iBooks for Generation Z in STEM education

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ABSTRACT – Science, technology, engineering and mathematics (STEM) education plays a key role in sustained growth and stability of Malaysia economy, and are critical component in helping Malaysia win the future. Generation Z will be the main workforce of future nation's development. However, there is a generation gap between educator from earlier generation to learner from Generation Z which has different dominant behavioral characteristic and this leads to ineffective knowledge transfer process. Thus, a technology enhanced based Bloom's Spiraling technique which match the characteristic of Generation Z is proposed in this paper.

1. INTRODUCTION

STEM education creates critical thinkers, increases science literacy, and enables the next generation of innovators. According to the U. S. Department of Commerce, STEM occupations are growing at 17%, while other occupations are growing at 9.8% [1]. Students graduated from STEM education have a higher income even in non-STEM careers. To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past [2]. The university students are majority Generation Z which has now started brought in new worldview and different expectations. Generation Z living in an era of high-tech communication and technology driven lifestyles. Comparison between Generation Z and other generations has been listed in Table 1.

Table 1 Generation dominant characteristic [1].

Generation	Year range	Dominant behavioural characteristic
Traditionalists	1900 - 1945	Loyal and discipline
Baby Boomers	1946 - 1964	Responsible, strong work ethics
Generation X	1965 - 1980	Independent thinkers, efficient
Generation Y	1981 - 1994	More social, confident, less independent
Generation Z	1995-2012	Poor communication skills, extensively engaged to technology

Each generation has been dominated by very different behavioural characteristic. This illustrates significant generation gap which needs to be addressed especially in education. Most of the educators are from earlier generations range from Baby Boomers to Generation Y which their behavioural characteristic is dominated by strong work, responsible and more sociable compared to university students from Generation Z which dominated by the poor communicating skills and extensively engaged to technology. Bridging Generation Z with other generations are important in order to ensure the knowledge can be transferred effectiveness between generations.

2. CHARACTERISTIC OF GENERATION Z

Characteristics of Generation Z mainly associated with highly connected of having the lifelong use of communication and technology [3]. There are four main characteristics as listed in the following:

a) Hypertext mindset
Generation Z's is widely influenced by the digital technology, with lack of physical interaction. They generally knows having a poor face-to-face interaction and less likely to use brain logic when it comes to thinking. This characteristic is less advantage in pursuing knowledge in STEM.

b) Overprotected
Research in [4] mentioned Generation Z as curling generation as their parents will help them clear the path and ensure them march effortlessly towards their future. In other word, Generation Z are more likely being spoon-fed by their parent. Thus, it is most likely they would demand the same atmosphere to be created at universities.

c) Lack of communication skills
Generation Z could also be named as Google generation who take for granted that the information is always readily for them in instant. This has made them to be less patient, rebellious and expecting instant result [5]. This generation has the ability to form huge communities and a constant communication loop with people they have never met. They are more sociable on the net, and tend to be less well able to develop personal relationships in the real world.

d) Instant gratification

With extensively exposed to the internet, this has make Generation Z with a lower attention span or in psychologist term "acquired attention deficit disorder". Generation Z becomes increasingly distracted, irritable, impulsive and instant gratification.

3. BLOOM'S SPIRALING WITH TECHNOLOGY ENHANCED TECHNIQUE

This study focuses on the approach taken to embed STEM education through utilising e-content such as iBooks in conjunction with Blackboard Learn. This approach by designed, it focuses attention away from content and instruction, and instead emphasized the "cognitive events" in the mind of Generation Z. Bloom's Spiraling has been implemented in this iBook through recalling, defining, explaining, etc, thus achieving progressive increasing the level of thinking.

4. iBOOKS FOR STEM EDUCATION

In this work, an iBook has been developed for teaching and learning in Microprocessor Technology subject. We achieve better interactive with students compared to the content of traditional, printed books that is confined to text and static image as shown in Figure 1. The developed microprocessor technology iBook is able to display stunning images in full screen which students can interact with using gestures they are familiar with like pinch to zoom. Inclusion of galleries and interactive exercises reduce boringness in traditional printed book and achieve better understanding to the topic of discuss as shown in Figure 2. Students is able to identify any misconceptions or gaps in their knowledge through instant feedback from answering interactive questions.

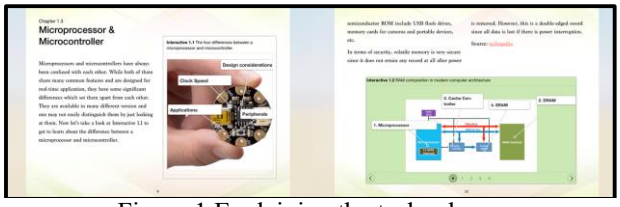

Figure 1 Explaining the technology

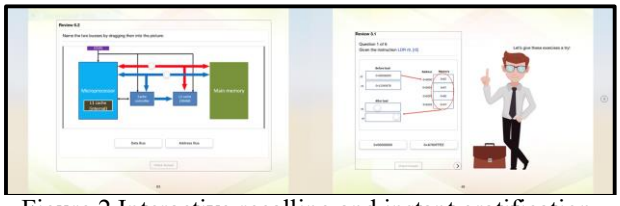

Figure 2 Interactive recalling and instant gratification

A number of video demonstrating microporcessor applications based projects have been included in the ibook as shown in Figure 3 and Figure 4. This enables students to explore what is a microprocessor and what is it used for in their daily life and thus increasing their interest in this topic.

Figure 3 Microprocessor in problem based learning

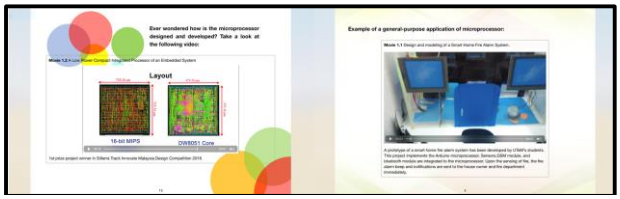

Figure 4 Demonstration of real world application of the technology for inspiring purpose [5]

5. SUMMARY

An example of using technology enhanced technique to deliver STEM education to Generation Z has been presented in this paper. This technique is bridging earlier generations as an educator to Generation Z as a learner which has dominant behavioural characteristic of poor communicating skills and extensively engaged to technology. Bloom's Spiraling has been implemented in this iBook through recalling, defining and explaining, thus progressively increasing the level of thinking. By providing a better design of learning experiences, and this means giving every student especially Generation Z room to breathe cognitively and creatively.

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