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Describing Pre-university Students’ Learning Strategies Using the Rasch Model

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Abstract

Over the past years, metacognition and metacognitive and cognitive strategies, have been a subject of considerable research. This study aims at looking into the cognitive and metacognitive strategies employed by pre-university students through the administration of the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. The cognitive and metacognitive strategies scale of this instrument is divided into five sub-scales namely rehearsal, elaboration, organization, critical thinking and meta-cognitive self-regulation. The questionnaire was administered to 524 pre-university students attending a science programme and the data analyzed using the Rasch Measurement Model. From the model a “Students’ Learning Strategies Scale” was developed where the five sub-scale was ordered along a linear line in ascending order of the strategies used by the students. The results obtained revealed marked differences in the use of the learning strategies of the pre-university students as compared to the scale plotted by the mean obtained by the studies of Pintrich et al (1991). These results suggest differences in the learners’ cognitive and metacognitive strategies employed in their learning process.

Introduction

Self-regulated learning is a way of approaching the academic tasks, which can be learned regardless of age, gender, ethnic background, actual ability level, prior knowledge, or motivation. Apart from that, it gives the students the opportunity to control their behavior, motivation and affect, and cognition in order to improve their academic learning and performance. This implies that all students can learn to become self-regulated learners and that faculty can explicitly help them achieve their academic goals.

At the same time, faculty can help students learn how to control their own learning by providing opportunities for student choice and control of academic tasks.

Self-regulated learning describes how learners cognitively, motivationally, and behaviorally promote their own academic achievement (Zimmerman & Schunk, 1989). Pintrich (1995) summarized self-regulated learning into three major aspects of academic learning (1) self-regulation of behavior, which involves the active control of resources students have available to them (2) self-regulation of motivation and affect, which involves controlling and changing motivational beliefs and (3) self-regulation of cognition, which involves the control of various cognitive strategies for learning.

The theoretical basis of this study is from the cognitive constructivist approach which has its roots in the Gestalt theories of perception, cognitive psychology, theories of development and the works of Vygotsky. The cognitive constructivist views learners as individuals who play an active role during their learning and recall. They view students as scientist who construct theories that regulate their own learning. Paris and Byrnes (1989) suggested that children have a general theory of self-regulation which is comprised of four component theories: self-competence, effort, academic tasks and instrumental strategies. The later describes the deliberate mental and physical actions taken by the learner to process information.

Individual differences in self-regulated learning

According to Zimmerman (1989), all learners try to self-regulate their academic learning and performance in some way but there are dramatic differences in methods and self-beliefs among students. Other evidence suggest that some learners maybe less inclined or able to self-regulate than others (Zimmerman & Martinez-Pons, 1990). From the perspective of self-regulatory processes, learners can be classed into naïve self-regulators or skillful self-regulators. How do naïve learners differ from skillful or knowledgeable learners?

Table 1 Differences between naïve and skillful self-regulators

NAIVE SELF-REGULATORS	SKILLFUL SELF-REGULATORS
Low quality goals	Specific, proximal goals
Low efficacy	High efficacy
Unfocused on performance	Focused on performance
Adopt self-handicapping strategies	Adopt self-instruction/imagery strategies
Avoid self evaluation	Seek self evaluation
Negative self reaction	Positive self reaction.

Table 1 summarizes the differences between naïve self-regulators and skillful self-regulators. Naïve self-regulators do not lack goals but instead are handicapped by the low quality of their goals. Their goals tend to be nonspecific and distal (Schunk & Zimmerman, 1998) Skillful self-regulators however form a graduated system of specific goals that are linked to their distal goals. By contrast, skillful self-regulators form a graduated system of specific, proximal goals that linked to distal goals in a hierarchy (Bandura, 1991). Goal hierarchies provide skillful learners with a personally relevant self-standard for evaluating their performance and completion of these goals conveys explicit

feedback of proximal success and enhances their self-evaluation (Earley, Connolly, & Ekegren, 1989).

Skillful self-regulated learners also perceive themselves to be more self-efficacious than do naïve learners. Self-efficacy beliefs instill not only greater motivation to learn (Schunk, 1984) but also greater motivation to self-regulate one's learning. This leads to accurate self-monitoring and positive self-reaction.

In terms of performance control processes, skillful self-regulators are able to concentrate their attention on their learning performance whereas naïve self-regulators are easily distracted by diversions or competing thoughts. Students report that sustaining attention and motivation during learning are usually the most difficult tasks involved in self-regulating academic learning (Zimmerman & Bandura, 1994; Zimmerman & Martinez-Pons, 1986). Corno (1993) and Khul (1985) suggest that attention of naïve self-regulators is drawn to their emotional states or the surrounding conditions whereas skillful self-regulators are better able to remain focused on their learning performance. In implementing their strategies of learning, skillful self-regulators use techniques such as self-guiding verbalization in controlling one's attention or employ vivid imagery to enhance learning. In contrast, naïve self-regulators seldom verbalize, and if they do, it is often negatively self-directive (Biemiller et. al, 1998). Naïve self-regulators are also unaware of the importance of imagery as guide and instead tend to rely on the results from trial and error experiences. In extreme cases naïve self-regulators may intentionally create obstacle to success (self-handicapping) in order to maintain self-reactions, such as deliberately exerting low effort or procrastinating until it is too late (Garcia & Pintrich, 1994).

Self-regulated learning strategies

Students' theory of strategies involves knowledge about what strategies are (i.e. declarative knowledge), how they are used (i.e. procedural knowledge), and when and why they should be used (i.e. conditional knowledge). The latter two forms of knowledge are often labeled meta-cognitive learning strategies. Students who have more articulated theories of effective learning strategies consistently score higher on measures of academic achievement and learning (Paris & Barnes, 1989).

Pintrich et al (1991) proposed five factors that influences cognitive and metacognitive strategies used by students.

1. *Rehearsal*. Basic rehearsal strategies commonly used involve reciting or naming items to be learned. These strategies are best used for simple tasks and activation of information in working memory rather than acquisition of new information in long-term memory. The assumption is that these strategies influence the attention and encoding processes, but do not appear to help students construct internal connections among information or integrate the information with prior knowledge.
2. *Elaboration*. This strategy help student store information into long-term memory by building internal connections between items to be learned. Some of the strategies include paraphrasing, summarizing, creating and connecting new information with prior knowledge.

3. *Organization*. This strategy helps students select appropriate information and also construct connections among information learned. Organization strategies include clustering, outlining and selecting main ideas.
4. *Critical thinking*. This strategy refers to the degree to which students report applying previous knowledge to new situations in order to solve problems, reach decisions or make critical evaluations.
5. *Metacognitive self-regulation*. Metacognition refers to the awareness, knowledge, and control of cognition. Metacognitive self-regulatory activities include planning, monitoring, and regulating. Examples of planning activities include goal setting and task analysis. These two activities help activate relevant aspects of prior knowledge that makes organizing and comprehending the material easier. Monitoring activities tracks one's attention as one reads and self-testing and questioning assist the learner in understanding the material and integrating it to prior knowledge. Regulating activities includes fine-tuning and continuous adjustment of one's cognitive activities. These activities are assumed to improve performance by assisting learners in checking and correcting their behavior as they proceed on a task.

Self-regulation of cognition involves the control of various cognitive strategies for learning, such as the use of deep processing strategies that result in better learning and performance (Garcia and Pintrich, 1994).

Objectives: This study was done to with these objectives in mind

- (1) To determine the cognitive and metacognitive learning strategies employed by the pre-university students.
- (2) To plot a "Students' Learning Strategies Scale" based on the mean measure of each learning strategy dimension.
- (3) To identify the learning strategies employed by naïve and skillfull self-regulators.

Methodology

The "Motivated Strategies for Learning Questionnaire (MSLQ)" developed by Pintrich, Smith, Garcia and McKeachie (1991) was used as the quantitative instrument to measure the students' learning strategies. The original version of this questionnaire consists of two broad scales, namely, "Motivation Scales" and " Learning Strategies Scale". The Learning Strategies Scale is further divided into 2 categories; the cognitive and meta-cognitive strategies and the Resource management Strategies. The former subscale was employed in this study. This subscale consists of 5 dimensions: "rehearsal", "elaboration", "organization". "critical thinking" and " meta-cognitive self-regulation". The cognitive and meta-cognitive strategies subscale measures the students' perceptions on 30 items that represents the different kinds of study skills strategies adapted by the students in their learning.

The questionnaire was translated from the English language into Bahasa Melayu, and we have asked teachers and lecturer to look at the items and give their suggestions for further refinement and check its suitability. The Bahasa Melayu version was then promptly translated back into the English language to ensure that the essence of the items were neither diluted nor lost. For each item, the responses are recorded on a five

point Likert type response scale. The five point Likert scale allocated for each item were 1,2,3,4 and 5 represents each response category from 'not at all true of me', 'not true of me', 'sometimes true of me' 'true of me' and 'very true of me' respectively.

Pilot testing of the questionnaire was done on 524 students from Penang Matriculation Center and analysis was carried out using BIGSTEPS (Version 2.82) a computer program for Rasch Measurement Model. The fit statistics was used to see whether the items' infit and outfit values (MNSQ) are within the proposed range, that is between 0.7 and 1.3.

Findings

Output of the Rasch Model Analysis

This study uses the Rasch Measurement Model as a basis for data analysis. This model is based on the assumption that data must conform to some reasonable hierarchy of less than/ more than on a single continuum of interest. This idea of measuring a single variable is depicted with a map of person and items on the same scale. The model specifies the form of the relationship between persons and the items that operationalized one trait. This means that the likelihood of higher scores increases as people have more of the trait and decreases as they have less of the trait, whereby items becomes more difficult to endorse. The Rasch Model assumes that item responses are governed by a person's position on the underlying trait and item difficulty.

The responses of 524 students were analyzed using BIGSTEPS (version 2.82), a Rasch Measurement computer program for obtaining objective fundamental measures from stochastic observations. The analysis was only done on 523 students responses because one of the sample had extreme score and was thus excluded from the analysis. The final analysis showed that the infit values of the 30 items were between 0.64 and 1.27, and the outfit values were 0.65 and 1.24. The results also showed that the Person Separation Reliability was 0.89, and the Item Separation Reliability was 0.98, (i.e., indication of "**unidimensionality**" of the constructed scale. The calibrations of the items ranged from -1.01 logits to +1.25 logits with mean 0 and the standard error of 0.08. The person measures ranged from -2.27 Logits to +5.43 logits with a mean of +0.77 logits and the standard error was 0.36.

The Cognitive and Meta-cognitive Learning Strategies Scale

Figure 1 shows the map of "The Cognitive and Meta-cognitive Learning Strategies Scale with its " associated dimensions positioned according to their mean calibrations. They were ordered from the dimension that indicated, "**most frequently used strategies**" to the dimension that indicated, "**less used strategies**".

The dimension that students admitted to have used most was REHEARSAL (mean - 0.36 logits). This was followed by ORGANIZATION (mean -0.19 Logits), ELABORATION (mean -0.06 logits), CRITICAL THINKING (mean +0.05 logits) and the least used strategy is METACOGNITIVE & SELF-REGULATION (mean + 0.19).

Figure 1. The cognitive and meta-cognitive learning strategy scale

Refer to file <BAH03426-appendix.pdf>

Discussions

REHEARSAL strategies were used for simple tasks like activating information in the working memory but not to construct connections nor integrate information with prior knowledge. Students rehearse materials and try to memorize the key words but rarely try to list out the important terms used in the course and memorize it. Most frequently used strategy under this dimension was the item 40 which stated “ When studying for this class, I read my class notes and the course readings over and over again”

The scale shows that strategies under ORGANIZATION were also used frequently. These include constructing connections among the information they have learned. revising readings and class notes and try to find important ideas and concepts. Visual organisation like making simples charts, diagrams, or tables were done but students rarely outline the material so that they can organize it in their thoughts. Even though this dimension was ranked second after REHEARSAL as containing most frequently used strategies, an item in this dimension was the most frequently used overall strategy that is item 38 which stated “ When I study for this course, I go through the readings and my class notes and try to find the most important ideas”. As is evident from its placement on the scale, this strategy sets itself apart from other strategies in the same dimension with the rest bunched together on the higher end of the scale (items 32, 42 and 52).

To make more meaning for what they have learned, the more competent students will use the ELABORATIONS learning strategies where they build internal and external connections among the materials learned. In this dimension students summarize material and develop relationships between what they learned in lectures with what they have read from other sources. They also try to relate what they have learned with their prior knowledge, but did not cross reference with what they have learned in other lectures (item 51)

Learning will be meaningful if they can use the knowledge they have acquired to solve the problems or to make critical reflections about what they have learned. However, the CRITICAL THINKING learning strategies were less adopted by the students in the sample studied. Not all students will try to find/decide on good supporting evidence about the theory(item 41) nor make interpretations or conclusions that have been presented in the class or in what they have read. This is evident from item 41 which is one of 4 items rarely used by the students. Item 43 which stated that “ I treat the course material as a starting point and try to develop my own ideas about it” was surprisingly a strategy used quite often by matriculation students being ranked second most used strategy in the overall ranking of items on the scale.

Going by the means (+0.19), the strategies from **METACOGNITIVE SELF-REGULATION** were the least used by the sample of the students in this study being adopted only by the more successful students. A lot more students employed strategies as indicated in items 47, 39,60, 61, 37 and 59. These include changing study styles to fit course requirements and instructor’s teaching style as well as setting goals and clearing confusion during lectures after class time. As can be concluded from the scale three items (48, 34 and45) were placed at the top end of the scale meaning that these were the least employed strategies overall. These strategies were “I often find that I have understood what I have been reading for class (item 48), “When reading for this course, I

make up questions to help focus my reading (item 34) and “Before I study new course material thoroughly, I often skim it to see how it is organized.

However, when viewed from the distribution of student frequency, the data allowed us to simplify the sample of 524 students into 2 clear categories based on non-overlapping of 2 times the standard error between the means. These 2 categories are labeled as (1) students employing ineffective learning strategies (26.1%) on the lower end of the scale and (2) students employing effective learning strategies (73.9%) on the higher end.

Using the Rasch Model has made it possible to see the development of learning strategies employed by the students. The learning strategies scale reveals how students develop their learning strategies and specific strategies employed by students of various self-regulated abilities. The mean scores of the various dimensions suggest that students move from ineffective learning strategies (rehearsal) to more advance learning strategies (meta-cognitive self-regulation). The plotted means also suggest that more advance learning strategies are employed by high self-regulators and ineffective learning strategies employed by naïve self-regulators.

Data analyses by Pintrich et al (1991) revealed mean scores of 4.14, 4.16, 4.53, 4.54, , and 4.91 for the dimensions of organization, critical thinking, rehearsal, meta-cognitive self-regulation and elaboration respectively. Mean scores using the usual statistical package do not reveal development of learning strategies in self-regulators. Values obtained only suggest the most used to less used learning strategies by the whole population. Mean values also do not reveal strategies most frequently used by naïve self-regulators as compared to skillful self-regulators. The means scores seem to suggest that the organization strategy (Mean = 4.14) being least used and students adopted elaboration as a highly used strategy during learning. Values obtained from mean score of SPSS could not identify item and person fit indices and does not show gradation on one scale. This would not make it possible to see the employment of lesser-used strategies as compared to the more used strategies by naïve and skilful self-regulators on the same scale.

Conclusions

In conclusion, the mapping showed that students with ineffective learning strategies (26.1%) used the lower level cognitive learning strategies such as rehearsal and organization while the students with the effective learning strategies (73.9%) adapted the higher level learning strategies such as critical thinking and meta-cognitive and self regulation learning strategies. The less effective self-regulators while lower in numbers could be helped to attain skills for better learning strategies for as reported by Zimmerman & Kitsantas (1997), they tend to attribute this to their lower abilities. In view of this, it is important that instruction should provide support for self-regulated learning in the classroom. Embedding self-regulating support in instruction can help enhance or supplant existing capacities and skills for learners who have difficulties with self-regulation (McCombs 1989). The data also indicated that these students utilizing only rehearsal and organization strategies need to normalize themselves with strategies from elaboration and critical thinking dimensions in order to progress to the metacognitive self-regulation dimension.

The data indicated that the majority (73.9%) are able to self-regulate and make continuous adjustment to their cognitive activities in order to achieve their goals. This

finding is not surprising since matriculation students are selected students based on their high academic performance in the public examinations and are therefore skillful enough to self-regulate their learning to their advantage. The matriculation curriculum should take this opportunity to develop their students high capability at self-regulating and tailor their instruction to make it more dynamic and challenging thereby empowering their students for a more progressive learning environment at the tertiary level.

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