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Application of Innovative Technologies and Computer Aided Approach in a Resilient Teaching Practice for Engineering Students

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ABSTRACT

Constructive alignment is an outcome-based teaching principle which aligns the teaching and assessments according to the learning outcomes. Therefore, the philosophy of constructive alignment encompasses three pillars of teaching goals, learner evaluations, and educational methods. To have a successful educational program, a bespoke curriculum should be devised according to the learning goals and learner's interests. In essence, the program should be engaging for the students in order to reach to the ultimate goals. On the other hand, the innovative technologies can be utilised to better reach learning outcomes and to provide more engagement for the students. This study interrogates effect of utilisation of a type of online collaborative real-time document tool, real-time mind-mapping tool, and online communication tool in engagement of the engineering students for a third year unit at two different years at Curtin University in Perth Western Australia. The results showed that application of these innovative tools highly improved (i.e., from 85% to 90%) students satisfactions about unit's learning outcomes and engagements to the topics.

Key words : Pedagogy; constructive alignment; reflective teaching; quality learning

1. INTRODUCTION

A. Selecting proper learning goals are key factors in successfulness of every educational program. This can be done by utilising national curriculum standards and manuals as well as by application of the formulised approaches such as cognitive, behaviourist, a modified approach to utilise both, or classification system [1]. The cognitive and behaviourist approaches are opposite each has an advantages and disadvantages. In cognitive, the approach is going from general to particular goals and in a behaviourist, the approach is moving from specific to some general goals. The cognitive approach is a suitable method of formalising teaching goal for the subject with long term goals like achieving a certificate or degree as practicing this approach is requiring time [2,3]. In cognitive approach, a series of objectives are defined and then a series of indicator are defined for each of them. However, a behaviourist approach is satisfying for the short-term goals, and students learn how to perform a practice step by step until reach to the final goal. For instance, taking steps to perform an experimental test in laboratory is an example for formulising behaviourist approach. Utilising the best formulising learning approach highly depends on the types of educational institution. For instance, for engineering students at university where working toward a bachelor's degree, combination of both method would suites their learning outcomes.

A venue for learning usually is a diverse place where learners with different backgrounds, interests, and capabilities are gathered to reach their educational goals. There is no doubt that a learning teaching approach should be reflective enough to be able to reach the learning goals. In fact, this requires having a differentiated instructional approach where there are extra focus and attention on learners who need more. Response to intervention (RTI) is a differentiated approach where defines the levels of differentiations into three tiers when the most extra help and attentions are provided to the individuals or student groups at the third tier for a short period of time in order to reach to the learning outcome set at tier one [4-7]. Curriculums and learning outcomes usually are devised by educators and teachers where there is no involvement from learners. Utilisation of this approach usually faces with lack of interests, and engagements of students and failing to

achieve the learning outcomes. In fact, designing curriculums which is not motivational and engaging for students and making students to master those objectives will not reach its learning targets. Emergent curriculum is an approach to involve students in design a learning outcome. In this approach, the curriculum is built based on the interests expressed by learners. Understanding interests of learners can be built through the time by noting their comments and feedback or by brainstorming and mind mapping techniques from subjects that have been proposed by educator and proposed by learners. The latter technique is known as curriculum webbing.

Some other activities like utilisation of the internet and taking part in the real or visual field trips are effective approach to make engagement of the students and to reach learning outcomes. These approaches are even more effective in connecting curriculum with the students interests if learners already have a knowledge and experience with them. In this case, the educator can activate the prior knowledge of learners and make them more interested to the topic by opening a discussion amongst students. This can be done by demonstration a simplified theory and bridging the learning outcome with prior knowledge of learners. For instance, suppose a graphical drawing that shows the water cycle in the environment and how precipitation, evaporation, infiltration, and run-off works in the reality [8].

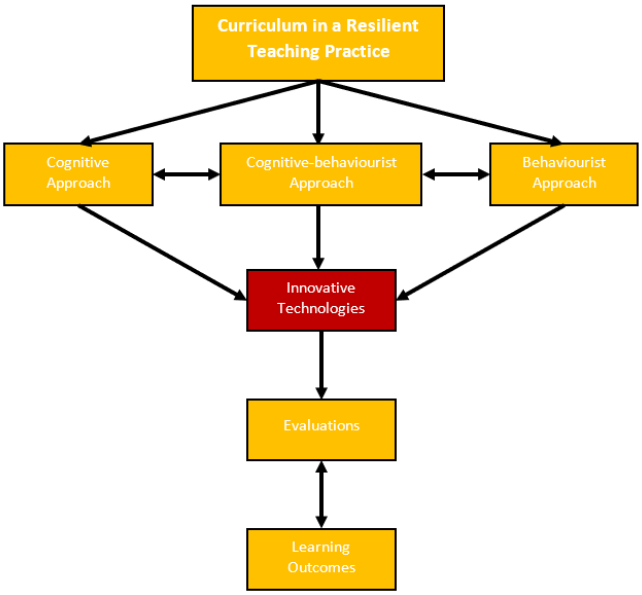

Figure 1: Position of the innovative technologies in a resilient educational approach diagram.

2. INNOVATIVE TEACHING TOOLS

Innovative teaching tools utilising for educational purposes encompass a wide range of tools and software as listed below. Fig. 2 shows a diagram of these tools.

- Online collaborative real-time document tool
- Online collaboration tool
- Real-time mind-mapping tools
- Online Course Builders
- Virtual whiteboards (tablets)
- Game-based teaching tools

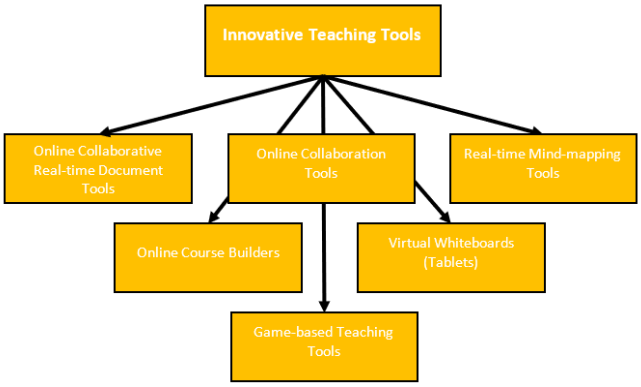

Figure 2: Innovative teaching tools can be utilised in tertiary institutions.

2.1. Online Collaborative Real-time Document Tools

Sending and receiving several emails along with updated versions of attachments is the old model of online collaboration among educators and learners. The new approach is application of a cloud-based online tool to collaborate on building a document. A collaborative document is a type of output which is written, edit, and amend by various learners in order to reach to its ultimate version by a collaborative approach. This document could be a report, spreadsheet, presentation, map, video, etc. The type of document that gets prepared depends on the type of organisation. For instance, usually a word type format is prepared in a school and university and a graphical document is prepared in a design company. Google Docs, Padlet, and Dropbox are example for some of collaborative documenting tools. The main benefit along with this type of tools is that as this provides an interactive learning opportunity, students will have a more involvement and interest in a teamwork task. Also, the collaborative task manager tools can promote the engagement and interest of the students in a teamwork task [10-12]. This tool was applied in presentation of many research paper and report example for fibre application in soil [13-20].

2.2. Online Communication Tools

Online communication tools are strong interactive features that can be utilised in supporting learning outcomes and to provide more engagements for the students. These tools usually have some attractive features like audio and video call, chat, visual presentations, screen sharing, and audio and

video recording that provide the opportunity the presented materials to be reviewed in future. Some of the most common types of the online communications tools are Skype, GoToMeeting, and Microsoft Team [21-23].

2.3. Real-time Mind-mapping Tools

The brainstorming or mid-mapping is an educational technique which forms by collaboration and gathering new ideas and thoughts on charts, diagrams or topics [24-26].

2.4. Online Course builders

Online course builders are interactive online applications that have a high potential of engaging students. Learners have access to the teaching materials like documents, spreadsheet, presentation etc. and they can access them at any time that they would prefer [27,28].

2.5. Virtual Whiteboards (tablets)

Virtual whiteboards are handy tools that easily can be carried in a classroom or in a field trip. These tools are able to show presentations, record information and data on the go. They are also applicable in both cognitive and behaviourist in devising curriculum for learners [29,30].

2.6. Game-based Teaching Tools

Game-based teaching tools are a platform for educators to build teaching materials based on the questions, survey, and discussion along with games in completion of the classroom teaching. This approach provides an engaging and fun environment for learners to learn while learning or reinforcing their prior learnings. The Kahoot and Socrative are some example for game-based learning tools that can be utilized in desktop as well as in mobile devices [31-33]. There are other methods to improve general educational knowledge [34, 35] which can referred to them.

3. EFFECT OF INNOVATIVE TECHNOLOGIES ON STUDENTS SATISFACTIONS

To interrogate effect of innovative teaching technologies on student's satisfactions to achieve learning outcomes, a questionnaire containing a series of questions has been requested to be filled by engineering students at Curtin University after completion of a unit. In 2015, the unit has been run according to the pedagogical approaches and only online collaborative real-time document and online communication tools have been used for students to work on preparing their assignments and tasks. However, in 2016, application of real-time mind-mapping tool has been utilised in developing curriculum and game-based teaching tools have been added in students learning experience. Table 1 shows the results of effect of utilisation of the innovative teaching tools in improvement of the engineering student's satisfactions about learning outcomes. Also, Fig. 3 shows the results in a diagram.

Table 1: Effect of utilisation of the innovative teaching tools in improvement of the engineering student's satisfactions about learning outcomes.

No.	Quantities Item	Percentage agreement in 2015	Percentage agreement in 2017
1	Overall Unit Satisfaction	85%	90%

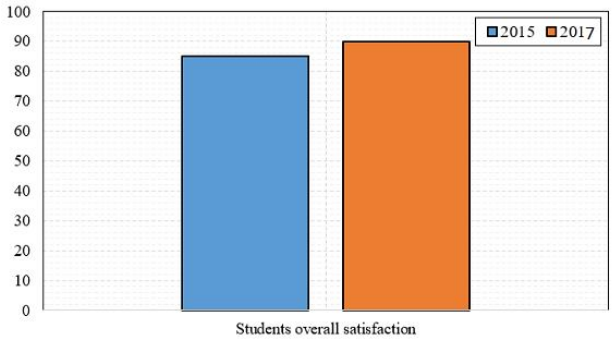

Figure 3: Effect of utilisation of the innovative teaching tools in improvement of the engineering student's satisfactions about learning outcomes.

5. CONCLUSION

A reflective teaching practice is a key pillar of constructive alignment and is a learner-centered approach that involvement and engagement of learners promote learning outcomes and educational methods as two other key pillars of constructive alignment. Nowadays, many learners are computer and internet educated and have prior knowledge of using computer and internet. On the other hand, combination of innovative technology in teaching practices build a bridge between learning outcomes and students prior knowledge which can promote student engagement and motivation in achieving learning outcomes. In this study effect of addition of two innovative technologies of real-time mind-mapping and game-based teaching tools on student's satisfaction in a same unit at two different years investigated and the results showed that all criteria showed improvement.

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