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(Trans) Formation through educational technologies

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Historically, the 3Rs (reading, writing, and arithmetic) have laid the foundations for student life-skills, however, to function in the 21st century, students need to embrace the 4Cs (collaboration, creativity, critical thinking and communication). Teachers need to employ a variety of educational technologies, which embrace various aspects of the 3Rs and 4Cs in their practice. This work provides a framework for teachers to practically implement the 4Cs in a transformative space so they are then able to apply the 4CS through technology by implementing this approach to their teaching. This mode of teaching prepares students with the necessary tools for the 21st century.

Keywords: Transformation, Educational Technology, Critical Thinking, Communication, Collaboration, Creativity.

Introduction

There is widespread agreement amongst educators and the general public about the importance of the traditional fundamental building blocks that underpin student learning. These skills are often referred to as the 3Rs – reading, writing and arithmetic. Traditionally considered to be the foundations of learning, nowadays, the 3Rs alone are not enough to provide students with the necessary skills needed to function in the 21st century.

Given the saturation of information and communications technology in education and industry, students' reliance on such technologies as the Internet, mobile devices, smart phones, social media and learning management systems has challenged the way teachers use these technologies in the classroom. Additionally, we need to prepare students for the future. They need to have a broader skillset than the 3Rs in order to function and contribute in the 21st century. The American Management Association, a leading body that provides services to businesses and government agencies, commissioned the Critical Skills Survey in 2010 and identified that employers want their employees to have more than the basic 3Rs. In fact, for workforce readiness in the 21st century, employers want their employees to have developed skills in the 4Cs, which are:

- critical thinking & problem solving
- effective communication
- collaboration & team building
- creativity & innovation (American Management Association, 2010)

The current work provides guidance to teachers who are leading in a technological environment of change. Employing technology in a transformative space prepares students with the necessary tools for the 21st century.

Successful learning

It has been long understood that for students to be successful learners, much more than the 3Rs is required. In developing the Taxonomy of educational objectives, Bloom's Taxonomy (1956) outlined ways of learning and thinking in a hierarchical structure. Bloom's Taxonomy defined thinking skills into six categories, namely: evaluation, synthesis, analysis, application, comprehension and knowledge. Using technology as a mode of instruction, Bloom's Taxonomy was revised in the 1990s to reflect the changes in the education landscape (Anderson et al., 2001). The revised taxonomy replaced the nouns with verbs to form the following categories: creating, evaluating, analyzing, applying, understanding and remembering. Biggs and Collis (1982) developed the SOLO taxonomy with five levels to distinguish between surface learning and deep learning. While not as hierarchical as the Bloom taxonomy, the SOLO taxonomy describes different levels of learning.

Other theories of learning such as Gardner's Multiple Intelligence (1983), and De Bono's Six Thinking Hats (1985) were developed to describe different approaches to thinking and therefore different ways of learning and communicating. Gardner's work describes how different individuals are predisposed to learning in different kinds of ways, whether they be, spatial, linguistic, kinesthetic, musical, interpersonal, intrapersonal, naturalistic and existential. On the other hand, De Bono's Six Thinking Hats, describe specific approaches to thinking with, particular application to problem solving. In contrast, Costa and Kallick (2000) identify 16 Habits of Mind which lead to successful learning. Most of these Habits are best described as psychological dispositions, which the learner brings to the task.

The mainstream use of the Internet in the 1990s along with the proliferation of personal computers has led to a great deal of discussion and debate about the effect of ICT on education and the types of thinking required for success in the digital age. One thing that is clear is that computers and networks have had a profound effect on modern society and education. This can be seen most crudely in the proliferation of 1:1 computer programs and government initiatives to provide students with computers (Rudd, Smith, & Conroy, 2007). The advent of mobile devices such as iPads© and Netbooks brings with it the ability to deliver information to students whenever and wherever they want (Johnson et al., 2011; Pohio & Falloon, 2010). According to the 2011 Horizon Report (Johnson et al., 2011), mobile devices have been embraced by schools for 1:1 programs due to their affordability and ease of internet connectivity (Morgan, 2010; Schachter, 2009).

It is in this changing technological context, that schools need to focus on more than just the basics (3Rs). For example, in the United States, the report titled "The New Commission on the Skills of the American Workforce (2006) asserted that it not only basic skills, but creativity and innovation which are essential for future economic and job security. Silva (2008) argues that "integrating 21st century skills into teaching and assessment, then, is not only an economic imperative, driven by changes in the workforce, but a vital aspect of improving learning." The necessity to ensure students acquire 21st century skills has been recognized in the Australian Curriculum (Australian Curriculum Assessment Reporting Authority, 2012). The development of the Australian Curriculum, is guided by the Melbourne Declaration (MCEETYA, 2008). According to the Melbourne Declaration, successful Learners:

- have the essential skills in literacy and numeracy and are creative and productive users of technology, especially ICT, as a foundation for success in all learning areas
- are able to think deeply and logically, and obtain and evaluate evidence in a disciplined way as the result of studying fundamental disciplines
- are creative, innovative and resourceful, and are able to solve problems in ways that draw upon a range of learning areas and disciplines
- are able to plan activities independently, collaborate, work in teams and communicate ideas (MCEETYA, 2008)

4Cs

Critical thinking is vital for problem solving. Often situations that are complex, uncertain and have no precedent require employees to solve problems. Critical thinking is the discipline of actively and skillfully conceptualizing, applying, analyzing, synthesizing and/or evaluating information gathered from, or generated by observation, experience, reflection, reasoning or communication.

Whilst students take for granted that they can communicate with others, there are various degrees of communicating effectively. To explain complex ideas, a concise, organized and measured approach is necessary.

To solve problems, students need to interact in teams. This provides the necessary social and learning environment to solve problems. Often educators underestimate the importance of working globally in virtual teams and asynchronously. As we are now heavily reliant on technology, and can use tools to assist in communicating with teams that may be dispersed internationally, collaboration and team building are necessary skills.

Creativity may be defined as *pushing the boundaries* to develop new ideas, and *innovation* is the development of these ideas into actuality. For example, though mobile phones were around for at least 20 years, the late Steve Jobs was able to convince the public in June 2007 that his new creation of the

iPhone© (Isaacson, 2011) with its multi-media, touch screen, combined a number of innovative technologies such as a music player, camera, wireless internet connection, Bluetooth and *Apps*, was the mobile phone to have!

3Rs + 4Cs = 21st century skills

Technology is an important component for the development of the 4Cs. Students in the 21st century live in a technology and media rich environment where they have access to a plethora of information, new, powerful digital tools, and the ability to collaborate and communicate with others. To be effective, students need to be able to demonstrate the 4Cs in relation to an online world. It is tempting, then, to believe that the simple way to address the development of the 4Cs is by providing students with computer devices. Certainly there has been a good deal of government policy that has been based on the assumption that access to technology is the key to achieving success. However, simply providing students with mobile devices such as netbooks, iPads©, tablets, and laptops will not develop these skills and enhance their learning. What the teacher does in the classroom with these devices is important for improved student outcomes.

There are those groups like Partnership For 21st Century Skills - a national American organization - that promote the importance of 21st century readiness for every US student. They fuse the 3Rs and the 4Cs, and provide resources and tools for these skills (Partnership for 21st Century Skills, 2012).

A framework for technology adoption

According to Puentedura (2011), the SAMR Model for technology adoption, divides technology usage into four distinct level as seen in Figure 1. In this model, *substitution* is the lowest level of technology usage where it is used to simply replace whatever was being done without that technology. For example, a word processor – without the use of enhanced features for editing - is used as a substitute for pen and paper. At the next level, *augmentatio*n is where the technology acts as a direct tool with some functional improvement, following on from the previous example, the use of sophisticated editing functions are used is this level. For example, the difference between *substitution* and *augmentation* is the use of features to improve the product. However, only basic learning skills take place. These two levels of technology use are defined as the *enhancemen*t stage.

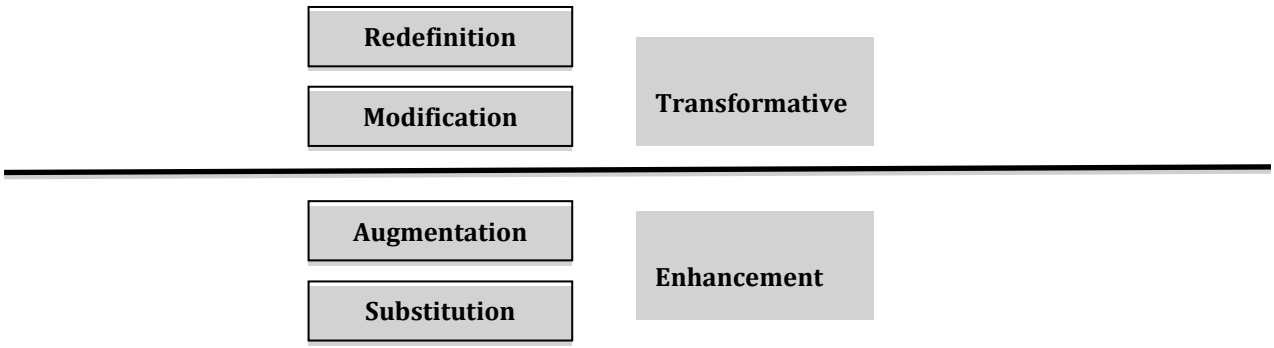

Figure 1: SAMR Model for Technology Adoption (Puentedura, 2011)

Whereas, in the *enhancement* stage, the task could have been completed satisfactorily without using technology, at the *modification* level the task becomes something quite different. So that rather than complete a word-processed piece to be printed out, the writing becomes part of a blog, wiki or social network exchange. The final level of *redefinition* is where the technology allows for the creation of new tasks previously inconceivable. This final level is difficult to describe as we are constantly redefining what is possible using technology in advance forms. These two levels, *modification* and r*edefinition* are identified as the *transformative* stage. It is proposed that teachers use the higher levels of the SAMR model in relation to technology adoption as their framework to improve student outcomes. The SAMR framework provides a dialogue to frame a discussion around teaching achievements and future directions.

Effects on learning

The possible effect on learning is mitigated when technology is only used in the *enhancement* stage (Herrington, Herrington, Mantei, Olney, & Ferry, 2009). Student mastery of the 4Cs happens when we operate in the *transformative* stage, which provides ideal learning conditions to be deployed. According to Oostveen, Muirhead & Goodman (2011), "It seems that meaningful learning is far more likely if the new technologies are recognized as providing transformative opportunities." Designing assessment tasks that require students to demonstrate their 4Cs is in alignment with the *transformative* stage in the SAMR model. What happens in the classroom with technology usage in schools occurs at the *enhancement* rather then *transformative* stage. Therefore we need to provide the appropriate situations that will allow students to develop a mastery of the 4Cs. Hattie (2009) argues that "It is what teachers get the students to do in the class that emerged as the strongest component of the accomplished teachers' repertoire, rather than what the teacher, specifically, does. Students must be actively involved in their learning, with a focus on multiple paths to problem solving" (p. 35).

Concluding comments

If the teachers' use of digital tools is confined to word-processing, emailing and researching the Internet, then it is little wonder that students do not have a broader skill set. To prepare learners for the future, schools need to cultivate higher levels of teachers' professional learning and so extend the students' development of the 4Cs. Professional development needs to focus on what teachers can get their students to do, so that the use of technology can help students confidently master the 4Cs. Future work will focus on determining the effectiveness of implementing the 4Cs for teacher professional development and evaluating student outcomes in a technological transformative environment.

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