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Improvement in The Mastery of Answering Science Process Skill Questions Through Self-Learning Module

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Abstract: This action research aimed to improve form one pupils' mastery of answering science process skill questions (in terms of comparing, making inference, hypothesizing and predicting) through a self learning module. This action research also aimed to determine the effectiveness of science process skill self learning module. This research used Kemmis and Mc Taggart's action research model which involved four levels: planning, response, observation and reflection. A number of self-learning modules were used, starting with a pre-test followed by activities using self-learning modules according to sequence and ending with a post-test. This research also involved observation of and reflection on the activities conducted. The research findings showed improvements in every aspect of science process skills. This research also suggested that the self learning module is more effective in improving the mastery of answering questions on science process skills than the traditional teaching methodology. It is suggested that this methodology be used as a learning approach for other subjects and at various levels. In order to strengthen these research findings, it is proposed that a series of research studies be conducted using a similar approach to the same aspects of science process skills at different schools within the same category.

Key words: Self learning module, science process skills, comparison skills, inference skills, hypotheses skill, pridiction skills

INTRODUCTION

Malaysia is in the process of undergoing a transition from an agricultural based to an industrialized country as stipulated in Vision 2020. One of the challenges stated in Vision 2020 is to establish a Scientific and Progressive Malaysian Society that is a contributor to the development of technological civilization rather than merely a user of technology.

According to Hussain and Brahim (2006), Malaysia realized the process of modernization and its rapid industrial development depended on the progress of science and technology acquired from science education in schools. The Malaysian Ministry of Education (MOE) has decided to introduce the sciences to pupils as early as year 1 in an effort to increase the interest in science and technology among pupils. At the same time, it also serves as a skill preparation work for achieving Vision 2020. Thus, pupils are now given the opportunity to better understand the phenomena around them and to explain such occurrence scientifically. Therefore, a strong foundation in scientific knowledge and attitudes as well as good values are being given to pupils in order to prepare them to learn science at a higher level.

The primary school science curriculum emphasizes the mastery of scientific thinking skills as well as the comprehension of basic scientific principles. The science curriculum is also meant to cultivate scientific attitude and good values in order to create progressive Malaysian citizen with balanced intellectual, spiritual, emotional and physical qualities. The emphasis is meant to be placed on mastering Science Process Skills (SPSs) rather than memorizing mere facts and scientific principles because a SPSs will last after memorized facts become obsolete or forgotten (Ango, 2002).

Problem statement: Science education emphasizes inquiry and problem-solving methodology which emphasize scientific and critical thinking skills. Scientific skills are important when carrying out activities according to scientific methodology (e.g., carrying out experiments, research studies and projects). One of the main objectives of scientific learning is the mastery of SPSs where the scientific skills consist of SPSs and manipulative skills.

A report from the Panel of Inspectorate and Quality Control (MME, 2010a) and findings from the observation on the science curriculum implementation carried out by

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the Curriculum Development Division (MME, 2010b) showed that most science teachers do not implement teaching and learning inquiry-based science. The results also showed that most students do not master the scientific skills either during experiments or in answering questions related to SPSs. SPSs are important as they enable pupils to inquire and seek solutions in a systematic way. The approach used for teaching and learning science education is very important to ensuring the expected objectives are achieved to produce a young generation with an interest in science. Teaching and learning strategies refer to the methodology or approach used by teachers during teaching and learning activities in order to achieve a specific objectives in the learning process.

One way to assess student understanding of content is asking questions. In order to help pupils master the ability to answer SPSs questions, researchers have suggested the use of self-learning modules. Shen (2008) states that a module is an independent and comprehensive learning unit with the main focus on achieving the objectives expected. Zerger *et al.* (2002), conversely define a module as a teaching and learning package or a block of self-learning completed with components of teaching and learning. These may include objectives, materials, learning activities, assessment activities, instructions and systematic methodology aimed at helping pupils to follow the learning unit (which can be carried out individually) in a systematic fashion.

Modular learning has been shown to improve teaching and learning quality in terms of pupils' attitudes (Klop *et al.*, 2010), mental effort (Tasir and Pinb, 2012), satisfaction (Bell and Wade, 1993), understanding and achievement (McClune, 2001; McGee and Hampton, 1996) as well as improving competency in teaching and learning, shorter cycles of learning, encourage new learning styles and promotes new teaching approaches (Taverner and Wright, 1997; Thomas, 1993).

Silkwood and Pujar stated that module can help users to understand more about the subject matter based on their backgrounds. Morever, it has been proposed that self-learning modules enable pupils to proceed with their learning process according to their ability and rate of learning and enable them to identify their strengths and weaknesses. If required, they can also repeat the instructional materials through restoration activities in the self-learning module (Jamaludin *et al.*, 2009; Yeoman *et al.*, 2011; Zerger *et al.*, 2002). In his research on the effectiveness of modular teaching in chemistry at a secondary school in the Philippines, Espinosa (2009) stated that the modular approach is one of the approaches that involves very limited or minimum teacher intervention. This teaching and learning style is pupil centered and pupils learn everything through the module based on their own effort and capabilities. It different somewhat from the traditional approach in which pupils listen passively in order to learn a concept or knowledge delivered to them.

The current research findings will reflect the national secondary school pupils' level of achievement in mastering the SPSs (in terms of making comparison, inferences, hypotheses and predictions) using a self-learning module. These research findings will also provide evidence on the effectiveness of using the self-learning module in learning SPSs.

Research objectives: The current research aimed to determine the effectiveness of using self-learning module to improve pupils' ability to answer SPSS questions. Specifically, this research aimed to do the following:

- Determine the achievement of pupils before and after using the self-learning module
- Determine the level of pupils achievement in answering SPSs questions (in terms of making comparison, inferences, hypotheses and predictions) using the self-learning module

MATERIALS AND METHODS

This study used Kemmis and Taggart (1988)'s action research model which involves four stages: planning, taking action, observing and reflecting. The scope of the research was limited to SPSs related to making comparison, inferences, hypotheses and predictions.

This study was conducted >8 weeks and participants were Form 1B2 pupils at a Putrajaya, Presint 8 secondary school. The school had seven levels of classes, starting with the religious trends classes (1KAA) and Japanese language classes (1KBJ). Form 1B2 was a moderate class (in terms of their academic performance) among the Form 1 classes at the school. It consisted of 29 pupils, 12 boys and 17 girls. Data were analyzed manually as they involved only the pre-test and post-tests scores. Data presented in the form of graphs showed the proficiency of pupils in four SPSs studied before and after following the self-study modules.

During planning, the researchers tried to find a way to demonstrate Form 1B2 pupils' mastery in answering questions that involving SPSs (e.g., making comparisons, hypotheses, inferences and predictions). The researchers conducted a test to identify the pre-test proficiency of pupils in the four SPSs. Hence, the researchers used the following self-learning modules to address this issue:

- Self-learning module 1; making comparisons
- Self-learning module 2; making inferences
- Self-learning module 3; making hypotheses
- Self-learning module 4; making predictions

The module was adapted from Zaidi and Afizan (2009) and elements of the SPSs from Curriculum Development Division (MME, 2005). The researchers also conducted a post-test after the pupils used the module to determine their achievement in the SPSs studied. In addition, the researchers observed and reflected on the activities undertaken.

RESULTS AND DISCUSSION

Pre-test findings: The pre-test consisted of questions related to the skills used in making comparisons, hypotheses, inferences and predictions. All 29 pupils took the pre-test. The pre-test results are presented in Fig. 1.

The findings showed that 22 pupils had mastered questions in the form of making comparisons, 28 pupils had mastered questions in the form of making inferences, 28 pupils had mastered questions in the form of making hypotheses and 11 pupils had mastered questions in the form of making predictions. Pupils that had not mastered any SPSs were then involved in the learning activities using modules concerning only the related SPSs. Seven pupils utilized the module on making comparisons, one pupil utilized the module on making inferences and making hypotheses and 18 pupils utilized the module on making predictions. Twelve of them followed more than one module in accordance with the specific SPSs.

Post-test findings: After following the self-learning module for 8 weeks, the pupils involved sat for the post-test. Table 1 shows the number of pupils who answered the questions related to the SPSs studied correctly.

The findings of the post-test showed that the use of the self-learning SPSs module had a significant effect on pupils' mastery of answering questions related to SPSs. Result showed that after following the module, all 29 pupils had mastered the SPSs of making comparisons making inferences and making hypotheses in answering the related questions. As for the SPSs of making predictions, >90% of the pupils had mastered the skill in answering the related questions. It can be concluded that the self-learning module led to pupil's improvement in mastering the SPSs.

Table 1: Number of pupils who answered the questions related to the SPSs studies correctly

SPSs studied	Number of pupils involved in post-test	Number of pupils mastered SPSs in post-test	Percentage of pupils mastered SPSs in post-test
Making comparisons	7	7	100.0
Making inferences	1	1	100.0
Making hypotheses	1	1	100.0
Making predictions	18	16	93.1

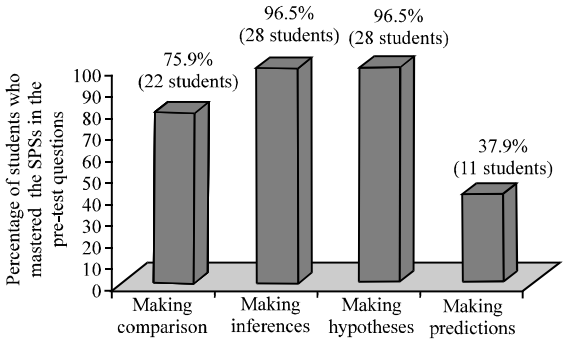

Fig. 1: The bar chart for the four SPSs levels of Form 1B2 pupils

Findings from observations and interviews: During the intervention, the researchers found that pupils followed all the instructions in the module correctly. They also carried out the proposed experiments in the modules in earnest. They occasionally asked for help and discussed their issues with the teachers. The pupils used the module in accordance with the SPSs tested in the pre-test. Each module consisted of five activities that depicted simple experiments or scenarios of daily life. Pupils used these modules during one science subject period each week for the duration of the study. Some pupils completed the module and mastered the SPSs studied in 3-4 weeks. Other pupils needed more time (7-8 weeks) to master the SPSs. Generally, all pupils were able to use the self-learning modules and understood the instructions and steps contained therein. Interviews were conducted with the seven pupils who had used the self-learning module. Four of them preferred the modules to teacher explanations because they were able to move on to other modules after they had mastered SPSs in the completed modules. The other three respondents interviewed said they were less fond in using the modules as there was too much text to be read. They preferred listening to and following the teacher's instructions.

Comparison of pupils' pre and post-test SPSs mastery: Data analyzed showed that the percentage of SPSs mastered different for each individual pupil. Not all pupils reached 100% mastery of SPSs under review. Table 2

Table 2: Differences in SPSs mastery scores

SPSs studied	Mastered in pre-test (%)	Mastered in post-test (%)	Score difference (%)
Making comparisons	75.9	100.0	24.1
Making inferences	96.5	100.0	3.5
Making hypotheses	96.5	100.0	3.5
Making predictions	37.9	93.1	55.2

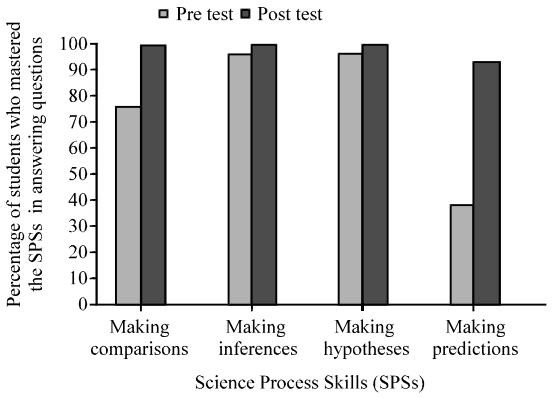

Fig. 2: Comparison between pre-test and post-test science

shows the analysis of pupils' post-test mastery (in percentages) compared with their pre-test mastery of SPSs.

The bar chart in Fig. 2 shows the different achievement levels of pupils in answering questions related to the four SPSs studied.

This action research aimed to improve pupils' SPSs involved in answering questions. Use of SPSs self-learning module was shown to have an effect on pupils' mastery in answering SPSs questions. It was found that using modules can increase the mastery of SPSs in answering questions as each module allows pupils to learn individually and progress according to their own abilities. The findings indicated that all pupils (100%) successfully mastered the skills in making comparisons, inferences and hypotheses because the modules allowed students to learn individually and according to their own abilities. While only 93.1% of pupils successfully mastered the skills involved in making predictions. The results of the interviews showed that these pupils were not interested in using too many modules as they required a lot of writing and reading as stated in the instructions therein. Perhaps, the prediction skills were somewhat difficult to master as this module required previous knowledge and decision-making skills.

However, according to Riasat (2010) individual learning modules allows individuals to make something useful for themselves as they are based on individuals' abilities.

In the current study, each pupil's performance differed. They also exhibited differences in their ability to learn and master skills. Thus, the modules were helpful as they allowed pupils to learn skills at their own level of ability. Pupils who had mastered the skills in module 1 could proceed to module 2 without the need to wait for other pupils.

This set of modules also allowed pupils to get instant feedback on their understanding and achievement as it contained elements of the assessment. Pupils also found it easy to learn because if they had not reached the expected level of mastery, they still had a chance to repeat the activities to improve their mastery. Pupils' motivation to learn was also indirectly enhanced due to their desire to complete the modules in sequence.

The teachers only needed to introduce the new material (i.e., modules). They did not need to check or marks the pupils' work. If this teaching module were to be used in the classroom, teachers would receive feedback by comparing the results of tests obtained from each pupil before and after the learning session (Espinosa, 2009). In addition, the use of modules could help teachers design more effective teaching activities as well as encourage pupil participation in various activities.

Research implication: The research findings have shown that applying the self-learning module to the teaching and learning approach is beneficial in that it addresses the differences in pupils' capability to master a skill. The self-learning module was also able to provide pupils with space to learn in their own way, at their own pace of learning. Moreover, it helped them to understand the SPSs in terms of making comparisons, inferences, hypotheses and predictions. The research findings support the opinions of earlier researches who have stated that modular learning improve teaching and learning quality in terms of pupils' attitudes, mental effort, satisfaction, understanding and achievement as well as improving competency in teaching and learning, shorter cycles of learning, encourage new learning styles and promotes new teaching approaches (Bell and Wade, 1993; Klop *et al*., 2010; McClune, 2001; McGee and Hampton, 1996; Tasir and Pinb, 2012; Taverner and Wright, 1997; Thomas, 1993).

CONCLUSION

Generally, this action research succeeded in achieving the objectives of determining the effectiveness of self-learning module in improving SPSs mastery. Students showed improvement in all SPSs area discussed after using the self-learning module. Thus, this method should also be used as an approach for teaching other subjects at different levels. In order to strengthen

these research findings, a series of research studies should be conducted on the use of similar approaches to the same aspects of SPSs at different schools within the same category.

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