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PRE-SERVICE TEACHER TRAINING FOR REALITIES OF 21st CENTURY CLASSROOMS

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ABSTRACT

Pre-service teacher training (PTT), programs are required to emphasise the importance of enhancing the theory practice nexus and on constantly developing a sense of teacher identity and teaching competencies (Liu & Low, 2015) for the 21st Century learners. The 21st Century Curriculum Research Project (21CP) sought to explore how pre-service teachers could be adequately equipped with 21st Century skills for ICT integration. This paper reports on the development and implementation of a technology integration curriculum conducted with pre-service teachers at a university in the Western Cape, South Africa.

The findings of the study have highlighted that a curriculum grounded in a sound theoretical base can yield desired outcomes in f2f/online context. It argues that the theory-practice nexus could be bridged through experiential learning from carefully designed activities. Furthermore, it suggests that cognitive access is crucial in the design and presentation of any curriculum.

KEYWORDS

Curriculum Design, ICT Integration, TPACK, SAMR, Pre-Service Teacher Training, 21st Century Skills

1. INTRODUCTION AND BACKGROUND

The expectation is that PTT will graduate new teachers with 21st century knowledge and skills and the know-how to plan and implement the integration of information and communication technologies (ICTs) in their classroom practice. Recent evidence shows that newly qualified teachers (NQTs) are joining the teaching professional not fully prepared for realities of the 21st Century classroom. PTT programs are required to emphasise the importance of enhancing the theory practice nexus and on constantly developing a strong sense of teacher identity and teaching competencies (Liu & Low, 2015).

An educator must have knowledge of how technology, pedagogy and content are interconnected, i.e. Technological Pedagogical and Content Knowledge (TPACK-Mishra & Koehler, 2006). However this is not sufficient to enable teachers to plan and present appropriate technology integrated learning activities and to teach with technology. This calls for a PTT curriculum that is appropriate and implementable so as to mediate constructive alignment through TPACK and the Substitution, Augmentation, Modification, Redefinition (SAMR) framework.

The 21CP study is a pedagogically focused digital literacy PTT program located within the curriculum studies subject as part of PTT. It sought to develop pre-service teachers with ICT integration competencies for teaching and learning. A curriculum was developed in alignment with the requirements and recommendations in provincial and national policies and guidelines for ICTs in education. All aspects of the planned blended f2f/online implementation were catapulted into exclusive online engagements on account of emergence of Covid-19 since March 2020. We reconceptualise our interaction and support with/for students and further had to revise the curriculum in terms of the number of activities and tasks.

2. PROBLEM STATEMENT, RATIONALE, AIMS AND RESEARCH QUESTION

The 21CP is viewed through an educational lens (theory-practice nexus). The situation we considered was: What is best suited to address the apparent disjuncture between the pedagogical-technology connections for teaching in a 21st Century classroom, and, how does PTT respond to these needs?

Based on literature and our experiences in PTT and continuing teacher professional development (CTPD), we focused on the following identified gaps to action: knowledge, understanding and skills: for planning and developing pedagogically sound technology integrated activities for learner engagement; for teaching with technology; to use technology to develop educationally sound learning objects. Given the above, the aims of the project focused on:

1. Developing a curriculum for PTT to effectively plan and integrate ICTs into curriculum delivery.
2. Equipping pre-service teachers with technological understanding, knowledge and skills to integrate these into their planning and teaching.
3. Determining the extent to which the design and implementation of the 21CP curriculum addressed the development of the necessary knowledge, skills and understanding for ICT integration.

We approached the study through a focused research question (RQ): How can the theory-practice nexus of 21st Century digital literature skills be enhanced in PTT through curriculum design?

3. THEORETICAL BACKGROUND

3.1 ICTs in Education

There is a strong belief in this millennium by developed and developing countries that ICTs are powerful tools that can help bring about transformation in education (Fu, 2013). In South Africa, research has also shown that, the use of digital technologies while integrating 21st Century knowledge and skills for teaching and learning has both direct and indirect impact on economic development. Meador (2014:1) argued that in this century "technological advances have exploded. Schools have not been left out in these advancements with classroom technology becoming increasingly more popular with "…technological tools … [that] provide teachers with methods in which they can actively engage their students in the learning process".

Current methods used in teaching with technology, to digitally savvy students, are proving to be ineffective. PTT providers have the responsibility to adequately equip graduating students with 21st century knowledge and skills to integrate technology into teaching and learning. This, according to Skoretz (2011:12), is complex as it involves much more than just learning how to use technology and adding technology-related activities to an existing curriculum.

Evidence (Sherman & Howard, 2012; Chigona 2015) show that NQTs are joining the teaching professional not fully prepared for realities of the 21st Century classrooms. Researchers have argued that for effective integration of technology into the curriculum, an educator must not only have knowledge of technology, pedagogy and content but have knowledge of how these three elements are interconnected (Koehler, Mishra, Akcaoglu & Rosenberg, 2013). Integration of ICTs implies that teacher should have knowledge, skills and understanding of technological pedagogical and content knowledge (TPACK) so as to enact SAMR in the teaching learning environment. Research has further shown that an educator's perception of his or her knowledge of ICTs for curriculum delivery coupled with the capacity to integrate them into the classroom has a direct impact on [attitudes, motivation] and self-efficacy beliefs (Moore-Hayes, 2011). Given the complexities of ICTs in education, the next sections set out the theories and frameworks to substantiate a theoretical framework of this study.

3.2 Illeris Levels of Learning

Learning is a transactional activity between a learner and the environment (Illeris, 2003:396). Illeris (2003:402) identifies four levels of learning: 1. "cumulative or mechanical learning"; 2. "assimilative or learning by addition"; 3. "accommodative or transcendent learning", and 4. "transformative or expansive learning". In

effect what this refers to is, the opportunities to learn along the 4 levels of Illeris is given life through Puentedura's SAMR framework. Laurillard's conversational framework and the Biggs's constructive alignment assist in understanding how this theory can take place in practice.

3.3 Laurillard's Conversational Framework

Laurillard's (1993) conversational framework maintains that there are constant interactions between the student-teacher and student-student. Laurillard (2002:29-30) identifies four kinds of activity for learning to take place: 1. 'discursive' - discussion between teacher and student; 2. 'interactive' - task/action/feedback cycle operating in the world of the content; 3. 'adaptation - description and task by teacher, and description and action by student; and 4. 'reflection' - on student performance by the teacher, and on experience by the student". This means that for a student to understand knowledge from the teacher or constructed themselves, the student must be able to experience it by practical applications in the real world – then the student has to reflect on this and through dialogue with the teacher/peers, they adapt the way they act on situations (Laurillard, 2002).

3.4 Biggs Constructive Alignment

Biggs's (1996) constructive alignment alludes to the constant interaction necessary among learning outcomes-activities-assessment, for effective learning, aiming to support students in developing as much meaning and learning as possible. Congruency of this is explicitly achieved when there is good alignment between a curriculum's intended learning outcomes, teaching and learning activities, and assessments of student learning.

3.5 Theoretical Framework

A synthesis of the theoretical framework literature yields a graphic flow (figure 1). It informs us of how the curriculum was designed and implemented, and for what purpose.

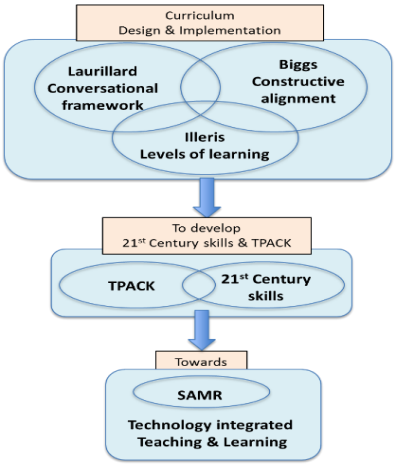

Figure 1. Authors conceptualisation of the theoretical framework

4. PRESENTATION OF THE CURRICULUM

4.1 21CP - Content and Design of Materials

Our approach to the curriculum design used 'backward mapping' as the method for developing a reliable curriculum aligned with Wiggins & Mc Tighe (2005). The 21CP curriculum comprises 5 modules: 1. 21st Century skills/Digital literacy; 2. Tools and technologies; 3. TPACK/SAMR; 4. Integration-planning;

5. Integration-strategies/techniques. The curriculum context drew on TPACK; SAMR; Laurillard's learning events; SA national policy and the Western Cape Education Department (WCED's) ICTs in education technology affordances. Student's subject specialisation provided the content for activity applications.

The curriculum was delivered through a blend of instructivist, constructivist and connectivist methodologies using a blended f2f/online mode. New content was addresses when necessary and the task expectations were discussed. The f2f/online blended mode required students to continue and complete work via the LMS. All resources (physical and human) were made available: resource materials; surveys; journal and forums were available through the LMS via links; personal support was enabled through a specific help (Q&A) forum; peer support via their own back channels; personal WhatsApp groups; e-mail and a student-lecturer WhatsApp group.

The materials were designed in alignment with Illeris's levels of learning (2003); Laurillard's conversational framework (1993) and Biggs's constructive alignment (1996). Our reason for combining these three was to: enable depth of knowledge and engagement progressively; to provide opportunities for learning through collaborative means; and to provide realistic and authentic alignment among the outcomes, activities and assessment. The following sections provide brief insights into the content, and how each of the frameworks/theories (table 1) featured in, and informed the design of the 21CP curriculum. Table 2 provides some examples of how the theoretical framework was operationalised for developing TPACK and SAMR.

Table 1. Theory / framework key concepts

Key Concepts		
Illeris levels of learning	**Laurillard's conversational framework**	**Biggs's constructive alignment**
1. Cumulative/mechanical	A. Discursive	i. Outcomes
2. Assimilative/by addition	B. Interactive	ii. Activities
3. Accommodative/transcendent	C. Adaptation	iii. Assessments
4. Transformative/expansive	D. Reflection	

4.1.1 Illeris Levels of Learning

(Modules built on one another to achieve progressive scaffolding)

1. *Cumulative/mechanical*: Selective tasks required basic-moderate use of technologies to (re)produce their understanding of the lessons and content. Students had to learn/know mechanically and through construction/collaboration certain content that was factual (e.g. Mind map of technologies and extending to individual affordances of the technologies).
2. *Assimilative/by addition*: Activities/tasks were ordered so that prior knowledge, skills and understanding could be used and built on for each successive module (e.g. Micro-ICT lesson plan built on learning events and SAMR).
3. *Accommodative/transcendent*: Inclusion of tasks based on higher order engagements (creating new knowledge (non-reproduction) (e.g. 4IR Forum discussion; Digital learning object creation).
4. *Transformative/expansive*: Extending learning to create something new aligned with redefinition in SAMR (e.g. LMS built on the 21CP design).

4.1.2 Laurillard's Conversational Framework

(Module design used combinations)

A. *Discursive*: We facilitated through constructivism and collaboration with minimal instructivism. Students constructed meaning through f2f and virtual interactions and discussions.
B. *Interactive*: We approached the task/action/feedback cycle with feedback (verbal/written) as well as with clarity of tasks and concepts –resources and help you files were made available to supplement teacher-student interaction.
C. *Adaptation*: Detailed guidelines and module information was made available (see Biggs below). Surveys and task assessment criteria were designed to encourage reflective engagement.
D. *Reflection*: Focus was on both cognitive (surveys) and affective (surveys and journal). At the end of each module students were expected to complete a survey on their learning. The journal was available throughout the course for reflections on their understanding, learning and feelings about the course and its implementation.

4.1.3 Biggs's Constructive Alignment

(Curriculum alignment with some examples)

I. *Outcomes*: Each module included Module outcomes (MO) and Student learning outcomes/indicators (LO) which emphasized and stated explicitly what was to be achieved and demonstrated (e.g. MO: develop knowledge and awareness of different types/affordances of various technologies/systems/services; LO: demonstration of collaborative abilities and technological understanding of the interrelationships and affordances of tools/technologies by creating a wiki (group work).

II. *Activities*: Engagement through the teaching (T) and learning (L) activities attended to the practical implementation of the modules (e.g. (T) overview of TPACK & SAMR videos (concepts/interrelationships) – (T/L) mediated time stamped discussions of above (focus-core concepts and application); (L/T) discussion of tools/technologies / apps / programs/software / systems/services using animated presentation).

III. *Assessments*: Tasks were organised aligned with SAMR and included assessment (for, of, as) (e.g. demonstrate knowledge and understanding by synthesising discussions/notes in a WIKI on the interrelationships between TPACK and SAMR; demonstrate information literacy skills by sifting and analysing a range of data and synthesising into a document outlining the teacher/learner promoting / prohibiting factors for ICT integration).
Guidelines: We additionally provided guidelines for all activities/assessments to hedge the chances of success towards the outcomes (e.g. when posting comments…address the challenge practically and logically. *First* make your opening comment on your own thoughts on the challenge *and then* ensure that you make reference to how you will plan and also how you will deliver accordingly - *Thereafter* you …do not simply comment that you agree or disagree…etc.; e.g. purpose of this module is to give you the opportunity to use easy to access technologies… It seeks to develop conceptual understanding that you can apply in any context).

Table 2. Operationalised theoretical framework for TPACK/SAMR

Task	Task: Context	Task: Digital Literacies Focus & Activity Emphasis	Task: Application	T P A C K Targeted	S A M R Targeted
Forum discussions	4IR hype - Mobile phones/ tablets not permitted in class	· Information & Technological literacy focus. · Interrogate information and provide argumentative / deep thinking with responses to colleagues.	*Student Application*	**TPK** **TCK**	SAM**R**
Using technologies to create learning objects/resources	3 Digital Literacies - Subject specific context - Tools and technologies	· Information, Technological & Media literacy & Pedagogical focus. · Creating a quiz through intermediate use of application & developing documents with freeware.	*Student Application*	**TPK** **TK**	SA**M**R SAM**R**
Planning ICT integrated e-Lessons	Subject specific context	· Information, Technological & Media literacy & Pedagogical focus. · Plan & develop ICT integrated lessons - cumulative application.	*Student Application*	**TPACK**	**SAMR**
Completing journal & surveys	21CP course specific - 5 X 21CP module specific	· Information, Technological & Media literacy & Pedagogical focus. · Reflect on learning, teaching, course, etc. and key-takeaway of each module.	*Student Application*	**TPACK**	SAM**R** SAM**R**

5. RESEARCH DESIGN AND METHODOLOGY

This study is underpinned by an interpretivist philosophy to gain rich insights into the complex issue of ICT integration professional development for PTT. We used the phenomenological tradition to guide the research focus. A qualitative research method was used.

A purposive sampling method was used. The population numbered 244 final year (4th year) pre-service teachers. Data was available from 166 respondents who agree to data collection. Clean usable data was available from 90 of the 166 students. These 90 students were invited for classroom observations, individual and focus group interviews.

Primary data specifically for this paper was collected through surveys and journal entries. Both open and closed questions were included in the surveys closed questions required selection of appropriate leads and/or rating of leads. Journals were completely open-ended requiring students to reflect on the curriculum, their learning experiences and feelings about learning in an online environment.

6. DATA ANALYSIS AND FINDINGS

We used iterative inductive and deductive reasoning for thematic analysis. Our process was to inductively atomise and assign codes to the data under the most relevant themes and categories (e.g. Effects of the curriculum design: on implementation (modality); on learning (pedagogical/competencies)). Deductive analysis comprised deductions from data aligned with existing theories/frameworks (e.g. Curriculum alignment: outcomes, activities, assessment, materials, engagement and facilitation). Our codification method was organised to provide us with findings related to the outcomes of the curriculum (effects) and of the design of the curriculum (alignment). The findings and analysis in this paper are confined to the theme of *Curriculum alignment* and will briefly present some related aspects of the *Effects of implementation modality* theme only.

6.1 Theme - Curriculum Alignment

The data revealed prior experiences of technology-integrated learning were not widespread among students. They commented that the layout of the curriculum on the LMS was useful and developmental.

"We were not exposed to these in High schools that is why sometimes it takes time for us - intimidated because I have not been exposed to the opportunity to self-mediated learning from subject/course outlines and working it out for myself - I have not been exposed to seeing what is expected and going to happen all at once…I am not used to reflecting on my learning after each day/session - It is kind of difficult not to sit in a classroom and being taught the content…we are familiar with someone physically teaching us - There is a need for students [to be] inducted from 1st year to an on-line environment."

"All the information for the course is provided and broken down for students…the new and improved setup created an organized and simple program layout - Module outline with the guidelines for the tasks are useful to manage and take charge of my own learning through knowing what is coming up in the following modules…the online elements of this curriculum provide an advantage to continue uninterrupted learning at your one's own pace - It was useful to know and see the different modules' learning outcomes upfront…I'm starting to realize that this module is extremely well structured and planned…resources were quite helpful - I enjoy coming to the classroom for that reason and it shows how prepared the lectures are…the assessment tasks sufficiently covered a range of ways to assess learning."

Many acknowledge that the curriculum layout and presentation was useful to enable learning especially as the Covid-19 context severely changed the course of instruction and learning. Lack of prior engagement in a technological environment appeared to be a factor that resulted in newer experiences from a blended f2f/online curriculum for students. Student's appeared to 'enjoy' the learning experiences and inclusive nature of the curriculum.

6.2 Theme - Effects on Implementation

Reactions to the modules and the amount of effort and work required were mixed. The data highlighted that some students felt the cognitive level was extremely challenging and that it was overloaded with little time to complete all the work.

"The module has been paced well enough for me to gain an understanding of the different facets - it takes too much time as all students have other tasks and responsibilities - The modules were not as easy as I thought they will be…I faced some challenges in completing them."

Notwithstanding reservations of some students, the majority appeared to find a value-laden element of usability and applicability in the modules. These include the engagement with activities and pedagogical benefits for them. There appeared to be a progression in student's knowledge and skills.

"The learning materials/resources for the whole course are useful in informing my understanding of the work - has developed my understanding as to how ICT can be integrated into learning and teaching - I enjoyed engaging in the on-line discussion forum to verbalize my opinion - I am really happy with the activities and task of this modules, they motivate teachers to be more technological - I would make use of this knowledge."

"I have learned new techniques and strategies - gained more skills that i can use during planning and executing of tasks - I know now that when I plan a lesson I should think about what skills - I'm now getting more equipped with knowledge that will help me."

Aspects of student's pedagogical reflection came to the fore in the data. There appeared to be a satisfaction in the methodologies used during the course.

"There is a great inclusion of technology and a learner centred method in the way the teaching takes place - I know exactly what to do when it comes to my assignment because it was discussed in depth - This is collaborative learning at its best and it allows students to think in a critical manner - I am being exposed to new ways of using ICT for learning as opposed to the use of ICT for social means."

The reflective activities appeared to have stimulated student's thinking beyond their previous experiences. The nature of activities and f2f/online engagements appeared to have set a base for bridging the theory-practice disjuncture.

"…made me realise that there is more to the sessions than just the content…provoked my thinking - Made me to look at the integration of ICT in schools differently - This module of ICT has prepared me to use technology in everything that i do."

As the curriculum progressed students began to acknowledge the intensity of the content in justifying its relative heaviness. Student's preferred learning styles emerged through the data. They specifically referred to the need and preference for the 'teacher' explaining/teaching a lesson - where they could interact and see on a 'whiteboard' (share board). Implied in the data were student's take on self-paced and self-determined learning. There are some indications in the data that students are not used to taking charge of their own learning and learning on their own. The data showed that students were reflecting on their learning in different ways.

7. CONCLUSIONS

7.1 Curriculum Design and Implementation

The overall presentation and design of the curriculum for f2f/online was considered useful and sound for student's development. Student's prior experiences or rather lack thereof to operate in an 'e' environment can be debilitating in that it diminishes access to learning. This, coupled with institutionalised traditional methods at many universities, shapes the varying learning styles, attitudes and self-efficacy beliefs of students. We believe that our attention to the alignment of the elements of the theoretical framework contributed to promoting cognitive access.

We acknowledge that the number of tasks could be less heavy, but we do not believe that they were unreasonable. The particular challenges, which lead to this situation, were that we were tasked with completion within 6 months and Covid-19 upturned the planned run. Our response, to the concerns and Covid-19

imperatives, was to reduce the number of tasks while maintaining the integrity of the content and reworked or supplemented our materials to be more online appropriate.

Overall, students' notions show an acceptance of the contribution of the 21CP curriculum towards the use and prospective integration of various ICTs for teaching and learning. Most of the comments indicated that regardless of the challenges faced by the students, the modules/topics and various activities were valid, useful and beneficial in developing essential knowledge and skills. The curriculum provided opportunities to bridge the gap of a theoretical knowledge of ICT integration and practical knowledge through experiential learning. This was evident in the data when students noted that they were learning new 'things' by doing tasks that they now believed could be used by them.

Beliefs about gains are rational thoughts that we believe emanated out of the level of critical thinking of students. This could be attributed to number of opportunities to reflect that we presented and the method of delivery. We argue that sufficient quality opportunities to reflect on learning are a sound methodology to encourage critical thinking. This is aligned with (Bain et al., 2002) five elements of: Reporting, Responding, Reasoning, Relating and Reconstructing.

The 21CP curriculum appears to have equipped students with sufficient skills to plan for the use of technology effectively in classroom situations. One could conclude that, besides developing and enhancing: technological knowledge and skills, integration knowledge and skills, the 21CP reinforced positive attitudes of using ICTs among students.

7.2 21CP Outcomes

Our reflections on the 21CP are summed up through students' acknowledgment that the approach to the curriculum for ICT integration was of use to them and that they found value and derived benefits. Many of the students further acknowledged that it assisted them in thinking and doing beyond the normal with technology and as such opened them to newer possibilities.

There is a high probability that the university (where the research was conducted) will realign its curriculum to progressively incorporate the 21 CP curriculum from 1st to 4th year. The 21CP curriculum has additionally been adopted by a university (in a different province) for its PTT and is being researched in a doctoral study.

Given the findings thus far, we offer the following recommendations:

- The 21CP curriculum should be integrated in all subject offerings to students so as to synergise the different approaches to subject specific planning that does not currently give adequate attention to ICT integration.
- The curriculum should be offered from the 1st year of university. It should be sensibly spread over year at a time. This is to pay more attention to Illeris's levels of learning and progressively induct the students into an ICT integrated world.
- The next step of this work that would greatly benefit the implementation of this curriculum would be additional systematic evaluation that include but not limited to: Teacher educator preparedness to integrate ICTs in instruction; an exclusive on-line delivery mode and adaptability of the curriculum to different context.

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