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TEACHERS' COMPETENCY TOWARDS TEACHING PERFORMANCE OF THINKING SKILLS IN SCIENCE CLASSROOM

Nurzatulshima Kamarudin

Faculty of Educational Studies, Universiti Putra Malaysia, 43400 Malaysia.
nzshima@upm.edu.my

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Abstract: *The purpose of this paper is to briefly discuss teachers' competency in teaching higher order thinking skills, or HOTS in the (science) classroom. Thinking skills has an essential outcome in the educational process. Yet, we realize that the teaching of thinking skills in secondary education is lacking. Many students are not able to think out of the box. Educators have recognized improving the quality of students' thinking as a key issue. This concerns mainly, the ability of Malaysian students to think critically, creatively, and effectively. Improving the thinking and reasoning abilities of all students' calls for substantial changes in the mission of schools, the preparation of future teachers, and the methods of instruction. Teaching thinking skills to promote students' intellect has been a major challenge for educators for a long time and there are continual demands to improve students' learning and thinking skills. Thus, teachers need to possess a body of knowledge and be able to apply that knowledge to a variety of situations within their professional setting.*

Keywords: *Thinking skills, Intelligent, Creative, Teacher Competency*

Introduction

The most current commitment by the Ministry of Education (MOE) on teaching thinking skills is shown by the statement "Every student needs to possess a spirit of inquiry and learn how to continue acquiring knowledge throughout their lives, to be able to connect different pieces of knowledge, and most important of all in a knowledge-based economy, to create new knowledge" in the Preliminary Report: Malaysia Education Blueprint 2013-2025 (MOE, 2012). This indicates that the MOE's commitment is to promote the teaching of higher order thinking skills in Malaysian educational institutions. Critical thinking and problem solving are among the skills delineated as necessary for college and the workforce (Lai & Viering, 2012).

According to the 2011 results of an international benchmark, Trends in International Mathematics and Science Study (TIMSS), Malaysian students have dropped in test scores for both subjects in the 1999-2011 period. In another international education benchmark on higher order tasks; Programme for International Student Assessment (PISA) 2012, Malaysian students' Science scores saw a decline versus the older findings in the 2009 edition (UNESCO,

2012). As thinking skills were identified for students, issues were also arising in the teaching and development of those skills. It has been found that in many classroom setting, teachers have a tendency to talk to students about thinking more than to stimulate them to use it (Costa, 1985). Hence, it is not surprising that many researchers or science educators from different backgrounds are keen to try different interventions to enhance students' thinking skills, hoping better students' academic achievements (Lee et. al., 2016; Ali, 2012; Milner-Bolotin & Nashon, 2012).

Rosnani (2002) examined teachers' perceptions and practices in the teaching of thinking and showed that majority of the teachers felt a low sense of personal teaching efficacy in teaching thinking skills and processes. Rajendran (2008; 2001) reported that teachers in most cases are not adequately prepared to infuse the teaching of thinking skills into their respective subjects. This report was supported by the UNESCO, 2012 findings which found that teachers are less prepared for teaching and learning for the purpose of promoting higher level thinking skills. Another local report was also revealed that most teachers implement less creative and innovative teaching approaches to promote higher order thinking skills (KPM, 2011; MPN, 2011). As such, teachers need the opportunities to upgrade their knowledge and skills to teach thinking skills in their respective classroom. However, there are very few comprehensive and systematic continuous professional development training scheme for teachers to teach thinking skills (Rajendran, 2004).

As a consequence, the notion of a more qualified education has been highlighted. The changing and developing notion of education has raised the question of teacher quality due to the fact that teachers constitute one of the variables that determine the quality of education. Therefore, enhancing the quality of education first relies on identifying the competencies required teachers. The characteristic qualifications of today's teachers are encapsulated in their competencies in content knowledge, professional knowledge, and pedagogical content knowledge (Shulman, 1986).

Bloom's Framework- Higher Order Thinking Skills (HOTS)

The concept of higher order thinking is derived from the Taxonomy of Educational Objectives, Handbook I: Cognitive Domain (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). More popularly known as Bloom's Taxonomy, this system identifies a hierarchical progression to categorize lower to higher order levels of cognitive processing. The six levels of Bloom's Taxonomy include: *knowledge, comprehension, application, analysis, synthesis,* and *evaluation*. In Bloom's taxonomy, *knowledge, comprehension* and *application* levels are considered as lower order thinking; while *analysis, synthesis* and *evaluation* as higher order thinking (Mainali, 2012). Chen (2016) emphasizes that in order to engage learners to think at the higher order level, teachers are required to pose higher order questions to them. The author also commented that it becomes crucial when the teacher's questioning technique or behaviors are not effective in producing higher-order thinking students. Traditional questioning is practised by students giving answers whenever teachers ask a question. This might cause the students to answer the questions passively and reduce chances for the students to interact with each other in order to maximize their higher order thinking skills. Thus, an effective framework is necessary for teachers to conduct questioning which can enhance students learning behavior (Chen, 2016).

The use of Bloom's Taxonomy as a conceptual framework for research in higher order thinking would be remiss without a discussion of the revised taxonomy. Anderson and Krathwohl's (2001) revision of Bloom's Taxonomy transforms the original classification system to two-

dimensional tables: knowledge dimension and cognitive process dimension. Within the cognitive process dimension, lies the original hierarchical classification of cognitive processes. In the revised taxonomy, the cognitive processes of *remember, understand, apply, analyse, evaluate,* and *create replace knowledge, comprehension, application, analysis, synthesis,* and *evaluation*. Furthermore, evaluation is classified as a lower cognitive process than creation in the revised taxonomy.

Resnick (1987) stated that the characteristics of higher-order thinking: (1) involve non-algorithmic sequences, (2) include levels of complexity, (3) yield multiple solutions, (4) involve nuanced interpretation, (5) involve the application of multiple criteria, (6) include uncertainty, (7) involve a self-regulated thinking process, (8) involve imposing meaning, and (9) require effort to process or understand. On the other hand, Miller and Stoeckel (2016) suggested that thinking can be include various features such as remembering, making observation, recalling facts, making arguments, making assumptions, making reviews, making decisions, ideology, producing different ideas, high curiosity, visualizing, inquiry, clarifying, and making hypotheses. All these aspects of the concept make a concrete definition of the phenomenon in human cognition. Collectively, HOTs "engage learners in discovery learning, reasoning, organizing, and argumentation" (Torf, 2003). Whittington, Stup, Bish, and Allen (1997) believed that thinking critically means thinking at a higher level of cognition, which is an essential skill and must be reinforced in school. Barak & Dori (2009) defined higher order thinking as not following step-by-step (non-algorithmic), and stated that critical thinking can generate various solutions or answers. Any school can become the center that can train students' higher order thinking (Miri, David, & Uri, 2007). Good thinking skills is essential for students to strengthen their ability to think critically and creatively (Salih, 2010). While Bloom's Taxonomy and other researchers appear to define higher-order thinking in various ways, in the end, the educator should teach according to the objective of learning in order to cultivate higher order thinking skills in students.

Content Knowledge & Pedagogical Content Knowledge in the Context of Teaching HOTS

Problem-solving is one of the higher order process of working that needed a person to think through details for a solution. Higher order thinking is needed to solve a problem which requires the person to identify the problem, give definition and have creative way of thinking (Nurzatulshima, Phang & Lee, 2017). Generally, in science field, students' higher order thinking skills can be nurture through teacher questioning higher order questions in close ended problem or open-ended problems (Nurzatulshima, et al., 2017).

Zohar (2013) refers to content knowledge of HOTS as "knowledge of the elements of thinking" which includes:

(a) Knowledge of individual thinking strategies such as making comparisons, formulating justified arguments or drawing valid conclusions.
(b) Knowledge of genres of thinking such as argumentation, inquiry learning, problem solving, critical thinking, scientific thinking or creative thinking (Schraw et al., 2011).
(c) Knowledge of metacognition.
(d) Knowledge of a variety of additional issues which are important for a successful "thinking classroom" such as thinking dispositions or habits of mind, and an appropriate "culture of thinking" (Perkins, Jay, & Tishman, 1993; Swartz, Costa, Beyer, Reagan, & Kallick, 2008). Zohar (2004) addressed teachers' pedagogical knowledge in relation to instruction of higher order thinking by using a special term: "pedagogical knowledge in the context of teaching higher-order thinking".

Teachers' Attitudes towards Teaching HOTS

Studies on teaching thinking should help to improve the practice of teaching thinking in schools, yet studies showed that it seems to be less explored (Rosnani, 2002). Thus, the teachers' own beliefs and perspectives about teaching thinking is called to be examined as one way to improve the practice of teaching thinking. Onosko (1989), found that outstanding teachers had more positive beliefs and attitudes towards the teaching of thinking than less outstanding ones. Outstanding teachers also gave a more detailed conception of thinking than less outstanding teachers.

Yildirim (1994) found that teachers who were content oriented emphasized on the content of thinking while teachers who were skill oriented emphasized the application of thinking skills. According to him, the teachers displayed significant differences in their attitudes by school level and training in teaching thinking. There were also significant differences in the teachers' orientations toward teaching thinking based on subject area and gender. Almost all Social Studies teachers had a mixed orientation toward teaching thinking and female teachers were more likely to be skill-oriented than male teachers. Zohar, Degani and Vaaknin (2001) commented that some teachers feel that lower achieving students are not prepared for higher order thinking tasks or activities. According to the teachers, the students are not prepared to involve themselves in problem-solving and generating their own ideas. The lower achieving students need more time to obtain lower order knowledge with 'cook-book' instructions before obtaining higher order knowledge. A mismatch in the teaching style and learning style sometimes causes frustration (Letele, Alexander, & Swanepoel, 2013) for the students and teachers can hardly obtain good academic achievements from the students as well.

HOTS in the Science Classroom

How can teachers ensure that their science lessons are not only meaningful but also interesting, meet the standards, and prepare students for their futures? According to Boone, Boone, and Gartin (2006, p. 25), "The solution is not to teach facts and figures but to teach students how to think". Interestingly, most teachers would agree that students should be able to think critically. However, they may be struggling with devising ways to prepare their students to do so. This may be, in part, due to a lack of training in and understanding of how to accomplish this. In order to prepare lessons that guide students through the thinking process, and to provide practice at it, it is imperative for teachers to have an understanding of that process and to recognize its characteristics.

Children should encounter science through a variety of experiences that actively engage them in the construction and pursuit of ideas, the crafting and implementation of a course of action, and the evaluation and interpretation of their results. After all, science is something that students do, not something that is done to them (Gooding & Metz, 2006). The National Research Council, in its publication How Students Learn: Science in the Classroom, asserts that learning experiences need to develop from first-hand concrete experience and that "students need opportunities to learn and inquire in the discipline [of science]" (2005, p. 512). Authentic instruction and its questioning strategies are consistent with a larger literature on critical thinking.

Teachers can also use tools to make learning interesting, assign and keep track of student's work and marks, create teaching resources, and connect with other educators. Teachers can plan better, which allows them to view, create, join or add events. Here are some benefits when teachers teach out-of-the box.

- Using teaching strategies that foster both the development of thinking skills and the mastery of subject matter under consideration.
- When learners succeed at tasks of any kind, focus their attention on labelling the thinking skills that have enabled them to be successful.
- Encourage students to reflect on what they do that is effective and to give names to these processes.
- Help students overlearn basic skills so that they can afford the leisure of focusing on how they are thinking rather than being overwhelmed by the basic skills included in the task at hand.
- Recognize the conditional nature of many thinking skills. Help students realize that a major part of using these skills is knowing when (not just how) to use them. Encouraging, giving support and motivating students at all time.
- Supply prompts to aid learners in monitoring the methods and depth at which they are processing information. These prompts can range from simple reminders or checklists to detailed scaffolded instruction programmes.

Nevertheless, creativity is one of the important elements as well that can influence students' higher order thinking especially in the process of teaching and learning. School can create a creative climate which can inspire creativity level of teachers and students during HOTS application and develop a better teaching and working environment (Arase, Nurzatulshima, & Hassan, 2016).

Conclusion

Teachers need to be experts in delivering teaching that includes thinking skills. By implementing a variety of teaching approaches, students will be exposed to different style of thinking. To achieve the higher-level thinking, teachers must try all types of teaching and use thinking tools accurately. The competency of teachers in integrating thinking skills in their teaching will allow students to attain their thinking skills to a higher level.

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