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MAINTAINING AND SUSTAINING TASK PERFORMANCE USING STRATEGIC THINKING IN PROCESS ORIENTATION

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This study provides empirical evidence that indicates that there is a positive relationship between higher attempts of strategic thinking skills activities with successful task performance. The results also indicated that there is significant difference in the learners' motivation after going through process oriented learning through the use of Strategic Thinking Skills Taxonomy online. Implications of the study are discussed along with suggestions for future research.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS PAGE

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Process orientation has been the main learning approach in the study of engineering and technical aspect. Process oriented learning requires the competence to use the processes involved and the ability to incorporate knowledge and technical aspect during the processes undertaken. Hence these two engagements required specific skills to be executed such as technical skills, physical skills and more importantly, higher order thinking skills. In order to meet these competencies, students need to be taught generic skills of thinking and learning skills that involve specific domains for process orientation.

Thinking skills are seen as important factors in the learning process. In the engineering and technical field where involvement of tasks and processes are required, thinking processes should be strategic, well organized and structured or linear. However, the strategic thinking execution in process oriented learning is non linear as it gives the user the flexibility to use any strategy which suits their level of knowledge or experience within the current situation.

To enforce strategic thinking skills in process oriented learning, students need to be taught how to think skillfully as recommended by Beyer (1987) who says that skillful thinking needs to be taught as it does not develop on its own. Therefore, teaching thinking for strategic purpose is important as it is the foundation in process oriented learning and task based approach.

1.2 Background of the Research

Education has long focused on teaching students to think and at the same time grading them on exam papers. In other words, the learning outcome is to enable students to get the correct answers. Students often do well on test, complete their assignments and get good grades but they still do not think effectively (Beyer, 1987; Brooks & Brooks, 2001). According to Brooks and Brooks (2001), teachers too often ask students to recite, define, describe, or list facts. Students are less frequently asked to analyze, infer, connect, synthesize, evaluate, think and rethink. Students have become familiar with this process of passing knowledge back and forth without inquiring into how this information applies to the real world (Black & Deci, 2000). The concern over the development or lack of effective thinking has led to a renewed focus of education.

In a research done for employability skills in Malaysia, the need for strategic thinking abilities is said to be of importance in hiring new graduates (Abd. Rahim et.al., 2007). More evidence is seen from findings by UTM researchers that companies need engineers with passion, systems thinking, the ability to innovate, to work in multicultural environments, to understand the business context of engineering, and to adapt to changing conditions (N.M.Nor. et.al, 2008) The development of strategic thinking has been identified as a major problem facing organisations (Bonn, 2001) and the development strategic thinking is considered to be important (Mason, 1986; Liedtka, 1998; Abd. Rahim, 2007; N.M.Noor, 2008)

Advancement in science and technology demands more than application of exam-based learners (Goold et al, 2010). As such, in line with the quest for the development of

thinking skills, particularly those pertaining to creativity and enterprise in a world of new challenges, is the call for a paradigm shift in education.

1.3 What are Strategic Thinking Skills?

Strategic Thinking is defined in numerous ways depending on various specific functions in a subject matter. In a learning process, the ability to synthesize which requires higher order thinking skills teaches students to act through a well structured, informed and sound mechanism to be able to arrive to the destination or goals. The mechanism here is seen as a strategy that helps the thoughts to act to achieve its destination while a well structured, informed and sound mechanism refers to the ability to perform through documentation, data gathering and reliable sources. All these denote strategic thinking.

Strategic Thinking in process oriented learning can be defined as a sequential process in which creative ideas are generated, carefully evaluated, and, if they then appear reasonable, are implemented (Hoskisson et.al. 2008). In a learning environment, Strategic Thinking is constructive as it helps in developing strategy, and allows students to design approaches that help them to successfully meet the challenges of an often unpredictable future. However, the use of strategy in thinking is not inherent (Beyer, 1987). Proficiency in thinking is more artificial than natural (Perkins, 1985). Piaget in constructive theory further elaborated that in order for students to experience learning they need to assimilate and accommodate the process.

Hence, developing thinking skills require explicit guidance in learning. It requires deliberate, continuous practice and guidance to develop to its full potential (Beyer, 1987). In order to make thinking developed, students need to be provided with opportunity to engage in learning to learn and learning through practice; to be able to make arguments, to debate issues, to decide on important matters, the ability to choose and evaluate in which these help sharpen their cognitive abilities. Students apply factual knowledge and the content from the classroom and to integrate their knowledge which was filtered from their perspective as they interact with the knowledge and each other. All of these performances are done with the presence of higher order thinking skills abilities, in an unconscious manner of doing but through a specific medium in a learning context.

As such, strategic thinking skills in this research employed metacognitive functions as its principle in learning thinking skills. Metacognitive functions will be further elaborated in Chapters 2 and 3.

1.4 Research Objectives

This research tries to look into the effectiveness of using Strategic Thinking Skills via technology application in the teaching and learning process. Therefore the objectives of this research are to find out:

1. How effective Strategic Thinking Skills are in enhancing learning performance.
2. How Strategic Thinking Skills contribute to self regulation in learning.
3. The strategy that is applied most in process oriented learning.

1.5 Research Questions

The research investigates the questions below.

1. How effective are Strategic Thinking Skills in enhancing learning performance?
2. How does Strategic Thinking Skills contribute to self regulation in learning?
3. Which strategy is most applied in process oriented learning?

1.6 Significance of the Research

The research outlines several rationales and benefits. It is intended that the present research will provide empirical evidence which will contribute to the improvement of technical and engineering education in the aspects noted below:

1. The research also lends a hand in employing different learning process/ techniques that could promote thinking ability specifically in engineering fields
2. Students will be given the opportunity to explore their thinking ability in order to infuse critical and creative thinking through engagement in thinking skills activities. These activities help students to facilitate self regulation in learning e.g. when making choices or making judgment. Students need to think about what they want to do first and later, and when they utilise a wide range of metacognitive skills, they are able to achieve their desired goals.
3. The study establishes learning processes rather than the product which contribute to one's ability to progress effectively in developing learning competencies. It develops proficient strategic thinkers who will be able to use the operations learnt effectively and efficiently in a variety of appropriate context e.g. thinking skills

strategies work in all disciplines provided the learner can master the basic strategies first.

4. The strategies employed will contribute to quality learning outcomes which demonstrate ability in judgment, creativity and innovation at the same time. This is because strategies will enhance higher order thinking skills through metacognitive functions employed through strategic thinking skills activities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter outlines theoretical perspectives on strategic thinking skills framework in a classification or taxonomy to observed engagement of cognitive processes in process based orientation. The role of technology refer to the use of a software to record procedures and to monitor the processes at three different stages a) before process orientation b) during process orientation and c) after process orientation as mechanism to enhance strategic thinking engagement in process orientation. The literature relating to theoretical aspects of strategic thinking which utilizes metacognitive skills as a constraint for thinking engagement will be discussed and will be used in this chapter as a framework to analyze the learning process engaged during process orientation. Secondly, the literature relating to the strategic thinking taxonomy design as a mechanism to engage in strategic thinking is outlined in this chapter.

2.2 Strategic Thinking Skills Theories

Liedtkal (1998) defines strategic thinking as a particular way of thinking. She includes five specific elements: it incorporates a *whole system* perspective, is intent-focused, involves thinking in *time*, space and it is hypothesis-driven, and is intelligently opportunistic. Having these competencies is what characterizes an individual as a strategic thinker.

Others emphasize strategic thinking as structure of meaning (Masifern and Vila,1998) which is both the medium of social cognitive action and its product. They suggest that it is more a *state of mind*, than just another planning process. For Mintzberg (1994) the situation is similar. "Strategy is a pattern, that is, consistency in behaviour over time."

The importance of having a strategy in learning higher order thinking is discussed by Vaidya (2008) who state that the need to be strategic learners is critical. Strategies make it easier for learners to learn something; at times, the strategies used are mechanisms to organize information so that learners can understand and learn more efficiently.

Strategic Thinking is teachable and must be taught to all levels of management. Engaging in the strategy of the learning and the principles would maximize innovative power and minimize mistakes. Harpaz (2003, p.6) further explains:

> These claims - teach thinking, not knowledge; good thinking is skills such he expanded that the importance of learning to think– swept educational discourse; and the 'educational market' was filled with thinking skills of various qualities e.g. skills of critical thinking, of creative thinking or of effective thinking (Harpaz, 2003).

In order to teach strategic thinking skills the employment of metacognitive functions is important as principles in learning. Metacognitive features of planning, monitoring and evaluating are the three principles focused in the engagement of strategic thinking of this research.

2.3 Metacognitive Engagement for Strategic Thinking Skills

Metacognition is an important aspect of student learning. It involves self regulation, reflection upon an individual's performance, strengths, weaknesses, learning and study strategies. Metacognition is the foundation upon which students become independent readers and writers. It also underlies students' abilities to generalize mathematical problem solving strategies. (Educational Performance Systems Inc. 2005)

Metacognitive functions utilized within this research for process orientation refer to metacognitive knowledge and metacognitive regulation to enhance strategic thinking skills. According to Flavell (1979, 1987), metacognition consists of both metacognitive knowledge and metacognitive experiences or regulation.

Metacognitive knowledge refers to acquired knowledge about cognitive processes, knowledge that can be used to control cognitive processes. Flavell further divides metacognitive knowledge into three categories: knowledge of person variables, task variables and strategy variables.

Metacognitive experiences or regulation involve the use of metacognitive strategies or metacognitive regulation (Brown, 1980). Metacognitive strategies are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal (e.g., understanding a text) has been met. These processes help to regulate and oversee learning, and consist of planning and monitoring cognitive activities, as well as checking the outcomes of those activities.

2.4 Strategic Approach

The approach used in this research is strategic in which it is organised thinking through deliberate use of a particular process (Ashman & Cornway, 1997; Wasilow, 2009). The content is structural in which it helps to identify common, underlying characteristic of subject explanation for the purpose of describing logic of science explanation (Segal et.al., 1985)

Developing thinking skills in students requires specific instruction and practice rather than mere application. If students are to learn how to think clearly and cogently, they must be provided with appropriate instruction (Beyer, 1987; Wilson, 2005)

The importance of having a strategy in learning higher order thinking is discussed by Vaidya, (2008) articulating that the need to be strategic learners is critical. Strategies to make it easier for learners to learn something; at times, the strategy used is a mechanism to organize information to understand and learn it more efficiently.

2.5 Building of Strategic Thinking Skills Taxonomy

Strategic Thinking Skills Taxonomy within this context is built based on Beyer's thinking framework (1987) on metacognitive learning approach. Within the framework metacognitive aspects of planning, monitoring and evaluating (Flavell, 1979; Brown, 1980; Beyer, 1987; Wasilow, 2009) was developed as thinking strategy framework. The taxonomy framework for this research focuses on the use of strategy (metacognitive processes) and task progression rather than the product of a process. The taxonomy details out six levels of learning strategies which utilize metacognitive functions with

each strategy accompanied by explicit activities. This research investigates the use of these strategies in the taxonomy framework.

The taxonomy comprises six thinking strategies. They are Decision Making, Planning, Monitoring, Checking, Evaluating and Revising. The functions of the six levels will be further discussed in Chapter 3.

	Decision Making	Planning	Monitoring	Evaluating	Revising	Final 100%
ST1	9	9	10	9	10	63.75
ST2	9	10	10	9	10	61.58
ST3	11	12	12	12	12	74.08
ST4	9	9	12	9	12	69.08
ST5	9	10	9	9	9	67.5
ST6	9	9	12	10	12	65.83
ST7	9	10	10	9	10	70.33
ST8	9	9	9	9	9	63.67
ST9	11	13	13	12	13	75.25
ST10	10	10	10	9	10	70.42
ST11	9	9	10	9	10	61.83
ST12	12	11	12	12	12	73
ST13	9	10	10	9	10	67.42
ST14	9	9	12	10	12	68.25
ST15	10	9	10	10	10	70.33
ST16	11	10	13	11	13	72.91
ST17	9	9	11	9	11	65.75
ST18	9	9	10	10	10	63
ST19	12	11	12	12	12	73.08
ST20	12	13	14	13	14	76.58
ST21	11	11	13	10	13	72.75
ST22	9	9	12	10	12	71
ST23	9	9	11	9	11	68.91
ST24	17	15	17	18	17	80.17
ST25	18	17	18	18	18	81.16
ST26	18	15	18	17	18	80.17
ST27	9	9	12	10	12	71.5

Table 2 Online Self regulation

CHAPTER THREE

STRATEGIC THINKING SKILLS TAXONOMY

3.1 Introduction

This chapter discusses the implementation of strategic thinking skills taxonomy in a language classroom through process based learning. The purpose of this study is to investigate the effects of strategic thinking skills taxonomy on language learners using metacognitive enhancement in process based online learning through the use of the Strategic Thinking Skills Taxonomy (henceforth STTaxo) software. It also examines the strategies used most frequently by students during the learning process and their effects on learners' learning performance.

The STTaxo software is designed to assist students in developing strategy in thinking skills while learning and to embrace learning as a process development rather than product assessment processes or a rote learning processes. Such development will provide the foundation for lifelong learning and character building. The software encourages learners to be committed in accomplishing the task as it tracks learners' attempts in their effort to learn. The software which allows learners to process their task, also enables learners to get feedback online from their teachers or facilitators who are guiding the learning process. Hence the approach is not one sided, unattended or unnoticeable but credible and reliable. As such, learners will feel that their learning process is worthwhile and the fact that they had to put in the effort to accomplish the task will develop in them a sense of wanting to learn, wanting to think it through on how to

accomplish a task, as well as will drive their motivation. They will not feel hampered or frustrated as they will be able to develop and progress to the next level.

3.2 The development of Strategic Thinking Skills Process

The Strategic Thinking Skills Process was built in a taxonomy frame to establish the sequence of actions and steps taken in a thinking and process orientation. The steps and actions taken during the process orientation are guided by a thinking engagement. The thinking engagement process which acts as the guideline will further enforce in-depth thinking as to how to perform the thinking about thinking.

The taxonomy consists of six generic strategies which embrace the strategic thinking skills main elements. They are:

- Decision Making
- Planning

} Planning

- Monitoring
- Checking

} Monitoring

- Evaluating
- Revising

} Evaluating

} Metacognitive Functions = Strategic Thinking Skills

The taxonomy was built based on metacognitive functions as an enhancement to gauge strategic thinking skills.

3.3 Strategic Thinking Skills Taxonomy Software Development

The taxonomy was used the framework in the STTaxo software, designed to complement self learning with three added features incorporated to sustain and maintain learning process. The features are as below:

a) Writing thoughts: The software requires students to write their thoughts on executing a task or assignment.

b) Self regulation: Every written piece will be recorded and saved for monitoring and checking purpose.

c) Feedback performance: As the work progresses, students will receive feedback from their instructors regarding their performance, in this case errors or unsatisfactory performance will need to be revisited. Hence students' judgment ability is essential and revision is required.

The STTaxo software was developed to assist students in process orientation development. The procedure of any task orientation to process orientation depends on individual's ability to sustain and maintain task performance to achieve targeted goal or task accomplishment. STTaxo with generic thinking skills enables students to write out, define task, plan, monitor and evaluate task as it progresses and to be able to receive feedback to amend and finalise the task. Illustrated below are extracts of the software features and functions.

Illustration 1: Front page of the software

Strategies	Cognitive activities
Decision Making	• Define the goal Identify alternative possibilities • Identify alternative possibilities • Analyze the alternative possibilities • Rank order the alternatives • Judge the highest-ranked alternatives • Choose the "best" alternative
Planning	• Stating a goal • Selecting operations to perform • Sequencing operations • Identifying potential obstacles/errors • Identifying ways to recover from obstacles/errors • Predicting results desired and/or anticipated

Illustration 2: Sample preview of part of The Strategic Thinking Skills Taxonomy Software online.

3.4 Six Generic Thinking Strategies

There are six levels of strategic thinking skills within this view. It helps to define what are the activities involved in the strategic level. Students will first read to comprehend the information displayed for execution purpose. Activities involved can and may be taken

by students to selection of their choice. They may proceed with the activities according to their understanding and suitability of strategies. Below are examples of all the six strategic thinking skills undertaken consolidate with activities for every strategy.

3.4.1 Thinking Strategy of Decision Making – Level 1

Decision Making is the first generic skill in the thinking taxonomy. The activities within this level consist of six activities. They are:

Activity 1: Define the goals

Activity 2: Identify alternatives possibilities

Activity 3: Analyse the alternative possibilities

Activity 4: Rank order the alternatives

Activity 5: Judge the highest rank alternatives

Activity 6: Choose the best alternatives

3.4.2 Thinking Strategy of Planning – Level 2

Similar to the level of decision making, in the planning activity, each step will require students to think about how to manage the task according to the activities provided and at the same time, the cognitive engagement taken for each stage assists students to think and act simultaneously. As they engage in the task they will be forced to think of why and how each step was taken.

Activity 1: State a goal

Activity 2: Select operations to perform

Activity 3: Sequence operations

Activity 4: Identify potential obstacles/errors

Activity 5: Identify ways to recover from obstacles

Activity 6: Predict desired or anticipated result

3.4.3 Thinking Strategy of Monitoring – Level 3

The Monitoring strategy helps students in maintaining good performance and sustaining interest during task execution. Students learn to discover obstacles, errors and mistakes made during the monitoring process. The activities under monitoring are time consuming and require patience and self endurance in the learning process. As such, the activities at this level help to generate awareness of accuracy, time management, resource management, self regulation and strong discipline. Thinking in monitoring activities cannot be visualized as it takes a considerable amount of brain processing in a long term thinking engagement. Having to remember for a period of time is crucial in monitoring engagement. This will help errors or mistakes made NOT be repeated. The activities are as follows:

Activity 1: Keeping the goal in mind

Activity 2: Keeping one's place in sequence

Activity 3: Knowing when a sub goal has been achieved

Activity 4: Deciding when to go on to the next operation

Activity 5: Selecting next appropriate operation

Activity 6: Spotting errors or obstacles

Activity 7: Knowing how to recover from errors, overcome obstacles

3.4.4 Thinking Strategy of Checking – Level 4.

The skills of checking establishes quality in work performance, process flow and outcome management. Checking attributes to requirement of constant monitoring, revising and adjusting. Therefore these requirements enhance thinking skills processes and self regulation.

Activity 1: Keeping proper records

Activity 2: Checking for accuracy and precision

Activity 3: Checking outcomes-evaluating the outcome against specific criteria of efficiency and effectiveness

Activity 4: Meet all the specific requirements

3.4.5 Thinking Strategy of Evaluating – Level 5

Evaluating skill is the highest level of cognitive ability in Bloom's Taxonomy. The ability to judge, assess, determine, verify and so forth requires a mind that has knowledge on the matter to be able to deal with specification of cause and effects of performance.

Activity 1: Assessing Goal Achievement

Activity 2: Judging accuracy and adequacy of the results

Activity 3: Evaluating appropriateness of procedures used

Activity 4: Assessing handling of obstacles/errors

Activity 5: Judging efficiency of the plan and its execution

3.4.6 Thinking Strategy of Revising – Level 6

The mental ability to reflect on what has been done and why it was done in such way enables assistance in monitoring errors and determining how to go about amending the errors. Persistence is the dynamic ability in the thinking strategy of revising. With persistence, students can maintain work performance and strengthen thinking skills ability to its highest form as reflecting skills manage all lower ability thinking skills.

Activity 1: Reflecting on what was done

Activity 2: Reporting what went on

Activity 3: Identifying steps/rules used

Activity 4: Clarifying the procedures

Activity 5: Giving focus on contributing factors

Activity.6: Recalling attributes of procedures, rules and information

Activity 7: Describing how to execute the operation

Activity 8: Identifying potential obstacles to smooth operation and possible ways to overcome obstacles

Activity 9: Reviewing steps/procedures

Activity 10: Stating the relationship

Activity 11: Reviewing or revising information/context

Activity 12: Stating the final/result

3.5 Constructive Learning of Strategic Thinking Skills

Using linear learning for thinking is not easy even though activities are outlined for learners to follow and act upon. Every activity given requires learners to think – what to do to achieve goal attainment (Strategy 4 - Checking: Activity 4), how to reflect on what was done (Strategy 6 - Revising: Activity 1). Therefore, students need to practice on strategizing and synchronizing what, how and why – which are the meta-cognitive elements of planning (what), why (decision making) and evaluating (how) to be able to perform one part or one activity out of the six activities given for the thinking resolution to achieve part of a whole task e.g. deciding on titles, what to do, area or areas of interest and so students need to think of ways to focus on ONE particular title, the suitability of the title and the task and student's ability to execute the task.

The activities from all levels of the six thinking strategies were arranged in linear form of thoughts on thinking of thinking before every step is finalized and further actions taken. However, it is not necessary or mandatory for the activities to be performed in a linear order. Learners can skip activities which they feel are not applicable or combine activities which are similar in attributes into one action. Overall, the decision making, planning, evaluation of choice and judgment of choice are skills intuitive to a person and these capabilities are actions that are indistinguishable to the eyes but only apparent once an action is present. Systematic and speculative thinking are apparent for this mode of learning. This is due to the requirement of the activities for learners to stretch their thinking skills divergently and be proactive learners.

Therefore in constructive learning the ability to construct meaning to suits the activity is composed by learners understanding based on knowledge and experience. Exploration towards associating meaning, task and thinking has enable knowledge to form. The process orientation required learners' mental capabilities to go through the activities to match it with his knowledge and to write out his thought in sentences that will capture his intention, understanding and experience of the task.

In conclusion, STTaxo software online enables students to explore the learning process by writing their thoughts out as guided by the strategic thinking activities. This enhances their knowledge and understanding of the processes in task performance. Repetition of these processes will build and strengthen students' capability in task performance.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This chapter outlines the methodology that is used in the research. It describes the population and sample, the experimental conditions, the research design, the instructional materials and instruments, the procedures, and data analysis procedure that was used in the analysis of data. The result of the experiment is also described in this chapter.

In this research, qualitative methodology is applied, where the essence of teaching and learning focused on the constructive approach to unfold the strength of process based learning and to enhance strategic thinking through meta-cognitive functions.

4.2 Qualitative methodology

This study is qualitative in nature as it involved human factors of which the nature of inconsistency in maintaining constant thoughts, feelings, attitude and approaches are of the essence (Morse. 1994) hence it is subject to change (Patton. 2002). Patton (2002) further explained that qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings, such as "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" (p. 39).

4.3 Constructive Approach

Raskin (2002) divided constructivism into three main streams: personal construct psychology or constructive alternativism (Kelly, 1955, 1991); radical constructivism (von Glasersfeld, 1995); and social constructionism (Gergen, 1985). In social constructionism, knowledge is a product of the linguistic activity of a community of observers while in constructive alternativism and radical constructivism, knowledge is a compilation of internalised human-made constructions through their experience with the external world.

In this study, the interest is in making sense of the cognitive and metacognitive structures of an individual student's learning process in problem-solving through various methods of data collection. It would not be within the capacity of this research to investigate social elements of problem-solving per se.

Von Glasersfeld (2000) said that he never claims that knowledge is "This is how it is!" but rather, it is "This may be how it functions" (p.4). The functional fit demands the knowledge constructed to fit and work functionally (von Glasersfeld, 1991). This is the essence of constructivism that will be the foundation of this research methodology.

4.4 Sampling

Intact classes were used to enable effective data collection. 24 students were chosen for the purpose of this research as an experiment group and another 24 were chosen as the control group but only 15 students' results were taken as these 15 students completed all the activities whereas the other 9 students did not. The experimental group was assigned

to use the STTaxo online while the control group was assigned class as usual. The control group is also represented by 15 students with completed activities.

4.5 Experimental condition

A quasi-experiment was used to distinguish the effectiveness of the STTaxo online: STTaxo online application (n=15) and control (T) using the traditional instructional method (n=15). A period of 14 weeks was allocated for the learning process.

4.6 Research Design

Dependent variables (Performance ability)	Independent variables (Instructional Methods)
Process orientation online (PO)	STTaxo T STTaxo(C)
Learning performance (LP)	1 2 3
Strategy Used (SU)	

O_1 X1 O_2 (1) X1: STTaxo (4 weeks)

O_3 O_4 (2) X0 : T

O_5 X2 O_6 (2) X0 : STTaxo (4 weeks)

$O_1 = O_3$ = pre-test

$O_5 = O_6$ = post-test

The independent variable of this study is the instructional method with three categories:

1. Strategic Thinking Taxonomy with Thinking In Writing Approach (STWA)

2. Strategic Thinking Taxonomy (ST)
3. Traditional instructional method (T)

The dependent variables are:

1. Learning performance
2. Process orientation

The design of the study looks at (a) strategic thinking taxonomy online (b) learning performance and (c) strategy used.

4.7 Instructional Materials

The Academic Report Writing module was used to elicit the effectiveness of incorporating strategic thinking skills online in process based learning. Five assessments were used to draw out the process based learning. All assessments involved writing documents, searching for information and finding data to produce an academic report from the proposal stage to the end product. All the assessments were evaluated using standardized rubrics from the UHL 2332 Academic Report Writing syllabus.

Students were to decide on a title as a research assignment, plan a working schedule and execute the plan while recording their progress from beginning till the end. At the beginning of the course, students sat for a pre-test before starting with the intended course and online activities. The test modeled after the test done by Pinprich et al. (1997) was

chosen because it measures students motivation, learning style and strategic thinking effectiveness.

Both groups had four hours of meeting with the instructors. For the experimental group, two hours were allocated for lab work aimed at doing STTaxo online throughout the 14 weeks. The online access was available even after class hours as long as students logged on into the system and it assessable anytime and anywhere for students to complete their assignments. The control group received no STTaxo software treatment.

During the intervention weeks, a different thinking skill was taught to the experimental class by immersing them into the thinking taxonomy curriculum. At the beginning of each week the researcher modeled the thinking skill to each individual. The students follow the content given from the structured course outline.

Students in the experimental group were instructed to fill in the processes for their assignment based on the strategies they use to complete their task using a writing aloud protocol. The writing aloud protocol was used to capture what the students intended to do. As there is no right or wrong answers, the students were free to express their thoughts in writing so long as it is within the course content. Even so, students are guided to select which processes or strategies they are using based on the activities given. The activities denote the thinking skills strategies. In completing their tasks, students had to learn to think when comprehending the needs of the activities.

A comment or remark box is provided for instructors to give feedback on students' work. This functioned to check students' learning process. They could discuss their progress with friends and lecturers. In addition, students could log in as many times as they wished and edit their work. Every time students edited their work, these were saved in the system for easy reference and retrieval. As such, the progress made can be monitored and checked for better production. Reports can be printed out for easy reading or discussion.

4.8 The Instrument

STTaxo was used for the purpose of the research. The taxonomy was built based on a teaching and learning concept by Beyer (1987) and Israel et.al. (2005) to exercise strategic thinking skills in a learning context through a process oriented learning for engineering and technical education. The taxonomy was applied in an online learning context (software).

The purpose of the online learning is to have students maintain and sustain their thinking skills through guided strategies, provoking them to venture through every step and to view the end result of their work.

4.9 The Procedures

A pre-test was conducted on both experimental and control groups at the beginning of the class. Then, the experimental group was introduced to the STTaxo software and it took them at least four hours to adjust to and comprehend the activities provided for the tasks they had to do. The contact hours for both groups were four hours per week in accordance with their semester schedule. Two hours were allocated for multimedia laboratory lessons. It was during this class meeting the online system for strategic thinking skills taxonomy software was utilized for the experimental group, whereas for the control group, they engaged in the usual way the course was conducted.

The experimental group students would interact with the system individually. They started off by selecting the task they had to do as had been set by their instructor and then proceeded with the first thinking activity of decision making followed by six guided activities. Once the first level was done they proceeded to the second level of thinking skills on planning with another six guided activities. The students needed to monitor their own progress. The monitoring and checking strategies would be automatically triggered in the system once the students started to edit their work such as changing the spelling of a letter in a word, changing the vocabulary in a sentence or changing the sentence construction.

The fifth level of evaluating would be done after each process had been executed. The evaluating level is attributed with five activities. The last level is revising with 12 activities listed to incorporate thinking skills enhancement.

The learning process and knowledge transferred while executing the process is seen through the students' written thoughts as a result of strategic thinking skills engagement. All written information can be saved and viewed for later revision. Information can be printed for further discussion if necessary.

The control group remained in the normal learning approach until Week 8 when they too were introduced to the STTaxo software. They were to use the software for the remaining 7 weeks of study. The purpose of the switch up was for the control group to engage in the STTaxo software so that there can be comparison to see if there is a significant change between both the groups when using the taxonomy for the three assessments. At this point, 3 assessments had already been submitted by both groups leaving only the final report and presentation to be assessed. The submitted three assignments were proposal, literature review and final assignment. Both groups' marks were taken and compared.

4.10 Analysis

Descriptive statistic was used to determine any differences in the means of the scores of the subjects. The SPSS Statistical package programme for Windows was used to run the analysis. This will be discussed further in the next chapter.

CHAPTER FIVE

FINDINGS AND DISCUSSION

5.1 Introduction

This chapter deals with the findings and discussion of this study is to investigate the effects of STTaxo with metacognitive enhancement in an online learning context. It also examines the effects on learning performance and the strategy most used by students during the learning process.

5.2 The results

5.2.1 Pre- and Post-Test Results

Both groups of students in the control (n=27) and experimental group (n=27) were given the same test based on Pinprich et al. (1997) to measure learners' learning strategy and motivation at the beginning and at the end of the fourteen study weeks. The experimental group was introduced to STTaxo in an online interface learning system from the beginning while the control group engaged in the conventional method of learning until week 8, after which the control group was also engaged in thought processes which were captured through written protocol using the STTaxo software.

	Learning Strategy		Motivation	
	Pre	Post	Pre	Post
Experimental	1.21	3.26	70.45	75.90
Control	1.17	1.26	69.21	69.86

Table 1 Mean Scores of quantitative pre- and post-tests

Table 1 presents the mean scores for the quantitative assessments of the experimental and control group. The questionnaire for the learning strategy showed an increase of 2.05 for the experimental group compared to the control group which has a slight increase of 0.09. While the motivation section for the experimental rose to 5.45 which is 4.80 higher than the control group (0.65). The increase in learning strategy and motivation for the experimental group is very motivating because it shows that using STTaxo software in classroom for task performance has changed the way students learn at the same time, it also increased students' motivation to learn.

5.2.2 How effective is Strategic Thinking Skills in enhancing self regulation?

Self regulation analysis was read by the system once the students were engaged with the strategic thinking skills activities. From the students' score in Table 2, it shows that students who obtained A (75 -100 marks) executed the learning process 14 times (revising) and more. While a B (74- 65) score student executed less than 14 times on revising the task. Monitoring showed the same result as revising (14 times and more with A score). In planning and decision making, however, students who attempted more than 13 times at this level obtained an A score (75-100 marks). Students who scored A+ (85-100 marks) n=3 attempted 17 and more times on all activities. Students who made 9 attempts would score at least a B (74-65 marks). This shows that students who attempted more than 13 times of execution will have better chance of realizing their mistakes and errors made and tended to rebuild the process to achieve desired goals; whereas students who made less effort in terms of strategic thinking skills achieved poorer task performance.

The analysis shows that the metacognitive component of monitoring is highly attempted by students (mean=3.04) compared to other strategic thinking skills. The monitoring skills coincide with revising skills in the sense that when a student makes any revision, he/she has actually executed the monitoring activity as well. Students seem to do the planning activities the least as the mean score for the planning component is 2.92. Therefore students should be taught more on planning as this skill will teach them the importance of strategy in a task execution. A well planned task will enable students to see the directions and targets to accomplish a task in a more defined manner.

5.2.3 How does Strategic Thinking Skills promote learning performance?

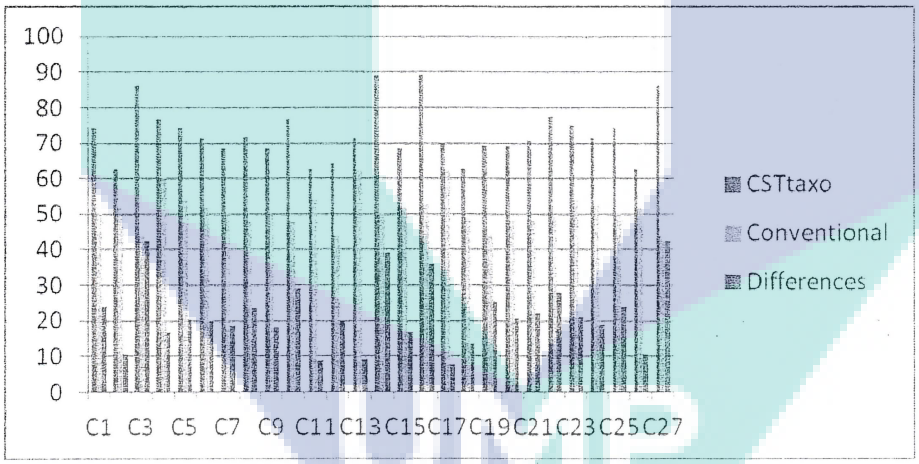

Table 3: Control group using Strategic Thinking Taxonomy

The table indicates the increase in learning performance for control group after using STTaxo. C1 increased 24.2% while C4 and C28 increased 42.31%. The least increase is by C17 which is only 7.69%. Overall marks increased up to more than 15%. The use of STTaxo has enabled students to improve in their task as the activities in the

metacognitive component have triggered students to act with thinking infusion in a process based integration.

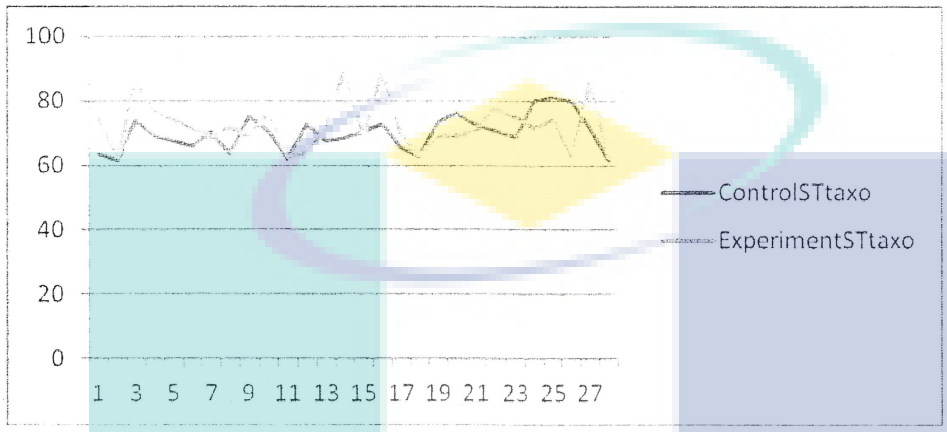

Table 4: Experimental and Control Group with Strategic Thinking Taxonomy

Table 4 highlights the increase in marks for the Control group using STtaxo with experimental group with mean for control group (m=62.61) and experimental group (m= 61.58). The control group was exposed to strategic thinking skills activities that helped them plot with their course of actions with thinking infusion. The analysis showed an increase of marks. Most students achieved a score of 75 and above.

5.5.4 Which strategy is most applied in process oriented learning?

Scale	Mean	SD
Planning	2.92	.488
Monitoring	3.04	.552
Evaluation	3.01	.532
Overall	2.99	.477

Table 5: Mean and standard deviation for students metacognitive skills

Table 5 shows the mean for students metacognitive skills. The lowest component is planning (mean=2.92) and the highest is monitoring (mean=3.04). Overall the study shows that the students' metacognitive level is moderate (mean 2.99). The analysis shows that students have moderate metacognitive skills as the planning and evaluation component have a low mean score.

Thus, students need to be taught more planning, monitoring and evaluating as this will help them manage their learning activities.

CHAPTER SIX

CONCLUSION AND FUTURE WORK

6.1 Conclusion and Future Work

The two main benefits of the introduction of STTaxo software in the classroom are that (1) it supports the importance of metacognitive development in the teaching and learning process as it makes students more aware of the process of task performance rather than performing a task without knowing that there are actually strategies that are time and effort saving; (2) the guidance provided by the software changes the way students perceived the way they learn and improved their motivation to learn. If all courses were to use this approach to teaching and students use this repeated, then we would have successfully instilled in learners effective task performance.

Although this research only tested the effectiveness of the STTaxo software in language classes, this software could actually be used in other courses, in all kinds of assignments or tasks and on many levels of study, even at primary and secondary school level. This is because the focus of this approach is on the process. Learners learn to think about the way they think to accomplish a task. They will see that going through all the activities of each strategy will make task performance more efficient. It is our hope that more research can be done on different learners and with different courses. Apart from that, future research should also include developing a framework to promote metacognitive development in the current education so that learners can better manage their learning activities.

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