or tool to support "*the way students learn from classroom teachers*" (Wang *et al.*, 2014, p. 101) rather than a tool to "*learn with*" (Salomon, Perkins & Globerson, 1991). Learning *from* technology perpetuates transmission, through information-centred pedagogies. In contrast, users *learning with* ETs exploit the affordances thereof to access and engage with distributed intelligence and expertise (Ng'ambi, 2013), hence, transforming learning experiences beyond the limitation of a single teacher, book or curriculum. This learner-centric approach, if suitably designed, has potential to actively engage learners in constructing, creating and evaluating knowledge using Bloom's HOTS. It further incorporates the development of new literacy skills beyond basic abilities with ETs: to identify and locate information and evaluate and synthesize this "*to answer, question and communicate the answers to others*" (Wang *et al.*, 2014, p. 103). This does however not exalt technology as the silver bullet but instead harnesses the potential of technology to "*redefine and enhance performance as students work in partnership. . .* ***with*** *a technology*," that equips them with thinking skills and strategies to "*reorganize and enhance their performance even away from the technology*" (Salomon *et al.*, 1991, p. 8; original emphasis).

Various frameworks have been developed as diagnostic tools to describe how teachers use ETs, with Gundy and Berger noting that at least 50 models are available (Gundy & Berger, 2016). One of these, Kuehler and Mishra's TPACK, suggests that integrating ETs into teaching practices requires technological skill and content knowledge (TCK), pedagogical knowledge to teach with technologies (TPK) and pedagogical content knowledge (PCK) to teach specific content regardless of the tool being used (Harris, Mishra, & Koehler, 2009a,b; Koehler *et al.*, 2011). Although this is not made explicit, the technological knowledge referred to in TPACK is not about computer skills but a high awareness of the affordances (Bower, 2008) of emerging technology tools for learning. It refers to knowledge about the affordances of ETs that impacts teachers' existing priorities and agendas, their concerns, motivations and incentives for use. In Anderson's (2003) seminal work

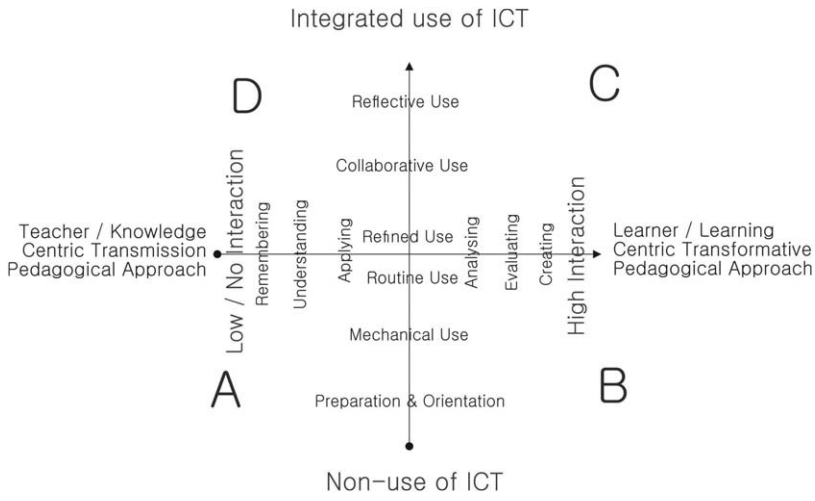

Figure 3: The first Teaching Change Frame

on the six types of interactions in education (student–student; student–teacher, student–content, teacher–teacher, teacher–content and content–content), he argues that deep and meaningful learning increases when a learning activity fosters an increased level of any one of the six interactions. It follows that ETs may be used to achieve deep and meaningful learning experiences if the affordances of a task are aligned with the affordances of the chosen technological tool (Anderson, 2003; Bower, 2008). It can thus be inferred from this argument that mapping different technology-mediated interactions using Anderson's Model (2003) on one hand, and, on the other tracing pedagogical goals according to Bloom's Digital Taxonomy (Churches, 2008) on the continuum (transmission to transformative), provides a useful diagnostic framework. The challenge with this approach is that it is difficult to capture teachers' existing pedagogies, their use of ETs, or how to affect change to these. The Concerns-Based Adoption Model (CBAM) (Gundy & Berger, 2016; Hord *et al.*, 1987) offers an alternative as a means to improve on this limitation.

The Concerns-Based Adoption Model (CBAM) gauges the level of ET use and maps the change process when an innovation is introduced. Although this work is pre-internet, it remains relevant as its seven stages of concern capture the interaction of individuals with innovations and maps different levels of use (Gundy & Berger, 2016; Hord *et al.*, 1987). The levels of use of an innovation can be used as a diagnostic tool to gauge not only teachers' adoption and integration, but also their progress in changing their practices (Hord *et al.*, 1987, p. 7). We mapped these levels of use onto the Continuum of Pedagogic Approaches, to create the first Teacher Change Frame (see Figure 3). However, while this frame depicts teacher-centric practices in quadrants A to D, it does not effectively represent transformative learner-centric practices using ETs, which theoretically could be located in quadrant C (integrated use of ICT; learner/learning centric, transformative approaches).

The Western Australian Department of Education and Training's Self-Evaluation Guide (2003), in contrast, describes different phases of transformative pedagogies that teachers employ when integrating ETs. However, while the Self-Evaluation Guide expands the levels of ET integration in terms of transformative pedagogies, it does not effectively account for teachers' use of ETs in non-transformative ways. Mindful of the dangers of technological determinism, ETs can play a useful catalytic role in transformative pedagogies, as much as they can also be used to support transmission pedagogies. Notwithstanding the role of ET, both transformative and transmission

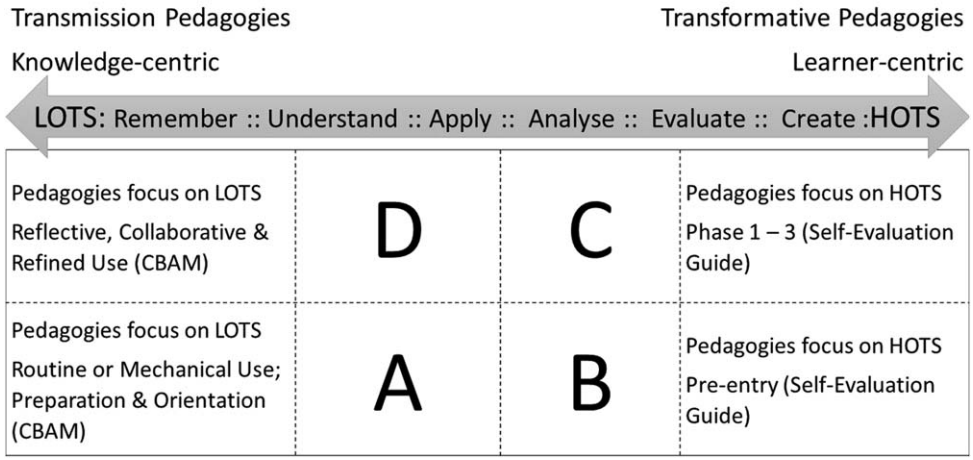

Figure 4: Teaching Change Frame (Theory driven)

pedagogies might take place without a catalyst. We argue that a teacher change framework should account for all such possibilities in order to diagnose existing practices and design for change. It was this quest for a comprehensive framework that led to a further revision of the framework.

Mapping teachers' use of emerging technology tools

Combining the strengths of the CBAM, the Self-Evaluation Guide and Bloom's Digital Taxonomy, the revised Teaching Change Frame (see Figure 4) is proposed. The framework has permeable borders, illustrating a less rigid, more fluid model. The CBAM's transmission/information-centric approach correlated with the left of the continuum, and the Self-Evaluation Guide aligns with transformative, learner-centric approaches on the right of the continuum.

At a theoretical level we described the potential uses and pedagogic practices of teachers in each quadrant:

- Teachers in Quadrant A either avoid or make very limited use of ETs. They focus on LOTS and learners engage in pen-and-paper activities, worksheet completion, copying off the board and writing in notebooks. Interaction is mostly between teacher and learner, or learner and content, regulated by the teacher.
- While teachers in Quadrant B employ learner-centric transformative pedagogies and focus on HOTS, they make little use of ETs, relying instead on pen-and-paper. They deliberately foster interaction.
- Teachers in Quadrant C employ transformative pedagogies that focus on developing HOTS and integrate ETs into learning activities that require students' active engagement in knowledge production. They foster high levels of interaction.
- Teachers in Quadrant D display far greater use of ET than teachers in Quadrant A. Teachers in this quadrant see ETs as an extension of teacher-centric transmission practices and as a tool to learn from. Interaction is mostly between teacher and learner, or learner and content.

Having developed in theory a diagnostic tool, we incorporate this into a theoretical understanding of change.

Understanding change

Using the Teaching Change Frame (TCF) developed above, one can map the movement teachers would need to make toward changing either or both their pedagogic orientation and/or their degree and type of ET use. Teachers in Quadrants A and D need to change deeply ingrained transmission pedagogies, while those in Quadrants A and B need to adopt ETs and integrate these into classroom practice. This necessitates change to often unthought-of perceptions, practices or beliefs about teaching. Bourdieu (1990) describes such perceptions, practices and beliefs as dispositions of the habitus, structures that function below the level of consciousness and that structure how individuals view the social world and, in turn, use these dispositions to structure the world they live in. Dispositions are formed in childhood and "*treat the body as a living memory pad. . . and as a repository for the most precious values*" (Bourdieu, 1990, p. 68). Early childhood experiences act as the primary conditioning of the habitus. Primary conditions create structures in the individual, which we term ***core dispositions***. Core dispositions are the structuring structures of the habitus and shape how perceptions, beliefs and embodied actions are formed. Unthought-of perceptions and embodied actions of the habitus are guided by *core dispositions* that function below the level of consciousness to structure practices, perceptions and actions. The influence of the primary conditioning the form of core dispositions is most durable, transposable to different contexts and resistant to change (Bourdieu, 1990), and affecting change to this is critical if change is to become sustained and self-perpetuating.

Methodology

The development of the Teaching Change Frame (TCF) formed part of a larger teacher change study following a Design-Based Research (DBR) approach (Amiell & Reeves, 2008; Reeves & Reeves, 2015; Reeves *et al*., 2011). DBR was chosen as it allows researchers and practitioners to work together and to collaboratively to identify, analyze and clarify practical problems, and develop potential solutions informed by existing theory, solutions or technological innovations. Solutions are tested, refined and retested through iterative cycles to find optimal solutions and, lastly, to identify design principles that may enhance future study and implementation. DBR aligns well with Bourdieu's fundamental assertion that practice and theory cannot stand alone as antithetical poles but are different aspects of human behaviour (Bourdieu, 1990, 2000)

Framed by DBR, the Teaching Change Frame (TCF) as a diagnostic tool was developed and tested.

Phase 1: Developing the teaching change frame

In the first part of the DBR process, the research team based at the University of Cape Town's Educational Technologies Inquiry Lab (ETILAB) worked closely with teachers who had approached the ETILAB to help them integrate ETs into their classroom practices. Three separate sandpit sessions with between 10 and 15 teachers in each were held in the ETILAB on three Fridays in May and June 2015. Ten (10) Grade 8–12 teachers from the same Cape Town High School came the first Friday and (9) Grade 10–12 teachers from the same school the next Friday. In June a mixed group of 11 (eleven) Gr 8–12 teachers from different high schools joined the sandpit session. This allowed the researchers and practitioners to collaboratively identify, analyze and clarify the practical everyday problems they experience with/without ETs. Informed by literature and framed by Bourdieu's thinking tools, the TCF was developed and refined as a diagnostic tool (as discussed above).

Phase 2: Testing the teaching change frame

Following the iterative nature of the DBR process and to establish the validity of the TCF as a diagnostic tool, it was tested and refined with vastly different participants in three varying

Table 1: Comparison between participant groups

	Group 1: 97 participants	*Group 2: 55 participants*	*Group 3: 173 participants*
Description	Experienced & Novice Teachers	Experienced & Novice Teachers	Education students (some with teaching experience)
Average age	38.6 years	41.5 years	25.3 years
Average years' experience	17.8 years	15 years	Generally none, although some had worked in schools before
Context	Resource-deprived rural schools	Resource-rich urban schools	Decontextualized (without limits)

contexts: under-resourced rural schools, resource-rich urban schools, and with decontextualized pre-service teaching students. The TCF had to:

a. Diagnose the pedagogical approaches of teachers across a range of contexts; and
b. Diagnose how teachers appropriate the affordances of various ET tools in their classroom practices.

Participants & contexts:
The TCF was tested with three groups of experienced and novice educators in diverse contexts as indicated in the accompanying table (see Table 1).

Group 1: resource-deprived rural schools
The ETILAB conducted a baseline assessment of rural Western Cape schools as part of a larger longitudinal study that would empower and upskill Grade 7–9 teachers to integrate ETs in Mathematics, Science and Language teaching. All but one teacher indicated that they had limited access to the internet when outside of school either on their smartphones, laptops or tablets. The group had almost even amounts of experienced (20 years+) and novice (less than 4 years) teachers, of which the majority were 45 years and older, indicating a high degree of sustainability. (The baseline also surveyed the school management teams at each school and a total of 2022 Grade 7–9 learners for triangulation of data.)

Group 2: resource-rich urban schools
A group of private, resource-rich schools in Cape Town initiated a Bring-Your-Own-Device/Tablet (BYOD/T) year of discovery to encourage ET integration into Grade 7–9 classroom practice. Teachers attended professional development and teacher training sessions and were given the freedom to "discover" and innovate pedagogies that integrate ETs. The ETILAB was commissioned to evaluate the effectiveness of BYOD/T at the school.

The teachers in the Gr 7–9 section had all been given their own tablets and laptops from the school, had interactive whiteboards in their classrooms, extensive broadband coverage and worked in the cloud as part of the Google Schools project.

Apart from using ETs to complete schoolwork, teachers typically went online to access "*social media, send emails, look for resources, watch movies and series and listen to music*" (CT34). Only one teacher in the group did not access the internet outside of school. The number of experienced teachers was more than double that of novice teachers, indicating a potentially low-degree of sustainability when experienced teachers retire or leave. (In total 55 teachers and 199 Grade 7–9 learners participated in the survey and the school management teams at each of the campuses were interviewed for triangulation purposes.)

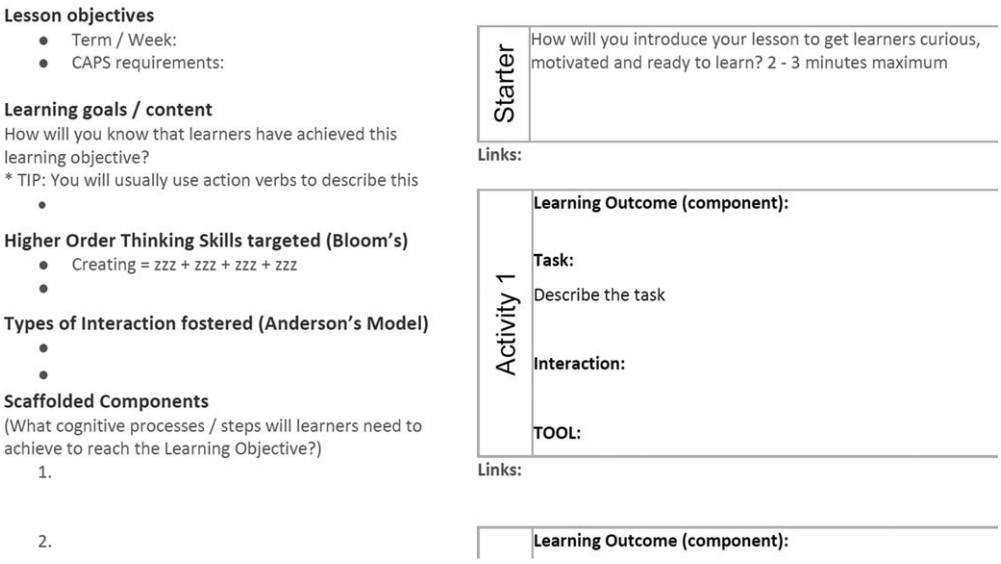

Figure 5: Learning design template

Group 3: decontextualized (without limits)

The researchers lectured approximately 180 education students who already held qualifications and/or were in professional fields but wanted to qualify as teachers. Students participated in a teaching practice session prior to the lecture series, in a range of Western and Eastern Cape schools.

In general, the greater majority of teaching students rated their self-efficacy as either experts or very confident users of, among other software, ICT systems and tools, Word Processors, Social Media and Short Messaging Tools, PowerPoint and Prezi. The majority displayed positive beliefs about the use of ETs in teaching. All students had ubiquitous access to the internet while on campus, although 11% reported no or rare access to the internet when off campus. Despite reporting high personal use and predominantly positive views of ETs, they made limited use of ET tools in their teaching (mostly showing YouTube videos at the start of their lessons or doing PowerPoint/Prezi presentations) and did not transfer personal "expertise" to the classroom. From the 180, 22 students felt it was either too difficult to teach with ETs or felt scared to use ETs in classrooms (age range of these 22 students: 21–33 years, average 24 years).

The transformative pedagogic approach was modeled: the flipped-classroom model was introduced and interaction deliberately fostered online 10 days prior to the first lecture. In class, students analyzed Anderson's Model and Bloom's revised Digital Taxonomy, having already read content about this, and evaluated the potential affordances of some ET tools (based on Bower's Affordance Analysis). As an assignment, they designed a lesson using the ETILAB Learning Design Template (*see* Figure 5) following this framework, to teach in the following term's practice teaching session.

Data collection

Data to test the TCF was collected by means of a survey that captured demographic information, data regarding participants' school and private use of ETs, their beliefs and perceptions regarding the role of ETs in teaching and learning as well as their perceived self-efficacy levels. The researchers further requested that participants report on their classroom practices with ETs including the

Table 2: Teachers' self-reported Pedagogical Orientation and use of ETs

Pedagogic orientation & ET Use	*Quadrant A*	*Quadrant B*	*Quadrant C*	*Quadrant D*
Group 1: Resource-deprived rural schools *97 teachers*	48%	13%	3%	36%
Group 2: Resource-rich urban schools *55 teachers*	47%	29%	2%	22%
Group 3: Decontextualized (without limits) *173 Education Students (survey responses **before** using ETILAB learning design framework)*	25%	71%	2%	2%
Group 3: Decontextualized (without limits) *173 Education Students (survey responses **after** using ETILAB learning design framework)*	7%	7%	58%	28%

frequency and degree of use. Teachers from Groups 1 and 2 were asked to include a description of how, in an ideal situation, they might integrate ETs into classroom practice. Group 3 education students submitted a detailed learning design (see Figure 5) set in a decontextualized "Smart Classroom" with full internet connectivity and tablets for each learner (such as those provided by the WCED in schools).

The DBR process fundamentally supports practitioner participation in the research process, thus validating the use of a self-reported survey tool.

Analysis of results

Retrospective Data Analysis was used to analyze the full range of evidence and document the evolution of the TCF design and rationale, and the iterative testing and refining cycles. Critical moves that took place in this process were identified as the development of the Continuum of Pedagogic Approaches using Bloom's Revised Taxonomy (see Figure 2) and mapping this onto the CBAM in the First TCF (see Figure 3). Piloting this with the three groups of teachers at the ETILAB was critical in identifying the limitations of other frameworks, including the CBAM and the Self-Evaluation Guide. Driven by theory and participants' contributions, the next critical move was the development of the Teaching Change Frame (see Figure 4) that we set out to test with Groups 1–3.

The data collected from experienced, novice and pre-service teachers' survey responses and lesson designs was analyzed to identify emerging themes. Since this type of content analysis is typically theory-driven, data was analyzed using Bloom's Revised Taxonomy and Anderson's Interaction Model, establishing teachers' degree and type of ET use according to the TCF. The data analysis placed teachers in Quadrants A-D of the TCF according to their predominant pedagogic approach and type of ET use. (Table 2)

This pointed to a relatively low use of ETs in classrooms, despite these being available to teachers in both urban and rural schools (Quadrant A & B). Rural teachers make higher use of ETs in classrooms using transmission pedagogies, while urban teachers made significantly higher use of transformative learner-centric pedagogies, but appear to use ETs less. This suggests that the majority of rural teachers would need to change their pedagogic dispositions and employ more transformative approaches to be located in Quadrant C. On the other hand, many of the urban teachers and education students in this study already display transformative pedagogical

dispositions but the data suggests that they need to change their pedagogical use of ETs to be more learner-centric. The ETILAB learning design framework used for the students' learning designs appears to have changed their theoretical orientation, but whether this will be implemented in their future classrooms will remain to be seen.

This analysis revealed two significantly different ways in which teachers used ETs in classrooms based on **who** used devices and the degree of regulation with which devices were used. Learner-centric uses placed devices ***in learners' hands***, scaffolding use to eventually give them the freedom to choose the tools most appropriate to their needs; we referred to this as ***nonregulated dispersed use***. Alternatively with teacher-centric uses, the devices were predominantly used by teachers, and when learners' used these the teachers prescribed which ET tools they should use and how; we referred to this as ***regulated restricted use.*** We correlated nonregulated dispersed use with the goals of transformative pedagogies and regulated restricted use with transmission pedagogies. This supports the OECD report (2015) findings that ICT use in and of itself does not lead to significant increases in educational outcomes or higher student performance, stating:

> Overall, the evidence from PISA, as well as from more rigorously designed evaluations, suggest that solely increasing access to computers for students, at home or at school, is unlikely to result in significant improvement in education outcomes. (OECD, 2015, p. 163).

The OECD report foregrounds the importance of ET use that integrates technology tools with high quality teaching, especially in mathematics and literacy, and improved social equity. This underscores the critical role of increasing interaction as part of nonregulated dispersed uses of ETs in a transformative pedagogical approach. Nonregulated dispersed use may, eg, create the impression that learners are free to do as they please, free to get lost in cyber-space or social networking. Concurring with the OECD findings, such an approach would have disastrous effects on learning.

This further refined our understanding of Anderson's interaction model. While teachers using transmission pedagogies may foster interaction through group- or pair-work, teacher-to-learner interaction, or learner-to-content, this was regulated and restricted to the priorities of the teacher. Teachers employing transformative pedagogies fostered less regulated and more dispersed interaction, in and outside of the class, encouraging learners to collaborate and create shared meaning. Thus, although interaction was fostered, the degree to which this was regulated varied, being dispersed or restricted: teacher-centric pedagogies favored regulated restricted interaction whereas learner-centric pedagogies favored nonregulated dispersed interaction. This does not negate the role of the teacher to that of a disinterested observer, quite the contrary. Using Anderson's model, the role of the teacher to increase meaningful interaction between teacher and student, student and student and student and content, is critical. The teacher fulfils a crucial role as guide-on-the-side to facilitate and guide learners' choices regarding the types of ET to use, effective learning strategies, and the responsible use of ETs and the internet, while the learner actively engages in using ET tools to critically evaluate and create knowledge and meaning. Over time this role may diminish and change as learners' become more self-directed and independent.

Accordingly themes emerged from teachers' descriptions of use. These were collated as descriptions to characterize use in each of the quadrants as indicated in Figure 6.

(In general, we were concerned about teachers' appropriation of tools for learning that was repeatedly set below the standard expected of learners'. The most extreme case required Gr 10 learners to complete an online Gr 3-4 level Mathematics game. This corroborates Hoadley (2012) and others' findings.)

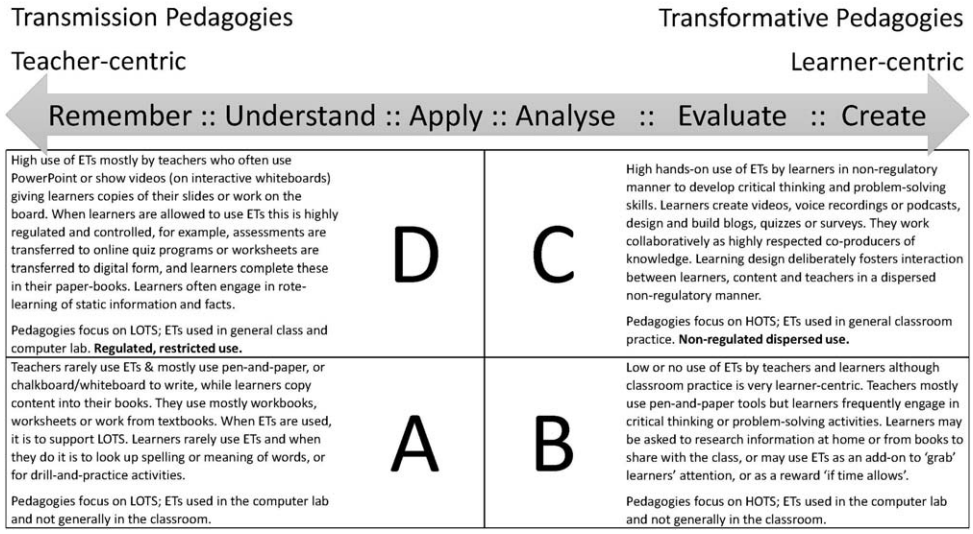

Figure 6: Teaching Change Frame descriptions of quadrants

Discussion

The use of the Teaching Change Frame to describe how ETs are used in classroom practice, and mapping it onto teachers' pedagogical approaches, is crucial in identifying the starting point from where change can be affected and plotting the change journey. As stated previously, we do not believe the TCF calls for an antithetical polarized description, where transformative pedagogies are pursued and transmission pedagogies villainised. Both approaches may address priorities in different contexts. CAPS, however, proved to be a constraining factor in the choice of pedagogy. Its highly regulated content coverage and pacing compel teachers to 'get through the CAPS', skewing their pedagogy toward transmission pedagogies in a regulated, restricted way. Accordingly, the majority of teachers following CAPS are positioned in Quadrant D or A, predominantly using transmission pedagogies, which indicates a skewing towards LOTS and ignorance of HOTS. Urgent change is required. Very few teachers were located in Quadrant C, but those who were employed transformative pedagogies and allowed learners to make nonrestricted dispersed use of ET tools. They design learning that foster unregulated, dispersed interaction and require learners to actively engage with the learning process by creating, evaluating and analyzing knowledge.

Teachers operating in Quadrant D predominantly use transmission-orientated teaching practices where learner engagement and use of ETs in the classroom is restricted and regulated. To change their practice would require changing this restricted regulated use of ETs to nonrestricted dispersed ways, fundamentally informed by a change of pedagogical dispositions towards transformative pedagogies. Teachers in Quadrant B employ transformative pedagogies and change for them would primarily focus on changing how they perceive and use ETs in learner-centric ways. Changing teachers in Quadrant A's dispositions necessitates change to their pedagogical orientation towards learner-centric pedagogies as well as encouraging the use of ETs. The ETILAB is fundamentally driven by the need to empathize with participants and works to find solutions for their immediate needs. Thus whatever change process is applied the immediate needs of teachers in Quadrant A must be central to this process.

Change is possible, as we noted with the education students. Although not intended as an intervention, our lecture series equipped these pre-service teachers with the necessary tools to design

learning using a different pedagogical approach. Students predominantly situated in Quadrants A or D before the lecture series, showed significant movement towards transformative pedagogies or greater dispersed, nonregulated use of ETs by learners. Content analysis of lesson plans situated 58% in Quadrant C compared to 29% in Quadrant D. This was a significant improvement on their limited use of ETs in their first teaching practice session a few weeks before the lecture series. What particularly surprised us was the lessons designs of the 22 pre-service teachers who indicated in their initial surveys that "*Technology scares me!*" or felt "*It is too difficult to teach with Technologies.*" The majority of these students' learning designs were situated in Quadrant C and a few in Quadrant D. This shows that this framework of scaffolding learning design that integrates ETs into classroom practices is potentially valuable to bring about change to pedagogy.

In conclusion

Data from this study has answered the DBE's call for verifiable data (DBE, 2015, p. 15), indicating how ETs are currently being used in many South African rural and urban classrooms. There is evidence to support international trends that that many teachers employ teacher-centered transmission pedagogies and use ETs to support this. However, as has been shown, teachers are changing their pedagogic dispositions, some slower than others, and it is encouraging to see that the education students are predominantly favoring transformative pedagogies. Changing how they appropriate ETs using the ETILAB framework for learning design had a significant effect on their lesson planning and one can only hope that this will affect their practice in future.

Changing the way that teachers use ETs to foster deep and meaningful learning, requires more than a drive to increase access to devices or policy directives to enforce use. It requires a process that may simultaneously impact pedagogy and the use of ETs, and change teachers' location from Quadrants A, B and D towards Quadrant C, using ETs in teacher-supported highly interactive learner-centric ways and employing transformative pedagogies that focus on developing HOTS. The development of the change process was informed by a "pull" rather than the typical "push" approach: traditionally teachers are pushed toward the change agendas of organizational leaders or systemic policy directives. Creating environments that "pull" teachers toward change is an alternative. Deliberately scaffolding the use of ETs, HOTS and fostering nonregulated dispersed interaction between learners, content and teachers, were identified as key drivers of change and are pursued in the testing and refinement of the change process.

Notes

[1]http://www.gartner.com/newsroom/id/3114217.
[2]http://etilab.org/.

Statements on open data, ethics and conflict of interest

The authors are grateful to the schools and teachers who participated in this study. To protect their confidentiality and privacy all names and geographic locations have been anonymised and participants' written permission received before they were involved in the data collection process. Their data is therefore not available for open access. Ethical permission was received from the University of Cape Town to conduct this study. There are no conflicts of interest that the authors are aware of.

References

Amiell, T., & Reeves, T. C. (2008). Design-based research and educational technology: rethinking technology and the research agenda. *Educational Technology & Society, 11*, 29–40. Available at: http://www.ifets.info/others/download_pdf.php?j_id=41&a_id=887 [Accessed December 2, 2014].

Anderson, T. (2003). Getting the mix right again: an updated and theoretical rationale for interaction. *International Review of Research in Open and Distance Learning*, *4*(2), 126–141.

Barrett (1968). *The Barrett taxonomy of cognitive and affective dimensions of reading comprehension*. Retrieved October 29, 2014, from http://www.vdac.de/vdac/index.php?option=com_docman&task=doc_view&gid=149.

Bloom, B. S. (Ed.), Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives. Handbook 1: Cognitive domain*. New York: Longmans, Green & Co.

Bourdieu, P. (1990). *The logic of practice.* California, United States of America: Stanford University Press.

Bourdieu, P. (1977). *Outline of a theory of practice*. Great Britain: Cambridge University Press.

Bourdieu, P. (2000). *Pascalian meditations.* Cambridge, United Kingdom: Polity Press.

Bower, M. (2008). Affordance analysis – matching learning tasks with learning technologies. *Educational Media International*, *45*(1), 3–15.

Christie, P. (1998). Schools as (Dis)organisations: the "breakdown of the culture of learning and teaching" in South African schools. *Cambridge Journal of Education*, *28*(3), 283–300. Available at: http://www.tandfonline.com/doi/abs/10.1080/0305764980280303 [Accessed May 27, 2014].

Churches, A. (2008). Bloom's digital taxonomy. 1–40. Retrieved June 16, 2015, from http://edorigami.wikispaces.com/

DBE, R. of S. A. (2015). *Action Plan To 2014: Towards the Realisation of Schooling 2025*. Retrieved 16 August, 2015, from http://tinyurl.com/2019-DBE-Action-Plan.

Department of Education and Training, W. A. (2003). Teaching and learning with ICT: a self evaluation guide what is effective practice in teaching and learning with ICT. Retrieved September 25, 2014, from http://det.wa.edu.au

Drucker, P. F. (1999). Knowledge-wroker productivity: the biggest challenge. *California Management Review*, *41*(7), 79–94.

Drucker, P. F. (2001). *The next society. The economist, 52*. Retrieved January 29, 2016, from http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=17065670&site=ehost-live.

Drucker, P. F. (2011). *The New Realities*. London & New York: Routledge.

Freire, P. (1970). *Pedagogy of the oppressed* (30th Anniversary Edition). New York & London: Continuum.

Gundy, M. S. & Berger, M. J. (2016). Towards a model supporting educational change. *International Journal of Information and Education Technology*, *6*(3), 232–236. Available at: http://www.ijiet.org/show-64-775-1.html.

Hargreaves, A. (2009). Change wars: a hopeful struggle. In A. Hargreaves & M. Fullan (Eds.), *Change wars* (pp. 1–10). United States of America: Solution Tree.

Harris, J., Mishra, P., & Koehler, M. (2009a). Teachers' technological pedagogical content knowledge and learning activity types. *Journal of Research on Technology in Education*, *41*(February 2015), 393–416. Available at: http://dx.doi.org/10.1080/15391523.2009.10782536.

Harris, J., Mishra, P., & Koehler, M. (2009b). Teachers' technological pedagogical content knowledge and learning activity types: curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393–416. Available at: http://www.jcu.edu/education/dshutkin/readings/Harris_2009_TPCK.pdf.

Hoadley, U. (2012). What do we know about teaching and learning in South African primary schools? *Education as Change*, *16*(2), 187–202. Available at: http://www.tandfonline.com/doi/abs/10.1080/16823206.2012.745725.

Hord, S. M., Rutherford, W. L., Huling-Austin, L., & Hall, G.E. (1987). *Taking charge of change*. Virginia: Southwest Educational Development Laboratory.

Jameson, J. (2006). *Leadership in post-compulsory education: inspiring leaders of the future*. London: David Fulton Publishers.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). NMC Horizon Report: 2015 K-12 Edition K-12th ed., Austin, Texas: The New Media Consortium.

Koehler, M. J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T. S., & Wolf, L.G. (2011). Deep-play: developing TPACK for 21st century teachers. *International Journal of Learning Technology*, *6*(2), 146–163.

Masondo, S. (2016). *Angie Motshekga reads riots act. City Press*. Retrieved 25 January, 2016, from http://city-press.news24.com/News/angie-reads-riot-act-20160123.

Naidoo, D. G., & Muthukrishna, N. (2014). Teachers' "Small Stories" about curriculum reform in South Africa: *"Square Peg in a Round Hole." Journal of Social Sciences*, *38*(3), 271–282.

Ng'ambi, D. (2013). Effective and ineffective uses of emerging technologies: towards a transformative pedagogical model. *British Journal of Educational Technology*, *44*(4), 652–661. Available at: http://doi.wiley.com/10.1111/bjet.12053 [Accessed November 24, 2013].

Ng'ambi, D., & Bozalek, V. (2013). Editorial: emerging technologies and changing learning/teaching practices. *British Journal of Educational Technology*, *44*(4), 531–535. Available at: http://doi.wiley.com/10.1111/bjet.12061 [Accessed May 27, 2014].

Ng'ambi, D., & Lombe, A. (2012). Using podcasting to facilitate student learning: a constructivist perspective. *Educational Technology and Society*, *15*(4), 181–192.

Ngassam, E. K., Ntawanga, F. F., & Eloff, J. (2013). A roadmap for rural area ICT solution deployment: a case of Kgautswane community in South Africa. *The African Journal of Information Systems*,5(2), 49–64.

OECD (2015). *Students, computers and learning: making the connection, Paris, France*. Retrieved February 6, 2016, from http://dx.doi.org/10.1787/9789264239555-en.

Reeves, T. C., & Reeves, P. M. (2015). Educational technology research in a VUCA world. *Educational Technology*, March-April, 26–30.

Reeves, T. C., McKenney, S., & Herrington, J. (2011). Publishing and perishing: the critical importance of educational design research. *Australasian Journal of Educational Technology*, *27*(1), 55–65.

Salomon, G., Perkins, D. N. & Globerson, T. (1991). Cognition: with intelligence technologies. *Educational Research*, *20*(3), 2–9.

Somekh, B. (2007). *Pedagogy and Learning with ICT: researching the art of innovation*. London, UK: Routledge.

Spaull, N. (2013). South Africa's education crisis: the quality of education in South Africa 1994-2011. Report Commissioned by Centre for Development and Enterprise, South Africa.

Vandeyar, T. (2014). Policy intermediaries and the reform of e-Education in South Africa. *British Journal of Educational Technology*, *46*(2), 344–359.

Wacquant, L., & Deyanov, I. (2002). Taking Bourdieu into the field. *Berkeley Journal of Sociology*, *46*(2002), 180–186. Available at: http://www.jstor.org/stable/10.2307/41035575 [Accessed February 5, 2014].

Wang, S.-K., Hsu, H.-Y., Reeves, T. C., & Coster, D. C. (2014). Professional development to enhance teachers' practices in using information and communication technologies (ICTs) as cognitive tools: Lessons learned from a design-based research study. *Computers & Education*, *79*, 101–115. Available at: http://www.sciencedirect.com/science/article/pii/S0360131514001572.

Wertsch, J. V. (1998). *Mind as action*. New York and Oxford: Oxford University Press.