EMANCIPATION FROM FUNDAMENTALIST TEACHING: HOW SCHOOL INHIBITS ICT CREATIVITY AND INNOVATION

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Abstract

The paper explores the inability of first-year students at a university in South Africa to use learning technologies in creative and innovative ways. They are products of an educational system that is beset with multiple problems: There are large numbers of unqualified or under-qualified teachers, many schools lack basic educational resources like text books and most do not have libraries, classes are over-crowded, there is massive loss of teaching hours due to teacher absenteeism. Most schools have limited or no access to Information and Communication Technologies for teaching and learning. Teachers use an outdated pedagogic model that supports knowledge development at the lower levels of Blooms Taxonomy. Therefore, many students arrive at university wholly under-prepared for the demands of higher learning and Twenty First Century learning. It was found that a year was not sufficient time for them to make the transition.

Keywords: Modern Learning, 21st Century Learning, Learning Technologies, Creativity, Innovation

1. INTRODUCTION

In this century, innovation, creativity, collaboration, and digital fluency are the pathways to success and prosperity. The modern world requires an education system that produces school leavers with qualities and competencies that are commonly referred to as 21st Century skills (Partnership for 21st Century Skills, 2008). It is a world that demands 'tech savvy' school leavers who are digitally competent, flexible, adaptable, work-ready, and who can show initiative. The Partnership for 21st Century Skills (abbreviated hence as P21.org) proposes learner outcomes that include the development of skills for innovative, critical and creative thinking, skills not only for career, but also for life, skills in communicating and collaborating, and Information, Media and Technology Skills (Trilling & Fadel, 2009). In order for these skills to be developed, teachers need to systematically apply teaching and learning principles using method that deliberately develop them. Such skills are best developed when authentic learning methods are employed (Herrington, Reeves, Oliver, & Woo, 2004).

The South African education system is currently wholly unable to produce school leavers that attenuate the demands of the global society. It is beset with numerous problems that prevent it from fulfilling this imperative. Some of these problems are situated within the teaching corps

itself; others have to with the provision of educational resources such as text books, classrooms, and media and computer technology. Further problems are caused by inefficient provincial and national education departments that have failed to implement policies and plans that were specifically instituted to improve education. Finally, the learner body itself is beset by problems of hunger, distance and poverty.

In this paper, I reflect on my engagement with first-year university student teachers who were enrolled for an ICT-integration module at the university where I teach. The research is driven by the question: How do the deficiencies of the school system inhibit the development of critical and creative thinking skills, and innovation in when students develop online learning environments? The struggles of the students in appropriating ICT as a productivity tool and a pedagogical tool serve as a stark reminder of the failures of the school system. The module was designed to cultivate pedagogical ICT skills, to foster creativity, and to advance innovative uses of ICT for teaching and learning. Yet, the majority of students created teaching and learning artefacts that failed to demonstrate an adequate comprehension of how to use ICT appropriately for teaching and learning. Only a few students transcended the model of teaching to which they have been exposed to most of their lives: the computer replaced the teacher as a mere disseminator of information. The computer tells, explains, instructs, measures, and even disciplines. In this mode of teaching, it is near impossible to develop critical or creative thinking skills, or use learning activities that are authentic, or to be innovative. Whereas it was the explicit intention of the module designer to emancipate students from these fundamentalist views of teaching, only a few could show innovation and creativity in their own learning designs.

2. BACKGROUND: A SCHOOL SYSTEM IN CRISIS

There can be little doubt that the South African school system is in crisis. The measure of the success of the educational endeavour, the annual examinations for the National Senior Certificate cannot be considered as an appropriate measure. Jubilant education officials celebrated improved matriculation results, and declared an official 2012 matric pass rate of 73.9%. Therefore, nearly three quarters of those who wrote the examinations were deemed to have been successful in their school careers. However, when one considers that, since the ‘Class of 2012’ started their school careers in 2001, approximately 620 000 learners dropped out along the way, the “success” rate becomes a more sobering and realistic 37%.

The Senior Certificate accredits the bearer, yet universities do not trust it. Prospective students are required to write the HESA commissioned National Benchmark Tests (NBT) prior to admission. The NBT verifies proficiency in Academic Literacy and Quantitative Literacy, and optionally also in Mathematics, if the qualification demands it. The message is clear: matriculation results are not considered to be an accurate measure of academic ability.

Another indicator that all is not well is the result local benchmarks tests that have been developed to assess the literacy and numeracy of learners in Grades 3, 6 and 9 nationally. In terms of the Annual National Assessments (ANA's), it has been shown that those learners in are not age-appropriately numerate or literate. Therefore, the education system is unable to develop learners to attain its own bench marks. South African learners participated in three international benchmarking studies in the past decade: Trends in Mathematics and Science Studies (TIMSS), Progress in International Reading Literacy (PIRLS) and Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ). The results show that South African learners consistently perform poorly in comparison to its more impoverished neighbours, and very poorly in comparison to developing countries in other parts of the world (Taylor, Fleisch and Schindler, 2008).

What may be the cause of the poor performance of the educational system? For the purposes of this paper, four dimensions of the schooling system are identified.

Firstly, the teacher corps of 425 167 individuals (Department of Basic Education, 2012) may not have taught the necessary higher order thinking skills, or may even not possess those skills themselves. The SACMEQ III language test performed on teachers in 2007 showed that teachers performed on average of 75.1% when questions were asked that were associated with information retrieval. However, when higher cognitive functions were invoked, scores fell significantly: inference (55.2%), interpretation (36.6%), and evaluation (39.7%) (NEEDU, 2013).

It is estimated that 9% of teachers are either unqualified or under-qualified (Department of Education, 2005 – National Policy Framework), and it is possible that these teachers simply do not have sufficient skills to develop the skills of learners. Further, there is an unnaturally high teacher absenteeism rate among teachers in South Africa. On any given school day, 8.5% of teachers are absent (Department of Basic Education, 2012). The average teacher stays away (takes leave or is absent) from school nearly four weeks per year (NEEDU, 2013) and the loss of teaching time is estimated to be around 10%. It can be surmised that teacher absenteeism may have a significant impact on learner outcomes, and the development of their cognitive skills.

Secondly, the lack of educational resources like text books, media centres and ICT facilities create conditions in which good quality teaching practices are near impossible. Only 25% of learners in South African schools have access to a library at school (Department of Basic Education, 2012). There is therefore limited exposure to additional resources or multimedia. A first year student at a university may never have seen an overhead projector or data projector being used in a classroom, or may have never watched an educational video.

Thirdly, due to lack of resources or experience, teachers may simply be using outdated teaching models. The pedagogy in the classroom is "telling", or "reading from the textbook". In the

absence of teaching resources and media, teachers cannot conceptualise another way of teaching other than "telling". Learner activity is reduced to "listening" or "writing down". The development of higher order thinking is practically absent in this mode. It is exacerbated by teachers who themselves only score 36.6% (NEEDU, 2013) when they have to invoke higher order thinking like interpretation. It would not be unreasonable to assume that they do not teach the development of higher order thinking skills.

Finally, the education system failed to meet its own goal that was set in in White Paper 7 of 2004. In the White Paper, the goal was articulated "*to have each and every learner and teacher 'ICT capable' by 2013*" (Department of Education, 2004). The vast majority of teachers in 2013 have limited or no experience in using Information and Communication Technologies. The vast majority of schools in South Africa do not have access to computers for teaching and learning, and a significant portion of learners exit school with no computer skills whatsoever. It is estimated that only 10% of the 28 000 South African schools that has one or more computers (Africa Institute of South Africa, 2012).

The preceding paragraphs offer possible explanations for the poorly developed skills of students who at universities struggle to cope with the demands of higher learning. It is clear that a large portion of these students were poorly prepared by the education system from which they came. They arrive with weak literacy and numeracy skills. They demonstrate poor study skills, have poor study habits, and they lack an inquiring, critical mind. It is clear that they were taught in an education system that perpetuated fundamentalist views on teaching and learning: The teacher and the textbook are the sources of all knowledge, and learning "off by heart" is how knowledge is acquired.

3. THEORETICAL FRAMEWORK

In the following paragraphs, conceptual constructs are briefly discussed that may illuminate understanding of the South African Education system. Firstly, the disjuncture between fundamentalist teaching and 'learning to be' is discussed. This leads on to a discussion of Authentic Learning, a manifestation of 'learning to be'. Then, the Structure of Cognitive Processes (Blooms taxonomy) is discussed as means to understand at what cognitive levels the educational endeavour can be understood. Finally, 21st Century Learning is pitched as a goal of education. These constructs constitute a useful frame for assessing the educational endeavour in the South African education context.

3.1 From Fundamentalism to 'Learning to be'

Fundamentalist teachers are often experienced teachers who are protecting the status quo. They typically use outdated teaching methods, and live by the maxim: "It has worked for me for X number of years, and it still works today". They are reluctant, or perhaps even unable to shift their pedagogic model. They are content focused, and reward memorisation of facts. They often see their primary role as imparting information. Teaching and learning is the transmission of knowledge. The discourse that supports this view is that of 'delivery' and 'reception'. The essence of this model is that it is the role of the teacher's to prepare, structure and transmit information to learners. The role of the learners is to pay attention, receive the information, store it, and act on it (Tishman, Jay, & Perkins, 1993).

It is assumed that knowledge comprises well-defined, discrete, units of information. Learning therefore means that learners 'receive' this information, previously packaged by the teacher into in smaller or larger amounts of increasing complexity in a pre-determined order. For example, to become a physicist, the learner needs to learn many formulas, rules and procedures of physics, and absorb a lot of experimental data (Brown & Duguid, 1996). Brown and Duguid criticise this conception of learning. They argue that "*knowledge is not a static, preformed substance: it is constantly changing. Learning involves active engagement in the processes of that change*." They explain that people do not become physicists by learning formulas, nor do people become football players by learning the rules of football!

According to Wessling (2010), this notion merely promotes passivity: "*Twenty-first-century learning embodies an approach to teaching that marries content to skill. Without skills, students are left to memorize facts, recall details for worksheets, and relegate their educational experience to passivity*". Therefore, learning to be a physicist, or any other type of professional, is about creating connections at interpersonal level between those who are learning, or apprentices, and those who are in the know, the mentors. It is also about creating intellectual connections between what is familiar and what is novel. It is about seeing, on a personal level, the connections that exist between a learner's personal goals and the "broader concerns of the discipline".

Bruner (as cited in Brown & Duguid, 2000) refers to this type of learning as "learning to be". He distinguishes between "learning about", which most likely is the type of learning that is found in schools today, and "learning to be". "Learning about" is the learning of facts, concepts and procedures. However, "learning about" is insufficient for developing effective ways of seeing the connections between disciplines and topics of learning that are required for modern times.

The problem that arises is that anyone who has ever been taught has a mental model of teaching tacitly embedded (Tishman, Jay, & Perkins, 1993). Much of the tacit conception of the teaching and learning methods that are embedded in student teachers emanates from their experience of

teaching. Their teachers in turn formed their own mental models from those who taught them. Most likely that has been a transmission model of teaching. The transmission model is ill-equipped to teach creativity, critical thinking and innovation.

Tishman et al (1993) suggest a dispositional model of thinking as an enculturation model: create a culture of thinking in the classroom. By using cultural exemplars, cultural interactions, and also directly teaching the cultural knowledge and activities, an inclination towards the desired skill will be developed. For example, a lecturer should a) not use the transmission model of teaching, b) require that students develop and experience other modes of teaching, let them interact with each other while they do this, and c) directly teach about alternative methods. In this way, student teachers may overcome their embedded conceptions of teaching.

3.2 Learning authentically

An appropriate manifestation of learning to be is Authentic learning. This the type of learning "*focuses on real-world, complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice*" (Lombardi, 2007). The term 'learning environment' is introduced, and it presupposes that learning takes place in environments that are purposely created or selected to enable learning, but that are not limited to classrooms necessarily. It may be an actual court room, on the stock exchange floor, in the streets, or a pharmaceutical laboratory. It could also be an inherently multidisciplinary environment that exists online and is similar to the 'real world' and that requires application of knowledge and skills.

Herrington, Reeves, Oliver, & Woo (2004) developed 10 essential characteristics of authentic learning environments and activities. Authentic learning environments and activities:

- Match as nearly as possible *real-world tasks* and are therefore relevant,
- Depend on *ill-defined problems* that cannot be solved easily by the application of existing algorithms. Learners have to identify for themselves the tasks and subtasks needed to complete the major task,
- Require *sustained investigation* over a period of time,
- Demand the use of *multiple sources and perspectives* that are not given to learners. They must examine the task from a variety of perspectives, and use a variety of resources and they are required to distinguish relevant from irrelevant information,
- Dictate *collaboration* with others within the learning environment and in the real world,
- Encourage *Reflection (metacognition)* and offer such opportunities,
- Can be integrated across different subject areas and therefore has *Interdisciplinary perspective.* They have consequences that extend beyond disciplines, encouraging students to adopt diverse roles,

- Utilises *integrated assessment* activities that seamlessly integrate into the learning tasks as it would happen in the real world,
- Produces *polished products* and culminate in the production of a product that is valuable in its own right, and
- Allow *multiple interpretations or competing outcomes*. There is not necessarily a single correct answer, allowing for diverse solutions that could all be correct.

Authentic Learning tend to motivate learners to persevere when the activities simulate their existing social structures and culture. They find the meaning of the discipline and they see its relevance (Lombardi, 2007). It helps them to associate with the discipline, and they end up asking: ”Can I see myself becoming a member of this culture?”

3.3 The Structure of Cognitive Processes (Blooms taxonomy)

It is clear that authentic learning activities require performance from learners that extend beyond the mere regurgitation of facts, which is what “learning about” is about. However, the reproduction of facts as learning tasks per se has limited value. Bloom’s taxonomy (1956) provides a useful frame to understand at what levels learners produce knowledge. In the original taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), learners at level 1 (the Knowledge Dimension) have knowledge of specifics, of ways and means of dealing with specifics (processes), and knowledge of the universals and abstractions in a discipline. The taxonomy describes incrementally higher dimensions of learning. The Comprehension dimension is about conceptual understanding: here learners can translate, interpret and extrapolate. At the Application dimension, learners can apply knowledge to different contexts, while at the Analysis dimension learners can perform analyses elements, relationships and organizational principles. At the next level, Synthesis, they can synthesize knowledge from different disciplines and perform unique problems-solving, they can plan, and they can derive abstract relations. Finally, at the level of Evaluation, learners can evaluate internal evidence and make judgements in terms of external criteria (Pacific Crest, 2007).

In 2001, the original taxonomy was revised by scholars who included David Krathwohl, who was one of the original taxonomy developers. It subsequently became known as Bloom’s Revised Taxonomy. The Revised Taxonomy retained six dimensions, and verbs are used to describe each dimension. Therefore, three dimensions were renamed, and two levels interchanged their order (Krathwol, 2002). The Knowledge dimension was renamed to include the verb aspect of it, *Remember*. The second dimension was renamed to *Understand*. Application, Analysis and Evaluation became *Apply*, *Analyse* and *Evaluate*. The latter however exchanged places with Synthesize, and was also renamed to *Create*.

The question remains: to what extent are learners in South African schools required to cognitively engage at the higher levels of Bloom’s taxonomy? Learners whose learning

experiences mostly required of them to function at the lower levels of Blooms taxonomy, may not only find themselves wholly under-prepared for university studies, but they would also not have the necessary cognitive strategies that are required for 21st Century learning.

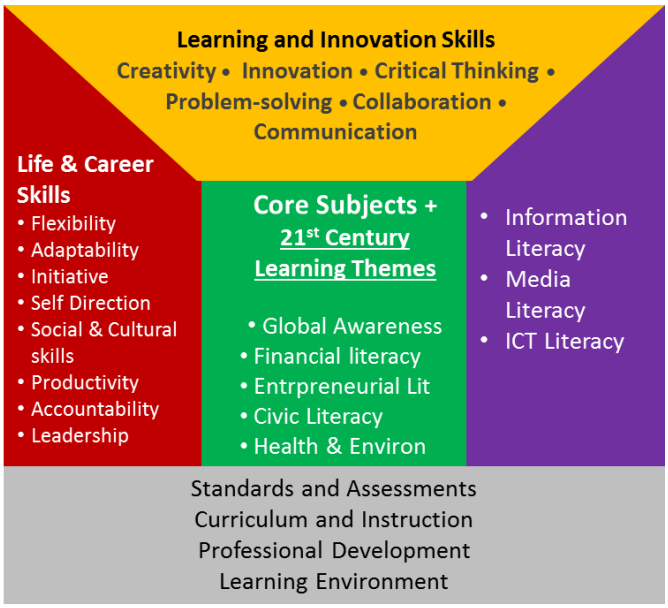
3.4 21st Century Learning

The challenge that is faced by teachers today emanates from this world and the very nature of the modern society: a society driven by access to massive amounts of information (Breivik, 2005) that is available virtually instantaneously on a variety of devices, many of which can be carried in the pocket of a user.

Naisbitt in his seminal work *Future Shock*, in 1982 cautioned that modern society will drown in information, but will be starved of knowledge. Clearly *information literacy* is a required skill in modern times. The use of computers for communication and information caused one of the most significant changes in Education ever (Garrison & Anderson, 2003), and it necessitated an awareness of new skills that are required to be learnt. Information literate people know when they have a need for information, can identify the information that they need to solve problems that are encountered, can find and evaluate the relevant information, and can subsequently organise and use the information effectively to solve a particular problem or to address a specific need (Breivik, 2005).

Organisations like the Partnership for 21st Century Learning (abbreviated as P21.org) developed "a vision for student success in the new global economy" based on what became known as "21st Century Skills". Despite some debate in the literature surrounding this concept, it is commonly accepted that there is indeed an imperative to establish a cohesive set of skills, knowledge and expertise for modern learning that would ensure success in the work place and also in life (21st Century Schools, 2010). Many of these skills are already viewed as being important in education, and have been considered so for several decades. These pertain to cognitive skills within the context of the core knowledge of academic disciplines, and include essential skills such as critical thinking, problem-solving, communication and collaboration. However, the P21-framework combines these with other dimensions of learning as shown in Figure 1.

Figure 1: The P21 Framework



Source: The P21 Framework, retrieved and adapted from www.p21.org

The framework proposes core subjects into which 21st century themes are interwoven. Core subjects include subjects such as English, reading, world languages, arts, mathematics, economics, science, geography, history, government and civics. The 21st century interdisciplinary themes that are interwoven into these subjects include Global Awareness; Financial, Economic, Business and Entrepreneurial Literacy; Civic Literacy; Health Literacy; and Environmental Literacy. The framework also proposes a specific emphasis on Learning and Innovation Skills. Those skills prepare learners for increasingly complex life and work environments. They include Creativity and Innovation, Critical Thinking and Problem Solving, and Communication and Collaboration skills.

In terms of the objectives of this paper, creativity and innovation are important constructs to consider, as the learning task to the students specifically required them to construct creative and innovative learning environments. In order for a learner to become creative, it is necessary that a teacher inculcates a disposition towards thinking creatively (Tishman, Jay, & Perkins, 1993).

Moreover, modern work environments require more from employees than thinking skills and content knowledge. Workers are expected to navigate the complex life and work environments. Learners should therefore develop sufficient life and career skills and be able to demonstrate the skills and dispositions of Flexibility and Adaptability, Initiative and Self-Direction, Social and Cross-Cultural Skills, Productivity and Accountability, and Leadership and Responsibility.

The P21-Framework further proposes a support system to assist learners in acquiring the necessary 21st Century skills. A set of standards should be developed, and the assessment practices in education should be examined and re-purposed. The curriculum and methods of instruction (teaching) should be redefined, and the professional development of teachers should be re-examined.

4. METHOD

4.1 Participants

The respondents were first year student teachers enrolled in 2012 for a module in educational technology in a Faculty of Education at a university in Johannesburg, South Africa. No form of sampling was employed, as all students who were enrolled were invited to voluntarily complete the survey. A total of 569 surveys were completed. As 663 students were enrolled for the module, the response rate was 85.82%, which is very satisfactory. No reward or incentive was offered for completing the survey. The gender distribution of the respondents is contained in Table 1 and the age distribution in Table 2.

Table 1: Gender Distribution

	Frequency	Percentage
Female	317	55.7
Male	252	44.3
Total	569	100.0

Table 2: Age distribution

Frequency	569
Minimum	17
Maximum	50
Mean	20.49

4.2 Design and methods

The first phase of the research comprised a survey. The survey responses were collected through an online questionnaire that was developed using a Google Form. The form was embedded in the online learning environment that was used for the module. The survey comprised four sections. Section 1 collected biographical data, although students did not have to enter a name or a surname. Section 2 collected data about their experience with computers, what electronic devices they owned, how and where they access computers, what kinds of online services they frequent, how they access the Internet (if they did), how often they used a computer, and the different online services like Facebook that they accessed. Likert-type scales were used where appropriate, and included responses from “strongly agree” to “strongly disagree” (extent of agreement), or from “Never” to “Daily” (frequency). Section 3 collected data about the use of computers by their teachers while they were in school. Section 4 collected data about the teaching methods that were prevalent in their high schools while they were pupils there. Descriptive statistics were generated for each item. Where appropriate, cross tabulations were drawn. Pearson’s correlations

were performed to establish whether relationships existed between, for example, computer experience and performance in the module. In some cases, variables were recoded.

Phase two of the research comprised the assessment of the projects of the students. Students were required to use several online tools to construct learning artefacts using different forms of media like text, images, sound and video. The final learning environment had to be a "polished product". Specific requirements were set for being innovative and creative. In addition, as part of the learning task, students had to write short notes justifying their specific selection of a method or tool, and had to describe how theoretical constructs manifested in their work.

The marks obtained for this learning task constituted a significant portion of the final mark for the module, and students were suitably motivated to pay due attention to this learning task. A comprehensive rubric was used to assess the student work. Due to the large number of projects, and the voluminous nature of the rubric, a team of seven lecturers marked the student work. The team leader moderated marked work to check for consistency between the markers. Table 3 is a compacted version of the rubric.

Table 3: The rubric

Dimension	**Marks Allocated**
Describe and justify tools	8%
Matching examples from work to theoretical constructs	4%
Relate learning activities to Bloom's Taxonomy	8%
Environment (Originality, effectiveness, innovation, language, technical errors, navigation)	30%
Pedagogy (Collaborative learning, Authentic learning, Assessment)	30%
Design, Look & Feel	10%
Reflection	10%

Each item on the rubric used a scale that allocated marks ranging through "Poor", "Insufficient", "Approaching", "Meets Requirements, Exceeds Requirements, and "Excellent (best practice)".

5. RESULTS

5.1 Learner computer experience, use and access

Nearly 43% of all the students (N=569) who completed the questionnaire used a computer for the first time when they enrolled at the university. Measures of central tendency were computed to summarise the data for the variable, and is captured in Table 5. The results are N = 569, M=2.20, SD=1.248. The mode is 1. Only 3.9% of the students had used a computer since before they started primary school.

Table 5: Computer Experience

	Coded	Frequency	Percent
I used a computer for the first time when I enrolled at UJ	1	244	42.9
1 - 3 years	2	99	17.4
Since High School	3	117	20.6
Since Primary School	4	87	15.3
Before Primary School	5	22	3.9
Total		569	100.0

When asked "how often do you use a computer", the students responded as tabulated in Table 6. Measures of central tendency were computed to summarise the data for the variable. The results is N = 569, M=3.24, SD=1.596. The mode is 1.

Table 6: How often do you use computers?

	Frequency	Percent
Never	123	21.6
Seldom - once or twice a month	71	12.5
Occasionally - once a week	114	20.0
Regularly - twice a week	111	19.5
Often - at least daily	109	19.2
More than once a day	41	7.2
Total	569	100.0

The questionnaire was completed approximately three months after the start of the academic year. Table 6 shows that more than a third of students were still not using computers at this time.

Respondents were asked what types of cell phones they possessed. The results of these items are tabulated in Table 7.

Table 7: Use or ownership of technological devices

	Percent
Own a cell phone with no access to the Internet	23.7
Own a cell phone with access to the Internet, but not a smart phone	48.3
A Smart phone	69.4*
A computer or a laptop	26.7
A tablet computer	2.3

* several students won more than one cell phone, therefore cell phone ownership exceeds 100%

Only a small percentage owns a tablet (2.3%). The majority of students however have access to the internet through their cell phones (76.3%). In order to establish whether a relation exists between owning a computer and the marks that students achieved, a point-biserial Pearson product-moment correlation coefficient was computed to assess the relationship between the computer ownership and performance in the module. There was a weak positive correlation between the two variables, r = 0.054, n = 569, p = 0.250. Ownership of computers was marginally correlated with performance in the learning task.

Table 8: The Correlation between marks achieved and computer ownership

		Computer Ownership	Marks
Computer Owned	Pearson Correlation	1	.054
	Sig. (2-tailed)		.250
	N	569	463
Marks	Pearson Correlation	.054	1
	Sig. (2-tailed)	.250	
	N	463	463

Table 10 shows that 71.5% of the respondents either never or only occasionally use the Internet. Respondents were asked to indicate whether they have uploaded data to the Internet (beyond status updates on social media). Were students also producers of information? Table 11 shows that in this regard, only a small portion of students contribute to the content store of the Internet.

Table 10: Students accessing the internet

	Percent
Never	21.1
Seldom and Occasionally	50.4
Regular and Often	29.5

Table 11: Students uploading content to the internet

	Percent
Uploaded a clip to YouTube	21.3
Built a website	16
Created a blog	7.6

5.2 Teacher computer use

How many teachers were using ICT at their respective schools? The respondents indicated that 23% of their teachers never used a computer for any purpose whatsoever. Table 12 enumerates that use of computer tools by teachers.

Table 12: How many teachers use computers in the classroom?

	Percent
Use computers for lesson preparation	22.2
Use computers for Assessment	4.7
Uses PowerPoint for lesson preparation	24
Use the internet in the classroom	15.9

It is clear that only a small portion of teachers use computers for teaching and learning. How often do the portion of teachers that use computers for teaching, use those? Table 13 shows that the teachers who use computers for teaching only do so for a small percentage of the time.

Table 13: How often do teachers …

	Mean	Never	Seldom	Occasionally	Regularly	Daily
Let learners use ICT in the classroom	1.70	56.2	29.3	4.4	8.8	1.4
Require learners to use computers?	2.06	36.6	41.5	6	11.8	4.2
Use computers in the classroom to teach?	1.75	52.9	30.9	5.8	8.6	1.8
Use a computer for lesson preparation?	2.51	25.1	36.4	12.3	15.1	11.1

The three variables listed first in Table 13 were computed into a summed 'Teacher Use' variable. In order to establish whether a relation exists between teacher use and the marks that students achieved, a Pearson product-moment correlation coefficient was computed to assess the relationship between the frequency of teacher use of computers and performance in the module. There was a weak positive correlation between the two variables, $r = 0.049$, $n = 569$, $p = 0.288$.

5.3 How authentic was learning at school?

Respondents were requested to respond to the question: How often was learning at your school based on the principles of Authentic Learning? Measures of central tendency were computed to summarise the data for the Authentic learning variable. The results of this analysis is $N = 537$, $M=1.46$, $SD=1.070$. Of particular interest here is that the mode is 2. It appears that most students were exposed to Authentic Learning environments either never or seldom. Table 14 shows that less than 12% of learners regularly participated in Authentic Learning.

Table 14: How often was learning authentic?

	Never	Seldom	50:50	Often	Mostly
How often was learning authentic?	22	23.2	36.4	9.1	3.7

5.4 Analysis of the assessment results

During the first round of assessment, only 56% of the students passed. Many students passed because their sites were technically correct, and they managed a pass. Due to continuous assessment, marks earned in other tasks helped students achieve a pass. However, a 56% pass rate was not acceptable, and special arrangements were made to give students a second opportunity to submit a more deserving product.

Ultimately, 360 students whose marks were recorded achieved a pass mark for the task, or 76% of the students. Measures of central tendency were computed to summarise the data for the marks variable in Table 14. The results of this analysis (N = 471) are M=56.97, and SD=12.822. The majority of the students (76%) achieved a pass mark.

Table 15: Assessment results

N	Valid	471
	Missing	98*
Mean		56.97
Median		58.00
Mode		50
Std. Deviation		12.822
>=50		360
<50		155

*The discrepancy in N here and N in previous tables are ascribed to students who did not complete the module

The learning tasks of the students were analysed and scored for exemplifying the theoretical constructs as indicated in Table 15, and which are reflective of 21st Century learning. The mean score (out of 6) for each construct is indicated. The responses ranged from "There is no evidence that {construct} was considered" (0), to "Poor exemplar of {construct} (1), to "The exemplar approaches "Meets requirements" (2), to "Meets requirements" (3), to "Exceeds Requirements" (4), to "This is an excellent exemplar of {construct}" (5). A score between 2 and 3 would therefore indicate an acceptable level of performance. The mean scores for each dimension are recorded in Table 15.

Table 16: Sub-scores for learning tasks

Dimension	Max Score	Score (mean)
Bloom's level (Critical Thinking)	5	2.87
Innovation	5	3.01
Collaboration	5	2.91
Authentic learning	5	3.05
Creativity	5	2.69

The combined mean for these items is 2.986, which means that students' performance was between "Approaches Performance" and "Meets Requirements". Individually for each of the items, a mean of "Exceeds" or "Excellent" could not be achieved.

6. DISCUSSION

On the whole, the performance of the students in the learning task was unsatisfactory. Despite the fact that the majority of the students passed the module, the low mean of approximately 57% means that students met the requirements by a small margin. Several factors contributed to the low performance.

6.1 Technical proficiency

Firstly, it was evident that their computer skills were insufficient. It was expected that students would self-learn and also learn from their peers, after a tool was briefly introduced during lecture time. This did not happen, and they expected to be taught every detail of every tool that was introduced to them. They were trapped in the realm of recipients of information (compare Tishman, Jay, & Perkins, 1993). Their ability to learn technical skills were impeded by a tacit need to be taught step-by-step, and an incapability of taking control of their own learning.

They found the plethora of tools overwhelming. They viewed each tool as a new tool to be learned, and initially failed to comprehend that generic functionalities and procedures exist in terms of process, application, and utility among tools, and that skills that were learnt in one tool, could be transferred to another tool.

The unfamiliarity with the online technological world manifested in other ways. For example, students may have used a tool like *Edmodo* to develop a learning activity. In their learning environments, they would include a link to the learning activity. Yet, this link would lead to the home page of *Edmodo*, and not to the actual learning activity hosted in *Edmodo*. This was anticipated by the module presenters, and students were instructed to, in cases where it would apply, give login details. This seldom happened. Similarly, many students' learning environments were not shared or made public, and were only accessible with login codes. In an

extreme case, a student constructed a learning environment that consisted solely of a list of links to online tools in which activities were developed.

Interestingly, many students who had excellent computer skills performed poorly in the learning task. Observing how other students struggled due to lack of skills, they thought that they were one up on those students. They underestimated the complexity of the task, and they expected to be rewarded for their technical skills. In many cases they created technically sound and even appealing sites. They often included gimmicky features to show off their skills. However, they underestimated the complexity of the task, and its real requirements. Despite this, it can be concluded that the lack of technical skills is an impediment to innovation and creativity.

6.2 Scholastic Cultural Capital and Thinking Dispositions

Students did not seem to have the Scholastic Cultural Capital (Lareau & Weininger, 2003) or the required Thinking Dispositions (Tishman, Jay, & Perkins, 1993) to engage with the requirements of the task over the extended time period that was required. There was little evidence that students systematically compared their work with the requirements of the task. In addition, the marking rubric was given to students prior to submission date. Many students did not use this to guide their work.

When participating in authentic learning experiences, prolonged engagement is required (Herrington, Reeves, Oliver, & Woo, 2004). However, the task seemed too long to read, too complex. Few students analysed the task, identified the necessary steps that were needed to be taken, comprehended the complexity, and systematically addressed each of the requirements. Ultimately, they made up their own task: The general idea that prevailed that "we must build an educational website".

The inability to pay attention to detail manifested in other ways. The task had to be submitted by entering the URL to their learning environment and attaching the planning document in the module online class, or by sending an email with the URL and attaching the planning document. Either process included steps during which students had to confirm that the submitted URL is correct, and that they have attached the planning document. At least 15% of students either submitted incorrect URL's, or failed to attach the planning document.

Further, the technical and "aftercare" of the work was insufficient. Many students clearly did not check the accuracy of links, or spelling and typing, before submission. Much of the work was error-ridden. They demonstrated their lack of understanding of the habits and practices of the discipline, which results when 'learning to be' is not implicit.

6.3 Perpetuating fundamentalist views of teaching

The majority of the learning environments that were constructed by the students perpetuated fundamentalist thinking about what teaching should be. The environments were carbon-copies of the "teacher in front" model, dispensing information. It appeared that they transposed the model of teaching that they were exposed to during their schooling to the online environment. The learning environments were mostly content based. Content was presented in systematic chunks, and the order by which content had to be worked through was pre-determined. Typically, content was followed by a small assessment activity. There were limited options or alternatives and pathways. The concept 'Learning activity' was generally not fully comprehended by the students, and those who would want to learn from the environments, would be engaged by reading mostly. Clearly, students have not overcome their embedded conceptions of teaching (Tishman et al, 1993). There was distinct absence of a coherent and cohesive vision of what education is and of what teaching is.

6.4 Lower cognitive processes invoked

The complexity of the content that was presented, was often inappropriately simple, and lacked depth and detail. A distinct absence of explicit attempts to develop higher order thinking was noticeable. There was a lack of differentiation among activities, and most activities required the simple recall of facts that were presented. These low-level assessment activities were pitched at the "Knowledge" dimension of Bloom's Taxonomy. It was only in exceptional cases that activities required learners to *Apply, Analyse, Evaluate* and *Create* (Krathwol, 2002).

6.5 Twenty-first Century Learning and Innovation

Despite 21st Century Learning being a central theme in the module, it seemed that students were unable to grasp the essence of what it entails. It was as if the theme was content that had to be learnt about, separate from the real world, with no impact on what on even the design of the learning environments. It did not become a lens through which Education could be viewed, and its underpinnings did not find itself into the work that they created. And when it did, it was by virtue of the tools that they were using. The tool may have, for example, facilitate communication and collaboration, but in the design and intent of a learning activity, this appeared to be only incidental.

And finally, the quest for authentic learning remained elusive. Where students could easily list the 10 requirements for *Authentic Learning* in a class quiz, they seemed unable to design authentic learning activities. These remained contrived, and they did not require prolonged investigations that had real-life significance.

It was only in cases that were the exception that students produced learning environments that could be considered innovative. It was clear that they have not been sufficiently exposed to innovative use of technology or innovative teaching. The remained the copy cats of their former teachers.

7. CONCLUSION

It is clear that the legacy of the school environment impacts on the ability of student teachers to become 21st Century teachers. The multi-varied deficiencies that students bring into higher-education education impede their ability to become part of a modern productive society. One year of exposure to alternative forms of teaching is not sufficient to overcome the impediments that burden students. The modeling of an appropriate ICT pedagogy by the lecturers accompanied by an explicit teaching regime that develops conceptual knowledge of such pedagogies is not sufficient to overcome the ingrained model that becomes tacit practice.

To reverse the trend, entrants should be exposed to a different educational system that supports not only the development of the necessary literacies, Numeracy, Reading, and Writing, but also that of ICT, Media, Information Management, and Life and Career skills. And, in addition, when those students arrive at the door step of university, they should also engage in learning activities that reflect the requirements of modern society.

Postscript

There were also many examples of good projects. Some of these were to be expected, given the cultural capital with which those students entered the university, and the resources they had access to. What was more pleasing to see was however, were the occasional effort of those who did not have the kind of background that would support their development of becoming 21st Century teachers, who managed to soar above the rest. They are the ones who "got it", who became it, and they are our pathfinders. In other related research, it is seen that by the time these students are third years, they have indeed transcended the legacy, and that they are becoming 21st Century teachers.

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