Teachers, technology and types of media: Teaching with ICTs in South Africa

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ABSTRACT

This paper intends to provide an understanding of pedagogical integration of ICTs to facilitate ICT teacher preparation that promotes productive use of these digital technologies in the classroom. A qualitative multi-case study of three school teachers selected for their successful ICT pedagogical integration into their teaching was conducted in three South African township secondary schools. In the findings, teachers created rich learning environments enhanced by their purposeful and proficient integration of ICTs into their teaching. In addition, there was consistency between the teachers' espoused and enacted practices as both digital (ICTs) and non-digital media augmented each other in the teaching process.

Keywords: ICT pedagogical integration, media forms, ICT affordances, enhancement of teaching and learning.

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INTRODUCTION

Efforts to introduce pedagogical integration of ICTs in South Africa have focused on provision of infrastructure, hardware and software. It has also concentrated on offering basic computer skills to teachers. This has proven insufficient to prepare teachers for effective integration of digital technology at their disposal in order to enhance their teaching practice (Blignaut et al., 2010; Mofokeng and Mji, 2010; Gudmundsdottir, 2010; Du Plessis and Webb, 2012). According to Bialobrzeska and Cohen (2005:13), "however good the ICT infrastructure in a school may be and however wide the range of software the school has, these are only as good as the teacher using them. ICT teacher training should therefore go beyond exposing teachers to technology as has been the case, but transcend to how the actual teaching (good or bad) is enhanced by its use".

The extent to which teaching is enhanced by the use of ICTs depends on the teachers' pedagogical beliefs about their subject, teaching, learner needs and perceptions about ICT capabilities (Fulton and Torney-Purta, 1999; Ertmer, 1999). These beliefs help expose the role and the value ICTs have in the pedagogical integration process that teachers orchestrate. This study investigates this exposure which has facilitated a description of this process. The research question guiding the study is: *What contribution do the practices of three South African township secondary school teachers make to an understanding of ICT pedagogical integration?*

ICTs as media for learning and teaching

An ICT tool can offer a wide range of multimodal texts and media forms in a given teaching and learning environment. This makes them more versatile than other teaching resources. Laurillard (2002) has categorised these tools into the following: Narrative, Interactive, Communicative, Adaptive and Productive media. These media are grouped based on their affordances, or what they can do to improve a learning experience. A clear articulation of these affordances is needed to understand how ICTs "can be most effectively used to support learning and teaching" (Conole and Dyke, 2004:113).

Media forms

Narrative media forms are non-interactive and often used

to present subject content structure. Laurillard (2002) argues that structure is rarely explicit and is difficult to apprehend. Non-linearity therefore becomes inevitable. It enables the teacher to link its aspects with prior knowledge and other dimensions of the text that make it more explicit. *Interactive media* forms allow the user to navigate freely and can respond to the user's input. Instant feedback is its affordance and it plays an important role in classroom conversation as concept understanding is developed. *Communicative media* forms provide space for users to discuss online synchronously or asynchronously. This form supports the giving and receiving of feedback that can be assessed and used to enhance learning (Vonderwell et al., 2007). *Adaptive media* forms can change their form depending on the user's input. They are able to give the user a simulated experience of the real world. This provides learners with a proxy experience and is of value in bringing inaccessible situations into the classroom to enhance learner understanding (Conole and Dyke, 2004). *Productive media* provide the user with the ability to articulate his or her understanding of new knowledge. It can therefore be used as authoring tools.

This study is focused on identifying the pedagogical value these media forms bring as teachers engage them to enhance learning.

ICT pedagogical integration

Pedagogy refers to "guidance-to-learn: learning in the context of teaching, and teaching that has learning as its goal" (Beetham and Sharpe, 2013:2). Teaching is therefore that which makes learning happen. In her Conversational Framework, Laurillard (2002) demonstrates how this happens through teacher-learner interaction. The interaction begins when the teacher presents a new concept and carries on until the learner shares more or less the same understanding. In her introduction of teacher pedagogical content knowledge, Shulman (1986) gives insight into how complex this process is as different aspects of pedagogy are brought into play during the act of teaching. Dron (2012) extends this understanding by describing pedagogy as an orchestration of 'all' that happens in the classroom that makes possible the achievement of educational goals. Pedagogy is therefore the integration of teaching methods, strategies, conversations and teaching resources. ICTs are included in this amalgamation.

Williams in Wang and Woo (2007:149) define ICT pedagogical integration as "a process of using any ICT to enhance student learning". The idea that it is a process associated with and contributing to the learning experience suggests it is not stagnant; neither does it occur on its own but within that which makes learning possible. It is therefore important that ICTs in this context are considered as part of teaching and not as add-ons. ICT pedagogical integration consequently entails infusion

of ICTs so that what the teacher has already been doing effectively is enhanced.

METHODOLOGY

This qualitative multi-case study investigates teacher practices of three selected teachers from three South African township secondary schools. The study interprets teacher espoused and enacted practices in order to understand what ICT pedagogical integration entails. As a multi-case study, the interpretation of each teacher's case is used to identify similarities and explore differences within and between cases (Yin, 2003). Each subject teacher is a case that contributes to the formation of a "collective understanding" of the phenomenon under investigation (Stake, 1995:4). This type of study is recommended by Miles and Huberman (1994) for its potential to develop a generic theory, which in this case is the ICT teacher training framework to be developed later. Purposive sampling was used to identify cases where most could be gained on the phenomenon under study (Merriam, 2009). The selected teachers self-declared that their ICT use had pedagogical value.

Semi-structured interviews were conducted with each teacher and were audio-recorded. Thereafter, one lesson observation per teacher was video recorded. Captured data was transcribed to facilitate a robust interpretation and coding of the data using the research analytical tool.

Analytical tool

The analytical tool (Table 1) based on Laurillard (2002) media forms and ICT affordances by Conole and Dyke was developed and used to interpret teachers' interviews and observations.

Media forms are used as themes to group possible ICT roles in the learning experience anticipated. The specific affordance described or observed is recorded in the next column. It responds to the question, what is the technology able to do in that particular theme or media form? What the media can do might vary depending on the description of the activity or learning outcome. The evidence is the activity or the description of what is observable as the ICT is integrated into the teaching and learning experience that can be used as the indicator showing that the ICT affordance is playing a particular role. Finally, the question, 'what pedagogical value does it add?' makes explicit what benefit the usage brings to the teaching and learning process. The identified value is an indication that there is effective integration in the use of the digital or and non-digital medium.

RESULTS

The findings concur with literature that claim teacher pedagogical beliefs influence their enacted ICT integration (Ertmer, 1999; Fulton and Torney-Purta, 1999). Each teacher in this study has his or her pedagogical belief or understanding of ICT integration, and that influences their enacted practice. ICTs are valued by teachers for their ability to present concept structure and that is consistent in all teacher practices. Through conversation, teachers interact with learners as they try and interpret the meaning of the structure. That gives teachers feedback which help them determine the direction the lesson should take or what teaching

Table 1. Analytical tool.

Media forms	Affordances	Evidence	What pedagogical value does it add
Narrative	Non-linear	Multimodality	Apprehending structure/ connections
Interactive	Immediacy	Immediate feedback	Exploration: misconceptions amended
Communicative	Collaboration	Discussion: class/ group	Re-descriptions of concepts
Adaptive	Diversity	Reproduction: experimental/role play	Concretising theory: practice
Productive	Articulation	Product: animation/ model	Knowledge construction

Source: Ndlovu (2015:100)

resources or methods to engage as they amend misconceptions and concretise theory.

Each teacher's role in the integration process is characterised and is a reflection of the individual teacher perception about the pedagogical benefits of the ICT affordance they use to enhance teaching and learning. The benefits relate to subject needs, teaching needs and learning needs.

Mpetha

Mpetha is a teacher whose pseudonym is a Zulu word and it means *expert*. The teacher is considered an expert because of his ability to maximise his advanced ICT technical skills to enrich his teaching of mathematics. Mpetha believes it is important that he makes explicit the process of solving problems in his subject. He states:

> The ICT helps with the procedure, because without procedure, you cannot do anything…but this one helps them to see how we can solve the problem…Like in Maths now the animation on the slides shows the movement from one point or the other, to show what is happening.

Mpetha's programming skills make it possible to achieve this goal in his teaching. He believes the quality of digital materials determine the effectiveness of their use. This links with his aspiration to make visible problem solving processes. Mpetha does not only rely on his materials design, but engages other teaching strategies to make explicit the structure presented by the technology.

There is consistency in what the teacher articulates about how he integrates ICTs in his actual teaching. He is able to create a rich learning experience by utilising the five media forms that he integrates with various components of the pedagogical ensemble. In his use of 6 slides, Mpetha is not limited to the use of technology but he incorporates role play, examples, and explanations, links concepts from other subjects, gestures and prior knowledge to interpret and make explicit the symbols that make up the concept taught. This is a clear demonstration of the complexity of integrating not only the media but all that the teacher can lay his hands on to help make learners understand new knowledge as revealed below.

In the narrative, structural clues on the slides seem to play a significant role in helping establish the concept structure and connections between steps and ideas. The interactive media form drives the pace and direction of the lesson as determined by the feedback the teacher gets from learners in each step or activity. If the feedback is affirmative, the teacher moves to the next step. If it is negative, he moves away from ICT engagement and solicits the use of other teaching strategies that connect learners to their everyday experiences in and outside the classroom. Once learners grasp the idea, Mpetha moves to the next phase in the concept structure that is available on a different slide. This move helps learners concretise the theoretical aspect that he would have presented before the ICT engagement. The communicative and productive media are reflected in the whole class teaching and the group work. Re-descriptions are made as learners collaborate to find solutions to problems.

In his presentation, Mpetha draws from his repertoire of teaching methods and strategies to help learners follow the development of the concept structure, processes and connections. Table 2 makes explicit how he manages to integrate all these aspects.

The role of the ICT is to present the content structure and to illustrate how different representations (tables, graphs, animations, and formulas) contribute to the development of calculating cumulative frequency.

Mlingani

Mlingani is a Zulu name that means *partner*. It is used in this study as the name of the teacher who collaborates with digital technology (video) to help expose township learners to mathematical language and different problem solving methods.

Although the teacher uses the video as a narrative form, he is aware of the limitations it has in making the content accessible to his learners. He therefore slots it in to establish components of the content structure in the standard subject language which he interprets at the level of learners' understanding without compromising it as follows:

It is an integer and it represents a revolution. Do you get it? Why that one is positive is because it is moving anticlockwise. *Ixesha musi lihamba kanje* (Xhosa to

Table 2. The 14 teacher activity interchanges.

Duration in minutes and seconds	Teaching strategy	Digital technology used with explanations of text
00:40	Question and answer (together with explanations are used throughout the interchange)	Slide with definition
03:15	Role play	
01:08		Graph
00:25	Analogy	
00:37		Graph
00:13	Role play	
00:11		Graph
02:10		Table
00:21		Graph
00:27		Table
00:16		Graph
00:38	Reference to prior knowledge/ other subject	
02:05	Object	
00:54		Graph

Source: Ndlovu (2015:165).

mean, time moves this way), *ne*? (Afrikaans to mean, isn't it?) [the teacher shows with his index finger how the clock hand moves clockwise]. Immediately *sithi* (Xhosa to mean, we say) *anti* (Greek word used as slang to mean, move in the opposite direction).

The conversation is adapted so learners have clear understandings of concrete aspects needed to apprehend what an integer represents. Interaction is between teacher and technology and teacher and learner as the concept is developed. The former is collaborative at teaching level and when confirmation is received from the technology after the teacher and the class have carried out the calculations. Although the video method of calculation is shorter, this gives the class a different problem solving technique. There is collaboration between the teacher and the expert in the video, with each playing his or her role. The teacher as the driver of this teaching experience occupies 69.62% of the period time and the video takes 29.31% of it. Learners participate in the development of the lesson as follows:

Teacher: So it can be what? It can be Sin -1352 equals?
Teacher: What will be the outcome, applying (points at the previous writing) the Thetas, do you get it?
Learners: Yes.
Teacher: What will be the outcome?
Learners: -Sin.
Teacher: What will be the outcome? What will be the Theta in this case?
Learners: 1352.
(Teacher writes –Sin (1352) = -Sin 1352)
Teacher: Are we together?
Learners: Yes (Ndlovu, 2015:187)

Learners are brought into the classroom conversation as

the teacher demonstrates how calculations should be carried out. Although this type of collaboration (one-to-many) is not ideal (Laurillard, 2002), learner responses indicate that they are working together with the teacher.

While the teacher admits that the ICT he uses has helped to enhance learning (based on incremental increase in his matriculation results over the last 2 years), the technology seems to have had an influence on his teaching. This is exhibited in the teacher's enacted practice where he uses storytelling to introduce the trigonometry lesson. When the video is played, the presenter uses the same teaching method. This type of collaboration does not disrupt the pedagogical flow, but enhances it as the concept taught is developed.

Bambisana

Bambisana is a Zulu name given to this teacher and it means *collaborate.* This teacher believes that for learners to grasp geographical concepts, they need to visualise them. She says:

Always, in every lesson I use them to teach the learners especially when it comes to visuals. Because when you teach the learners, my subject needs a lot of visuals because some of the things happen where they have never been.

These visuals are presented with both digital and non-digital media. The affordance of each media form has benefits in showing a particular representation that serves a specific purpose as demonstrated in Table 3.

Slides containing a description of the content on a word document with 3 dimensional features are used. In her

Table 3. Frequency of resources used.

Media	Total number used	Detailed distribution of usage
ICT	17	11/17 – 2D and 3D images 2/17 – task display 4/17 – response to questions
Whiteboard (drawing and writing)	10	5 – written text 5 - drawing: 4/5 - explanations / 1/5 – response to questions
Paper	4	3/4 - explanations 1/4 - response to questions
Object (in the classroom)	2	Explanation
Books – learner resource	1	Definition read
Total	34	

Source: Ndlovu (2015:211).

use of visuals as a narrative form, she uses an approach that is non-linear as she engages different media forms to try and make clear the structure and the process land forms adopt at different stages of their development. The feedback she gets from learners as she integrates the 'visuals' helps illuminate misconceptions and this prompts questions she responds to by using different forms of representation. As she does so, learners' theoretical understandings are concretised.

Both Bambisana's espoused and enacted teaching practices are driven by her subject's demands. She emphasises that learners should be able to identify geographical features in different forms. The geographical features are presented in picture, drawing, 3 dimensional colour (slide) and in 2 dimensional black and white representation.

In this case both, digital and non-digital technologies support each other as they are integrated into classroom conversation to enhance learner understanding. It is evident that while the teacher is aware of the value ICTs bring to her teaching, she upholds her conventional teaching and uses technology to augment it.

Teacher practice consistencies

In this study, the consistencies are not an indication of an isolated use of ICTs but an integration of pedagogical components that incorporate ICTs as the teacher guides the learning process.

In general, the espoused practices do not reveal much of what the role of the teacher is in the integration process. Teacher enacted practices appear to be an elaboration of what teachers espouse and a display of how *they* put into action what their pedagogical beliefs are, about ICT integration. The role of the teacher and that of the ICT become explicit as the pedagogical blend

takes place. During interviews, Bambisana and Mlingani did not show awareness of the significance of their communicative role in the integration process. This emerged in the actual teaching. Teacher communication augments weaknesses of different media forms as he or she mediates the concept development. Each teacher has his or her individual pedagogical belief or understanding about ICT integration, and that influences their role in the integration process which is to use different media forms to make learning happen.

The three teachers value ICTs for their ability to present concept structure. While digital technology plays this role, teachers interact with their learners through conversation in different ways as teachers try and interpret the meaning of structure.

DISCUSSION

This study sought to analyse three teachers' practices to make explicit what ICT pedagogical integration means by describing their espoused and enacted performances. The teachers' desire to enhance learning and teaching evident in their respective integration methods contributed to the emerging description of what the concept entails. The concept of integration appears to go beyond the infusion of ICTs and extends to the integration of teachers' repertoire of pedagogical resources, including non-digital resources as displayed in the reviewed version in the next section.

ICT pedagogical integration reviewed

It is evident that there is a need for teachers to drive the integration process by managing the augmentation as each medium plays its role in the act of 'making learning
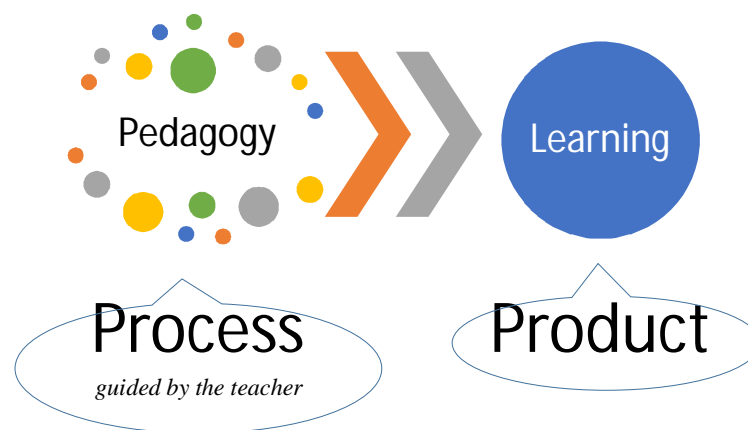
Figure 1. ICT pedagogical integration (Ndlovu, 2015:288).

happen'. Mpetha in particular, has made clear how not balancing the roles, but playing the roles proficiently in the development of learner understanding, brings value to the learning process.

It is therefore important to distinguish that which makes learning happen (pedagogy) and the role of ICTs to ensure each takes its rightful position in the integration process. That distinction could help show how digital technology enhances teaching and learning. The product of the process is learning and the process is pedagogy – a process that constitutes the amalgamation of media forms, teaching methods and strategies. When ICTs are used, any of these constituents either enhance or are enhanced by them. Figure 1 is an illustration of the interpretation of ICT pedagogical integration that emerges from the findings of this study.

The graphic does not label the position of the ICT affordance because it could be located anywhere in the realm of pedagogy as it enhances or is enhanced by other media. Where the ICT is engaged in the process by the teacher, it is significantly enhancing the process (as the rest of the components) and promoting the generation of the product, which is learning. Therefore, ICT pedagogical integration is effective when ICT use in the teaching act enriches the components that make up this complex process.

CONCLUSION

Pedagogy as a process that leads to learning in all cases in this study was guided by the teacher who eagerly drove it in a way that its constructs collaborated as he or she ensured they augment his or her teaching. It is the description of this activity that has revealed what actually happens when ICTs are integrated into teaching.

The purpose of this study was to understand what pedagogical integration entails to help develop a generic ICT teacher training framework. Focus on the positive pedagogical integration experiences has helped provide

an 'ideal' understanding of the concept. It is hoped that this study can help ICT teacher trainers identify effective and ineffective ICT pedagogical integration. That should help design modules that give trainees knowledge, skills and attitudes that promote good teaching practices with ICTs.

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