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Rural teachers as innovative co-creators: An intentional Teacher Professional Development strategy

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Abstract

The purpose of this paper is to provide insight into how rural teachers were empowered to become co-creators of innovative practices in their classrooms. The co-creation was operationalised as a merging of teachers existing knowledge of their subject, context and new knowledge of using mobile tablets towards enhancing their teaching practices in the Eastern Cape Province of South Africa over a period of 3 years. The intentional situating of teachers as co-creators was implementation through a Teacher Professional Development (TPD) course. The course consisted of 10 modules presented and completed over a one year period. The TPD course was developed as an artifact using Design Science as a methodology with three iterations of implementation to refine it. The development of the course and its iterative implementation and refinement was grounded in the Living Lab open innovation approach with elements of gamification and various stakeholders were incorporated. Technology endowments were integrated as part of the gamification and were dependant on predefined co-creation events. Each event was linked to a badge and teachers had to provide practice based evidence of how new knowledge, proficiencies and skills gained during the TPD sessions was adapted to their own subject and context knowledge and practically implemented in their classrooms. This presents an innovative way to introduce and use tablets in teaching and learning as teachers are acknowledged as domain and subject experts and through exposure to technology and pedagogical strategies in using the technology, they become co-creators of their own new enhanced classroom practice.

Keywords

Co-creation, innovation, teacher professional development, resource constrained

1. Introduction

Co-creation and innovation are every so often neglected concepts when teacher professional development is planned and executed. These concepts are more related to the process of innovation where the feedback of the user is regarded as significant to provide an improved product and service or process (De Arias et al., 2014). However in a recent TPD course which was developed for teachers in a rural context strong evidence of co-creation, innovation and an observed enhancement in classroom practice was evident. In this course teachers were exposed to the use of mobile tablets to support their teaching and learning. Technology and in this instance mobile tablets, are often regarded as the magic wand needed to facilitate technology-enhanced, student-centred teaching environments (Hermans,

Tondeur, van Braak, & Valcke, 2008). Hardman (2005) also indicates that ICTs have the ability to act as a catalyst to transform pedagogical practices in classrooms. However many ICT for Education initiatives in South Africa and the rest of the developing world have resulted in failure (Bytheway, Cox, Dumas, & van Zyl, 2012; Ford & Botha, 2010; Were, Rubagiza, & Sutherland, 2011). Teachers in rural areas are willing to use technology to support teaching and learning, but lack pedagogical and technological knowledge towards integrating it into their teaching activities (Bytheway et al., 2012; Ford & Botha, 2010; Were et al., 2011). They are exposed to training of how to use a device but not how to integrate, internalise and apply that knowledge in their classroom, often resulting in them avoiding using the technology. In those cases where ICT initiatives in schools do include some kind of training component, the focus might be on computer literacy, rather than how to use the technology as a tool for teaching and learning (Were et al., 2011).

The purpose of this paper is to provide insight into how teachers became co-creators of enhanced practice by integrating new knowledge and skills of using technology to their own expertise towards enriching their teaching practices in a resource constrained setting in South Africa. This was operationalised through the implementation of a specifically developed TPD course. This course went through three iterations of development and refinement towards value of evident co-creation.

The research question in this paper is:
How can teachers become co-creators through participation in a teacher professional development (TPD) course which made use of mobile tablets to support their teaching and learning in a resource constrained environment in South Africa?

2. Co-creation and innovation as part of TPD

Co-creation is a concept which normally refers to any type of user and in this instance teachers, participating in the ideation and further development of the solution, and this "user" is thus viewed as a value creator instead of a source of knowledge (Salminen, Konsti-Laakso, Pallot, Trousse, & Senach, 2011). The role of users in the research and development process has gradually evolved from lead user (Von Hippel, 1986; Von Hippel, 2005) towards user co-creation (Pallot, 2009; Pallot, Trousse, Senach, & Scapin, 2010; Prahalad & Ramaswamy, 2000; Ramaswamy & Gouillart, 2010; Sanders & Stappers, 2008). The more users are involved in this process, the greater the value created. The greater the value created, the higher the maturity level of the product or process. Co-creation is also a term which is often found when describing Living Labs (LLs).

The LL environment is used to create an innovation platform where academia, industry, researchers, government and other stakeholders can co-create new ideas and concepts that can support their teaching and learning, as well as improve their skills in a quest to address challenges (Callaghan & Herselman, 2015; De Arias et al., 2014; Guzmán, Fernández del Carpio, Colomo-Palacios, & Velasco de Diego, 2013). It is a concept which refers to a research and development methodology where innovations such as services, products and application enhancements are created and validated in collaborative, multi-contextual empirical real-world settings (Geerts, 2011). Also it is seen as a new character in the open innovation chain.

LLs are thus environments where the aspect of *living* is closely looked at, especially where people/users are involved. Concepts also evident from various definitions of LL are open

innovation ecosystems, territorial contexts, concurrent research and innovation processes were users get to play an active role in the development of new services, products or processes (Følstad, 2008). This closely links with social innovation where the participation of and collaboration with relevant stakeholders, cross organizational boundaries and jurisdictions (Bason, 2010; Sørensen & Torfing, 2011). This corresponds with the notion of 'open innovation' (Von Hippel, 2007; Von Hippel, 2005). Relevant stakeholders should be able to bring in their knowledge, information, skills, experiences and resources. As a result the produced outcomes of innovation processes are more relevant to them.

Innovation processes require the ability and willingness of the relevant actors to cooperate and to link and share ideas, as well as to exchange vital resources (Von Hippel, 1986, 2007; Von Hippel, 2005). However, this open innovation process is an embedded process, which takes place in a specific local and institutional context (Bekkers, Edelenbos, & Steijn, 2011). Recognizing the specific environment in which innovation processes take place is referred to by (Castells, 2011, p. 3) as *innovation milieus*. It can, thus, be argued that innovation processes should be studied from an ecological and context specific perspective ((Bason, 2010; Bekkers & Homburg, 2007; Osborne & Brown, 2011). This presupposes that these stakeholders, given their needs and experiences, are able to co-create and produce innovations that really matter to them as co-producers of knowledge (Evans, Hills, & Orme, 2012) This can also be related to professional development.

According to Wells (2007), professional development is the way in which organisations deal with the introduction of innovations into their practices. Clarke and Hollingsworth (2002) state that TPD consist of activities that enable teachers to improve their knowledge, skills and strategies. Wang and Gu (2014) view TPD as the attainment of practical knowledge. "Practical Knowledge is tacit, embedded the teaching practice, and is concurrent with the individual's thoughts and behaviours" (p. 41). A more expansive outline of TPD is given by Grant (1996). He confirms the practical nature of the endeavour and further implies that the process goes *beyond* training as an *acquisition* of skills to include the development of new insights into pedagogy and reflection by teachers on their teaching practice.

3. Background to the development of the TPD course

The TPD course was one of the artefacts developed as part of the ICT for Rural Education Development (ICT4RED) initiative. This initiative was part of a large-scale Technology for Rural Education (TECH4RED) project. This project was initiated by the South African Department of Science and Technology (DST) in collaboration with the South African Department of Basic Education (DBE), the Eastern Cape Department of Education (ECDoE) and the South African Department of Rural Development and Land Reform (DRDLR). TECH4RED focussed on the improvement of rural education via technology-led innovation (Herselman & Botha, 2014; South African Department of Science and Technology, 2013)

The ICT4RED component was implemented by the CSIR, Meraka Institute and mostly funded by the DST. It extended to incorporate 26 deep rural schools in the *Nciba Circuit* of the *Cofimvaba School District* in the Eastern Cape Province of South Africa. The district has a population of 35 500 and the schools are scattered over hilly and mountainous terrain and connected by a network of gravel roads (Herselman & Botha, 2014). The ICT4RED initiative involved 270 teachers and 6500 learners. This area can be regarded as a resource constrained context based on the definition of Anderson, Anderson, Borriello, and Kolko (2012). According to them a resource constrained context is an environment where there is low-

income communities and low bandwidth. These environments provide unique constraints (e.g. cultures) where people are unfamiliar with, or afraid of, technology and/or environments where power and network connectivity are scarce and expensive.

4. Methodology

Design Science research methodology (DSRM) was applied to develop the TPD course as a component of the ICT4RED initiative. In DSRM one can develop ways of understanding and working with socio-technical systems and to question existing structures and processes (Pirkkalainen, 2015). DSR relates to sustainable development as it similarly addresses wicked problems and measures alignment with innovation and creativity. The DSR process in addition allows for what open innovation 2.0 refers to as fail fast and scale fast (Salminen et al., 2011). Due to the iterative nature of the DSR process, an artifact, as solution or innovation, is emergent and opportunities exist for it to evolve. The artifact as solution is continuously evaluated through successive iterations, adapted and evolved through implementations and evaluations. The TPD course was thus developed as an artifact by applying the DSRM process of Peffers et al. (2006), and it evolved as it was evaluated and improved through three iterations or phases in the ICT4RED initiative.

Table 1: Phases through which TPD course was developed and implemented

Phase 1 (2012/13) – 1 School	Explore And Experience
This phase tested the design and enables the initiative to try and test various design constructs, so that the learning and research can be used to enhance the next iteration.	
Phase 2 (2013/14) – 1+11 Schools	Describe And Support
This phase took into account the learning gained from Phase 1, and essentially goes through a redesign process in order to implement the learning in a new iteration. This iteration is the first attempt to scale the initiative to additional schools, in different contexts (e.g. testing the model in junior secondary schools). At this stage, some general findings can be documented and data and evidence can already be produced that is useful to implementers and policymakers.	
Phase 3 (2014/15) – 1+11+14 Schools	Advise And Embed In System
This phase involved a final redesign, based on the learning from PHASE 2 and enables the initiative to improve the learning around both process and scaling. It is here where the initiative can make final recommendations, based on data and evidence, as input to implementers and policymakers.	

The TPD course as an artifact was developed and implemented by researchers from Meraka, CSIR, who evaluated it through three phases in a resource constrained environment (as discussed above) in the Eastern Cape province of South Africa. Gregor and Hevner (2013) indicate that evidence should be provided that the artifact is useful and the evidence should address criteria such as validity, utility, quality and efficacy. A rigorous monitoring and evaluation of the TPD course was done to track impact and improve the artifact. The following diagram illustrate the DRSM process of Peffers et al. (2006) as it was applied to develop, evaluate and improve the TPD course.
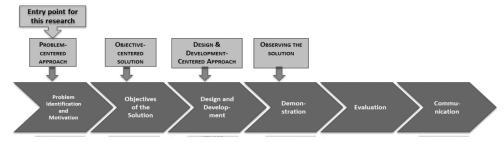

Figure 1: DSRM process of Peffers et al. (2006) as it was adopted to develop the TPD artefact
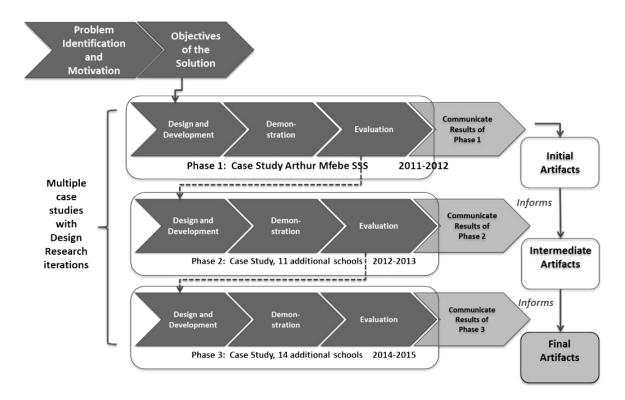
Figure 2: Applying multiple case studies during specific areas of the DSRM process to refine and develop the TPD based on feedback and analysis of data collected.

External consultants were brought in to supplement the skills, knowledge and tools of the internal CSIR, Meraka team, for example an ethnographer provided short-term support with detailed ethnographic descriptions, another organization assisted with transcriptions and data capturing. An organization, with an already developed School Functionality Instrument, was contracted to train the Meraka M&E team on the collection of the data and to support the reporting of the data.

The LL approach was applied to develop the TPD course as many stakeholders (with their own knowledge, information, skills, experiences and resources) were involved. These included the provincial government, teachers as users and co-creators together with district officials and the (CSIR) in South Africa as researchers and implementers were involved. Through the DSRM process the TPD was part of an innovative process of development, implementation and evaluation to refine and develop the course in order to address the needs of the user (teachers) in their context or innovative milieu (Castells, 2011) in Cofimvaba, South Africa.

5. Teacher Professional Development course.

The aim of the TPD course was to support and guide the development of relevant teacher knowledge and proficiency to enable rural classroom practice to portray a 21st century technology enhanced teaching and learning engagement.

The TPD course intended for **classroom practice** to change to reflect more of "emerging pedagogy for the information age" (Voogt & Knezek, 2008) through the change in knowledge, beliefs and attitudes of teachers towards the acquisition of new skills, new concepts and new processes related to teaching practice (Living Lab approach). The following were likewise regarded as important:

- To **engender a positive attitude** of teachers towards the adoption and integration of technology is significant to its successful integration.
- To **mitigate workshop fatigue** through *Gamification* as a design strategy to provide a more joyful but focussed engagement.
- To **purposefully support** teachers through collegial, facilitator and course material to translate integration of ICT.
- To facilitate the **physical access** to and availability of appropriate technology to integrate into classroom practice. A strategy of *earn as you learn* was adopted and teachers had to earn the eventual ownership of the technology through the attainment of intermin goals that were given as badges. On completion of all the compulsory badges, ownership of the tablet devices reverted to the individual teachers.
- To **scaffold sessions** based on the Gradual Release Of Responsibility Instruction Framework (Pearson & Gallagher, 1983). This implies that there is a purposeful shift of cognitive load from the TPD as a facilitated simulation of practice in the training session, to co-creation, towards the independent practice and application by the teacher in their classroom.
- Each of the 10 modules in the curriculum would be **about** relevant content, **through** a teaching strategy **using** technology to facilitate the teaching and learning interaction. For example Module 1 is **about** getting to know your tablet, **through** the Jigsaw teaching strategy, **using** Tablet Technology,

In addition teachers would be exposed to best practice in group work; different assessment strategies; concept of a reflective practitioner; and concepts regarding online learning and additional resources. Each teacher received a 3G enabled 15" Tablet that they could use (which they had to earn). After they had achieved the 13 compulsory badges the tablet ownership was transferred to the teacher. In addition, teachers received specific technologies such as a cover, SD card, earphones and a tablet pen as they progressed along the learning path. The ICT4RED TPD course was built in such a way that it could be run off line without having to connect to the internet. If a school provided enough evidence that 80% of the staff have successfully completed the first 5 modules, the school received a data projector and a mobile kit specifically designed to host 20 tablets in a bookcase with the chargers for learners to use. Provision was made for the availability of 1 device per class, 5 devices per class and 1 to 1 device saturation. This meant that if teachers only have access to one device they would still be able to integrate the technology into their classroom practice.

6. How did the TPD course work?

The guiding idea of the TPD is that teachers teach the way they are taught. As such the course is presented by modelling best practice, through the presentation of 10 purposefully chosen teaching strategies in 10 Modules. A social constructivist teaching premise was followed that implies teachers learn with and from each other.

The TPD course is presented as a learning path where the teacher moves from a commitment (Module 1), to using the tablet for their own personal use (Module 2 and 3), to use for teaching and learning (Module 4 to 7), to use for collaborating and sharing (Module 8 to 10) (Botha, 2014). The learning narrative is presented as a pathway that the teachers follow to graduate and earn their tablet.

Each module runs in the same way as presented in Figure 4 and outlined below:

1.   The teaching strategy, skills and other competencies built into each module are simulated (the facilitator acted as the teacher and the teachers took the role of learners) during the TPD session. This provides an opportunity to experience the strategy, learn more about a topic and gain technology skills. Each module is linked to at least one badge

as learning outcome. There are 13 compulsory badges and 5 challenge badges. The main difference being that the challenge badges are not facilitated. The compulsory badges are the ICT4RED badge, Jigsaw, Storytelling, Roleplay, Learning Stations, Educational Content creator, Mind mapping, Flipped Classroom, Game Based Learning, Filed Trips, Gallery Walk, Mobile Skills and Reflective Practitioner. The optional badges are E-mail, Twitter, App Evaluation, Assessment and Blog Collaborator. Each school had a dedicated facilitator that acted as a mentor and guide.
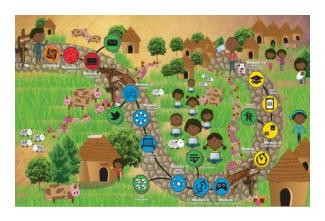

Figure 3: Learning path with badges which had to be earned.

Figure 4: TPD course flow

2.   After the TPD session, the teachers have about 3 weeks to apply the strategy for their own content, using technology in their own class. They need to record some evidence as outlined in the badge criteria. This step positions the teachers as a co-creator as they need to incorporate their existing knowledge, expertise and experience with new pedagogical proficiencies (presented as teaching strategies) and technology skills to enhance their classroom practice. The process is supported by the badge criterion that outlines the expected evidence the teacher needs to present.

3.   The following table presents the Jigsaw badge, linked to Module 1. The table outlines the instructions, what the expectation is and what to provide as evidence. The selection of subject content and the navigation of the specific context are considered the teachers contribution (co-creation):

Table 2: Example of how the Jigsaw badge had to be earned

JIGSAW BADGE Instructions:	What to do:	What to provide:
Use the Jigsaw Strategy in your classroom by creating at least four expert tasks for the learners to do, or learn about. At least one of the expert groups must use a mobile device.	You have created at least four expert tasks for the learners to complete. You have implemented the Jigsaw Strategy with your learners.	An electronic copy of your four tasks. This can be either a photo of hand written tasks or a word document. A photo of a *Home group* and an *Expert group* doing their tasks.

4.   A badge facilitator evaluates the evidence provided and either awards the badge or gives meaningful input on possible improvements. In the latter case, the teacher can resubmit at any given time.

5.   If there are still modules left, another TPD session will be done and the process repeats.

Evidence on how the teacher navigated existing and new knowledge skills and proficiencies had to be presented to an external moderator for each of the modules. Each of these modules highlighted various new skills and knowledge that the teacher had to integrate into their frame of reference in order to complete the course and graduate.

Each module is designed to not exceed three hours of training. It is suggested that there is a three week interval between each module presentation to allow teachers to integrate the new content and knowledge into existing practice. Taking school terms into consideration the course would then take about one academic year to complete. The course utilised Tablet Technology based on the Android OS as it is open and adaptable, has many free apps and closely resembled the majority of devices that the teachers owned.

7. Linking the TPD to co-creation and innovation.

The process of co-creation was followed to direct or influence the course of action of the teachers. Adapting the view of Allen, et al. (2009), co-creation is seen as the active, creative and social process, based on collaboration between the TPD course facilitators and educators. The co-creation activities are initiated by the ICT4RED initiative in order to generate value for the teachers, and ultimately the school and learners.

Figure 5: Process of innovation through co-creation

To illustrate this, the Technological Pedagogical Content Knowledge (TPACK) (Koehler & Mishra, 2009) was applied. The TPACK was adapted to present an ICT4RED pragmatic TPACK framework. This adaption facilitated the specific aims of the course, highlighted opportunities for co-creation whilst narrowing and directing the broad understanding of the TPACK towards an application instance. Each module incorporates the following which allowed the teachers to co-create:

- Technology Knowledge as suitable technology knowledge related to an Android Tablet is used to support the teaching and 21st century learning engagement. It is operationalised as technology skills related to the tablet.

- Content Knowledge is related to words like being, participating, teaching and learning in a digital world. Teachers are considered the subject domain experts. The TPD enhances their knowledge of skills and strategies to facilitate a 21st Century learning environment.
- Pedagogical Knowledge is limited to teaching strategies that would successfully outline the integration of technology into a 21st Century learning environment. The choice of strategies was done on its robustness and replicability. Knowledge on own practice was encouraged through reflection on practice towards reflective practitioners.

Teachers are thus equipped with the identified competence or skill, as suggested by the *ICT4RED pragmatic TPACK framework* and need to, through co-creation; demonstrate a communicated degree of proficiency in implementing a skill, competence or teaching strategy into classroom practices.

Classroom practice is considered the nexus of the TDP process. (Fullan, 2007) adds his voice to (Bate, Bevan, & Robert, 2004), which contends that for people to change, they first need to experience the desire to change. They reason that "[t]he concrete experience of participating…is crucial, meanings and value being formed after the experience not before it". As such, the *change* in classroom practice is seen as the result of a purposefully planned experience which ultimately results in action.

The 21st century learning design of the TPD course was evaluated using Microsoft Partners in Learning (2014) rubrics. These rubrics were developed and tested internationally for the Innovative Teaching and Learning Research project and the evaluation was done by expert reviewers. It represents an important skill which the teachers need to develop and employ in their own classroom practice. These skills are collaboration, knowledge building, the use of ICT for learning and skilled communication, self-regulation, and real-world problem-solving and innovation.

Using this rubrics allowed for the a 21st century classroom engagement in which IT-supported pedagogical practices can take place. Teachers therefore became co-creators, mainly because they could:
- apply their newly gained technological knowledge of integrating a mobile tablet to support teaching and learning into their classroom in their subject and at the grade where they taught
- made use of their own content knowledge in a subject and grade level to integrate new teaching strategies (above) as pedagogical knowledge with a tablet to support their teaching;
- create new lessons based on old content knowledge to demonstrate competence in applying skills like collaboration, knowledge building, the use of ICT for learning and skilled communication, self-regulation, and real-world problem-solving and innovation using a tablet to support their teaching.

Every phase of development of the course allowed for improvement of the modules. It was soon realised that acknowledgement should in addition be given to teachers interpretation of their own needs and interest in implementing and integrating technology to support teaching and learning.

8. Conclusion

The ICT4RED TPD consists of 10 modules of courseware presented through a gamification strategy. It is innovative as it presents a practical, free, practice based (three years and 3 iterations) peer reviewed course and methodology of how teachers in rural, resource constrained contexts can be empowered and supported to integrate technology to address 21st

century teaching and learning challenges and co-create new lessons. The significance of game design elements such as simulation and fun, technology endowment in need rather than in case (earn as you learn), adequate scaffolding, a clear learning path with interim learning goals articulated as badges and relevant ICT enhanced teaching strategies contribute towards the unique innovativeness.

Technology is not just earned but teachers become innovative co-creators of content within their own subjects and grades. As the new knowledge, skills and strategies spill over into classroom practice; teachers become facilitators and thus demonstrate and lead learners towards creating and evaluating content and information on tablets to enhance their own learning. Although the research is highly contextualised within a single area, the ICT4RED TPD course has been implemented in varying other environment with similar outcomes. Longer term study will be needed to assess the outcome of the intervention on learner marks in conventional assessment. Although the sustainability beyond this intervention would need to be assessed, it noteworthy that two of the teachers were National Teacher Award winners in 2014.

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