THE EFFECT OF ONLINE TEACHING APPROACH IN ENHANCING STRATEGIC THINKING SKILLS FOR ENGINEERING STUDENTS

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ABSTRACT

This research examines the effect of utilising strategic thinking skills in process based learning and its employment of self regulation towards learning performance. This research links online learning to strategic thinking skills by exploring at how strategies can manage learning performance and self regulation. This research used a pre-post test quasi experimental as the main data gathering method. Motivated Strategies for Learning Questionnaires (MSLQ) was used to investigate motivation and learning strategies. This study expand s previous research by including in its outcome, the use of thinking strategies as means to inculcate strategic thinking skills. It also sustained the conduct of enhancing strategic thinking skills strategies through self regulation as established in the research. It also measures online learning and conventional approach. Based on the pilot test outcome, the main study tested the hypothesis that using strategic thinking skills would assist engineering students in self regulation practice and to perform better in process based learning. Results from test scores and questionnaires supported the hypothesis. Results supported that students using the online taxonomy performed better than those who did not engage in self regulation practice. This research has come out with innovative study, unlike previous study that was done through classroom contact. As such, this study experience students learning through online system. Software was build to manage the teaching and learning contact. As a result, the study has identified new approaches that help established strategic thinking skills. The incorporated domain of metacognition in the six levels of strategies used for establishing strategic actions (taxonomy) and self regulation practice through think aloud protocols in process based learning contributed significantly to the study. Whereby, both are done through online intervention. The approaches have shown positive effects on process based learning that is predominant in engineering environment. This study also looked at students' learning performance, motivation, learning strategies and learning condition with the use of strategic thinking skills taxonomy. The findings indicate that strategic thinking skills help to enhanced metacognitive through self regulation and are suitable for students who were more attemptive in learning. .Hence, through the findings a taxonomy of six thinking skills has been proposed to explain the strategic cognitive processes. The taxonomy takes into account the strategies used for cognitive processes, metacognitive process and self regulation practice in an online learning approach.

ABSTRAK

Kajian ini menyelidik kesan penggunaan Pemikiran Strategik (Strategic Thinking Skills) kepada kaedah pembelajaran secara prosesan dan penggunaan pembelajaran kendiri. Kaedah ini menggunakan pembelajaran secara talian terus dengan pemikiran strategik bertujuan untuk melihat keberkesanan kepada kesan pembelajaran dan pembelajaran kendiri..Kajian ini menggunakan kaedah "pre-post test quasi experimental" sebagai data utama. Motivated Strategies For Learning Questionnaires (MSLQ) digunakan untuk mengkaji kesan motivasi dan strategi pembelajaran. Kajian ini telah memperluaskan dapatan sebelum dalam menerapkan pemikiran strategik. Penggunaan kaedah ini dapat menguatkan daya pemikiran secara berstrategi melalui pembelajaran secara kendiri seperti terdapat dalam kajian. Kajian pembelajaran secara atas talian dan pembelajaran konvensional juga dinilai. Ujian sebenar dijalankan berdasarkan dapatan ujian pilot sebagai asas kepada pembinaan pembelajaran diatas talian menggunakan perisian taksonomi yang mana penyelidikan sebenar telah mendapati bahawa pemikiran secara strategik dapat membantu pelajar jurusan kejuruteraan dalam mempraktikkan pembelajaran kendiri dan boleh belajar secara berkesan didalam pembelajaran yang melibatkan prosesan. Dapatan dari markah tugasan dan soal selidik mendapati bahawa pelajar yang menggunakan Pembelajaran Pemikiran Strategik menunjukkan prestasi yang lebih baik dari pelajar yang tidak menggunakannya. Kajian ini telah mencipta innovasi pembelajaran melalui penggunaan pembelajaran secara talian terus, berbeza dengan kajian sebelumnya dimana kajian dibuat diadalam bilik darjah. Satu perisian telah dibangunkan untuk mengendalikan kaedah pembelajaran pengajaran secara talian terus. Hasilnya, kajian ini mendapati satu pendekatan baru telah tercipta dalam pembelajaran pemikiran strategik iaitu dengan menerapkan kaedah metakognitif mengunakan enam peringkat pemikiran strategik dengan penulisan yang menerangkan penyataan pemikiran (*think aloud protocol*) yang diaplikasikan oleh pelajar secara atas talian. Kaedah pembelajaran ini telah menunjukkan kesan positif terhadap pembelajaran secara prosesan yang merupakan kaedah pembelajaran utama dalam bidang kejuruteraan. Selain dari itu kajian ini juga melihat kepada hasil pembelajaran, kesan motivasi, strategi pembelajaran dan kondisi pembelajaran menggunakan pemikiran strategik.

Oleh itu kajian mendapati bahawa penggunaan pemikiran strategik dapat menguatkan metakognitif dan pembelajaran kendiri serta sesuai bagi pelajar yang "attemptive" suka membuat banyak cubaan atau mengulang kaji kaeadah yang digunakan. Hasil dari kajian ini maka satu taksonomi telah di usulkan untuk menerangkan proses pemikiran secara berstrategi. Taksonomi ini mengambil kira strategi yang digunakan untuk proses pemikiran, metakognitif dan pembelajaran kendiri.

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LIST OF ABBREVIATIONS

ACTS	: Activating Children Thinking Skills
ARTS	: Arts Reasoning and Thinking Skills
CA	: Conventional Approach
CALLA	: Cognitive Academic Language Learning Approach
CASE	: Cognitive Acceleration in Science Education
CDC	: Curriculum Development Centre
CGPA	: Cumulative Grade Point Average
CLPP	: Computer Literacy Pilot Project
CMC	: Computer-Mediated Communication
CMLHS	: Centre of Modern Languages and Social Sciences
EAC	: Engineering Accreditation Council
EFL	: English for Foreign Language
ICSS	: Integrated Curriculum for Secondary Schools
ICT	: Information and Communication Technology
IT	:Information Technology
KBSM	: Kurikulum Baru Sekolah Menengah
McRAT	: Multicultural Reading and Thinking Program
MOE	: Ministry of Education
MUET	: Malaysia University English Test
MSLQ	: Motivational Students Learning Questionnaires
SOLO	: Structure of Observe Learning Outcome
STTO	: Strategic Thinking Taxonomy online
TESL	: Teaching of English as Second Language
UKM	: Universiti Kebangsaan Malaysia

UMP : Universiti Malaysia Pahang

UPM : Universiti Putra Malaysia

UPSI : Universiti Pendidikan Sultan Idris

UTM : Universiti Teknologi Malaysia

WGCTA : Watson-Glaser Critical Thinking Appraisal

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

This chapter presents the background and context of learning in an engineering environment, the need for and potential benefits of thinking skills in facing the challenge of today's globalization. The study provides explicit enhancement towards facilitating cognitive engagement in teaching and learning, as stated in Ministry of Education (MOE) Curriculum development 14.2.1 which emphasises the importance of knowledge and brain power, which are the main resources for graduates to successfully compete in the world, because through this combination, incomparable and inimitable know-how and ideas are created in the third world wave (Ministry of Education, 2006).

In establishing this quest the teaching and learning of the cognitive process is evident and crucial. Hence, students must receive an education that enables them to develop their potential to the maximum towards creativity and thinking, as well as their capability for innovation (MOE Curriculum; 14.2.2). The teaching of thinking with innovative engagement via technology enables the spread of knowledge, skills and cognitive engagement to be interconnected to produce effective and efficient learning context. Hence, this study evaluates an innovative and explicit approach to the teaching and learning process of cognitive engagement for process-based learning of students in higher institutions. The study hopes to establish the Ministry of Higher Education's mission, which is to acquire knowledge and skills that would enable them to be competitive through the implementation of research-led or knowledge-generating education (Ministry of Education, 2006).

This thesis will demonstrate the use of online teaching and learning with strategic thinking skills engagement. Software of strategic thinking skills taxonomy was developed to observe

the learning performance and self-regulation enhancement. The thinking engagement was drawn-out through thinking aloud protocol. Thus metacognition were used to facilitate activities that promote cognitive engagement, such as decision-making skills, planning, monitoring and evaluation. These thinking components were supported by activities that helped strategic functions.

1.2 BACKGROUND OF RESEARCH

The background deals with the need for thinking development in a learning process integrating online learning for process-based learning condition among engineering students, and the effort of making learning to think explicit both to the learners and teacher. Concurrently, enhancing self-regulation and learning performance.

In the light of assisting learning of higher order thinking, strategic thinking skill has captured interest as the mechanism for cognitive development. Strategic thinking activities involve mental activities, which by nature cannot be observed directly (Beyer, 1987). As a result, the teaching of thinking explicitly is due to cases where students failed to do the process of decision making and solving problems in a planned action because they did not know how to think in a strategic way, so that a plan looked and acted as they thought it should. This is the reason why things that they planned failed - because of what they had wanted it to be - or for most cases in a project base, why students resort to copying other people's work. As a result, the effort in developing thinking skills lessens, hence we need to assist and guide our students to keep on thinking (Jonassen, Peck & Wilson, 1999; Schwartz & Parks, 1994)

One of the reasons for the teaching and learning of strategic thinking skills in engineering education the roles of decision making and problem solving are focal. The aim of producing novel invention is ideal, therefore students need to be exposed to the learning process of creating novelty. According to Piaget Piaget's constructive theory, in order for students to experience learning they need to assimilate and accommodate the process. How do we do it? Students first need to be exposed to how to think. They need to be made aware

of thinking processes that involved the strategies of decision making and problem solving in learning (Piaget, 1972)

Studies on metacognition have indicated that strategic thinking can be fostered and learnt (Liedtka, 1998) through technology assistance, specifically through learning and teaching materials (Cropley, 2001; Cropley & Cropley, 2008). Despite the effort made to provide highly technological advantages to educational communities, the question that needs to be asked is whether this technology can be developed and utilised as learning tools in order to develop strategic thinking skills. Therefore, the present study aims to explore whether providing engineering students with taxonomy can enhance their strategic thinking.

1.3 EDUCATIONAL CONCERNS RELATED TO THE PROBLEM

There are a few concerns in regards to developing strategic thinking skills using technology. Firstly, is the impact of technology literacy and thinking engagement, secondly is the role of online learning as cognitive tools in delivering the practice for thinking engagement and third, emphasis of thinking skills in engineering education

1.3.1 Technology Literacy and Thinking Engagement

Technology literacy is introduced in Information Communication Technology (ICT) learning for Form 4 and 5 students as an elective subject which implies that not all students are included. Computers started to play a prominent role in schools with the launching of the Computer Literacy Pilot Project (CLPP) in 1986 for secondary (Form Four) school students (Gan, 2001). The objective of the subject is to acquire knowledge about ICT principles, processes and related fields, examine and understand ICT principles, processes and related fields and communicate and manage information effectively through Curriculum Development Centre, (CDC) in 2005. The exclusion of some students will affect technology literacy. Furthermore, schools that are not fully equipped with ICT have the tendency to produce students that are backward in technology handling. This impacts on the thinking development, learning efficiency, communication ability and problem-solving skills. Furthermore, there are still a number of literacy problems in the east coast

region of Malaysia, thus increasing difficulty in participating in the evolving knowledge-based society and making the area at greater risk in this digital age, deepening the social divide (Reimers, 2000). Innovative intervention to counter the effect of globalization and technological advancement will decrease the gap of uneducated people from society and will secure their well-being with the necessary skills needed.

The importance of learning IT (Information Technology) is evident in schools, as the trend appears to be toward integrating computer technology and instruction within subject areas that are taught in schools, such as Science and Mathematics, as well as toward the creation of software especially aimed at enhancing the usage of computers so that they would produce a fresh look at instruction and learning (Kumar, Che Rose, & D'Silva, 2008). The opportunity to learn IT at school level provides a lot of benefits for students when they reach higher learning.

Besides, the advent of World-Wide Web has given students easy and rapid access to ample multimedia information, flexible communications through electronic mail, and a variety of components that help students communicate visually and verbally with their friends, locally and internationally (Sia, 2000).

The engagement during a learning process using technological tools such as computers and the internet not only involves physical movement but it moves the thinking process at large in terms of decision making and problem solving. In return this contributes means to develop thinking skills. The emphasis in today's learning culture must be on thinking, the use of the mind to find solutions to emerging problems. Students must be taught the means through which they can maximise their creativity and capacity for innovation (Deputy Prime Minister Datuk Seri Najib Tun Razak, 2007).

Students are seen handling technology-based equipment throughout their years of studies in the university. Most of them become technology savvy as they go through exploring, scrutinising and enriching their experience with all the details almost every day of their life. However, these students are novel when it comes to exploring knowledge for the advancement of real life needs and lifelong learning. How many of these students can

create something new with the knowledge they read from the internet? Many projects done by the students are copied from existing materials. Little and shallow ideas are presented in their writing. This shows that the students did browse the internet but what they were searching for and how to process the information into action fell below expectations. This issue is addressed by Lynch and Wolcott (2001), saying that it is unfortunate that while teachers are aware of many of the skills they would like to exhibit, the steps between typical students' performance and desirable performance often remain unarticulated or vague.

This demonstrates that many students' produced pieces of work, be they their assignment or project works, are not recognised as 'advanced' as they should be with the aid and advancement of technology. Where did we fall short? The negligible aspect that is left unseen is when the students enter higher institutions, where an enormous amount of IT knowledge is required, especially in colleges of engineering. How many educators and students realise that their expertise in using this technology, with the proper aid of strategic thinking methods or strategic guidance, is critical in developing effective and quality learning outcomes? Most of these students are intelligent in their own ways but most of them are unaware of the existence of metacognition and the ability to focus on their metacognition to help improve performance based for lifelong learning or future use, because it has never been taught in schools before and neither is it implemented in the university.

Higher institutions in Malaysia, especially in the east coast region, are still lagging behind in the teaching and learning of thinking processes, let alone making it a subject to be learnt. All educators acknowledge that the teaching of thinking is teachable (Dewey, 1933). Bodies of knowledge are important, of course, but they often become outdated. Thinking skills never become outdated.

On the contrary, they enable us to acquire knowledge and to reason with it, regardless of the time or place or the kinds of knowledge to which they're applied (Sternberg, 1986). How can educators help these students realise that they can adopt a strategic thinking ability explicitly to enhance performance in the future. Effective ways

that we can teach thinking is to engage students in substantive tasks, requiring the kinds of thinking we want them to develop and then to explicitly teach, as the occasions and need arise, the specific cognitive operations they need to complete the tasks successfully (Beyer, 1987).

Nowadays, students are taught to think divergently, so as to expose them to higher order thinking skills, which most of them do implicitly. Unfortunately, these students do not realise their capabilities or how they can function effectively with the thinking skills taught explicitly, such as problem solving in mathematics, comprehension in reading or making inferences for hypothesis testing. In realising this, educators need to explore ways and approaches to strategic thinking using appropriate methodology with the aids of technology advancement.

Thinking skills has surfaced as a national priority in learning for all countries. The pedagogical aspect has been reviewed in order to attain the needs to teach thinking skills for students so that they will accelerate in life, not just for the purpose of learning but for survival too. Therefore, engineering students should be able to develop higher level thinking processes - the need for learners to go beyond mere recall of information. They need to develop deeper understanding of what is learnt, the need to be critical about evidence and facts to solve problems and the ability to think flexibly in order to make reasoned judgement and produce effective decision making. This helps students to be able to compete in conventional and outmoded ways and, in situations which previously ended up in failure. Students can now take the initiative to undertake new and original ventures in pioneering enterprises. Hence, the students need to be taught how to decide, plan, monitor, check, evaluate and revise their work quality, be it for the purpose of improving their grades, project work or, most importantly, the need to be quality-innovative via technology use

In order to do so, engineering students need to observe how they go through their learning process and manage their thinking skills for the benefit of present and future use. The country therefore very much needs human resources with this high level of creativity, people with the skills to carry out tasks without adhering to old procedures or imitating

other people (MOE. Part IV Excellent in Teaching and Learning: pg 126). Thus, the learning of strategic thinking with the use of technology integration will help develop human resources who not only think strategically but also critically, as well as being IT literate.

1.3.2 The Role of Online Learning as Cognitive Tools

University or college students are dynamic learners, eager to learn about the sophisticated and technologically-based world that they live in, and about the types of jobs that will be available to flexible, creative, lifelong learners.

Online learning as defined above brings forth valuable knowledge application and the ability to promote thinking in the learning process (Curtis & Lawson, 2001). As all university students nowadays are given access to use sophisticated technological equipment which helps them learn how to learn, they are learning new skills that will help them both in the classroom and in the workplace; they are learning how to communicate through media conferencing and use feedback that captures their interest. This learning process via online learning integration can only happen when one has the capability to think as to "how" first, before they can proceed to the "why, what, who, when" and so forth. In doing so, students have developed the ability to think how to use the equipment and what to communicate during the conferencing, which in turn impacts the learning process. The role of online learning as cognitive tools helps to develop metacognition, inquiry learning, motivation and skills application (Stanculescu, 2007). Gibson (1979) claims that technology affords the most meaningful thinking when used as tools.

In a technology-rich classroom, instruction often involves the use of problem-based learning, Internet research, computer-mediated communication, online dialogue and multimedia projects in a variety of disciplines. The process of learning to use these tools will engage the learners more and result in more meaningful and transferable knowledge in the learners. Thus integration of technology as a tool to gauge cognitive functions precedes the purpose as cognitive tools. Cognitive tools are generalisable computer tools that are