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Factors Affecting Reasoning Skills on Socio Scientific Issues (SSI)

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Abstract
Socio Scientific Issues (SSI) is one of the strategies used in teaching and learning to discuss particular current issues that related to health, environment, medicine and genetic engineering as frequently reported in the mass media. This strategy used in teaching and learning to approach students in understanding and empowering the science concept. The purpose of this study is to develop a model based on SSI in measuring and assessing the cause effect relationship of the identified variables for the proposed model of reasoning skills among the science students. The method used in this research is a quantitative study with survey approach that will measure the model fit. A total of 500 respondents form four students in biology classes around four zones in Malaysia responded to four variables in the questionnaire (content acquisition, epistemology scientific belief, adhered moral and ethics and reasoning skills). Data was analyses by using SPSS and Analysis of Moment Structure (AMOS) 21 to form Structural Equation Modeling (SEM). The results of this study is projected to contribute the understanding of students' reasoning skills especially in biology education. This study is expected to develop policies and guidelines towards the Centre of excellence in science teaching and learning.

Keywords: Socio Scientific Issues(SSI), Reasoning Skills, Content Acquisition, Epistemology Scientific Belief, Adhered Moral Ethics

Introduction

Socio-Scientific Issues (SSI) is one of the strategies teaching and learning which can relate the science concepts with particular current issues that have been reported by the mass media. Examples of issues has commonly reported is health issues, environmental issues, medical issues and genetic engineering issues. The SSI strategy is controversy issues that can stimulate students to debate. Indirectly, when it was discussed, each science concept connected with the learning objectives in biology curriculum will be dominated by students. According to Zeidler,

(2016), during the debate going, moral values and ethic can be perform and achieved during this strategy.

In addition, the SSI can be implemented in the form of writing by submitting current issue or problem issues and will answers by students based on their knowledge in science and experience in their daily life. One issue in this study is the decreases in the results of the TIMSS and PISA in Malaysia. This is because the format of the question TIMSS and PISA is to form long sentences and relate to student daily life issues. This causes the Malaysia students could not answer questions because the students are familiar with the format of examination questions that lead to the correct answer like as multiple-choice questions (Darus, 2012). Therefore, the approach to the SSI strategy can make learning in the classroom as informal as students have the opportunity to shape the discussion and argued even with the wrong answer (Zohar & Nemet, 2002).

According to Sadler and Zeidler et al., (2009), SSI strategies are consistent with the definitions issued by the TIMSS and PISA towards scientific literacy and scientific knowledge which requires students to identify questions, acquire new knowledge, explain scientific phenomena and make decisions based on evidence associated with the socio scientific issues given. In this results, students are not afraid to argue, even if their opinions are wrong. In an informal conversation approach, using current issues can give students an opportunity to diverging opinions, but can create a lots of experience for the students in the class (Mueller & Zeidler, 2010).

Bentley, Ebert, and Ebert, (2007) very supports the approach of using informal experiences students because it provides an opportunity to discuss and interact with each other in giving opinions on the issues discussed. Despite that, this discussion will encourage the exchange of ideas and sharing of ideas and knowledge and to expose students to the reality that science is more complex than memorization. Study findings from Bell and Lederman, (2002) stated biology student who uses SSI can achieve higher level of their scientific reasoning. Similarly, studies that have been done by Tal and Hochberg, (2003); Zeidler, Sadler, Applebaum, and Callahan, (2009) states that students are exposed to the SSI strategy has been proven to improve the skills of reflection on the issues presented.

The aim of this study is to develop Structural Equation modeling (SEM) of scientific reasoning among science students in Malaysia. Through this, researchers can identify and measure the impact of the variables contributing causal effects from three independent variables that have been. The results of this study is projected to contribute the understanding of students' reasoning skills especially in biology education. This study is expected to develop policies and guidelines towards the Centre of excellence in science teaching and learning based on model was tested.

Dependent Variable (Reasoning Skills)

Researchers need to determine the dependent variable to develop SEM. In connection with the choose of scientific reasoning as the dependent variable was to measure the level of reasoning and how students to make decisions based on their knowledge and experience. Basically cognitive theory used in this research involves the theory of cognitive development (Piaget, 1976) and subsequently complemented by reforms in all levels of thought and attitude (King, &

Kitchener, 1994; Perry, 1979). In science subject, reasoning skill is an important matter of principle in generating scientific knowledge. In the case of scientific reasoning, arguments are defined as given with confirmation and justification (Sadler, 2009).

Independent Variables

Content Acquisition to be studied are closely related to students skill in making decisions based on knowledge, applications and analyzes. In this study, high levels nearly Taxonomy Blooms equal to the SSI strategy that requires students to make a decision is analyzes (Crowe, Dirks, & Wenderoth, 2008). It refers to the cognitive domain Taxonomy Bloom revised, the highest level involving higher-order thinking skills (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Wittrock, 2001). Content Acquisition in biology is found in the curriculum specification that already available in form four biology subjects (KPM, 2012).

Epistemology scientific belief was selected because it relate with belief of students in their daily life. In accordance with the implementation of 21st century education and the implementation of the TIMSS and PISA assessments, the question that is always asked is related to the current issues especially in the environment and health issues. The theory of epistemology linked to cognitive development in decision-making. According to Tsai, (2010) found a positive relation between epistemological beliefs and SSI. One of the factors affecting student achievement is the epistemology scientific belief, because students play an important role in the learning process while make decisions (Neber, & Schommer, 2010).

In Malaysia, the National Education Philosophy and Philosophy of Science Education, apart from the students competence the cognitive domain, students are also required balanced in terms of their spiritual and emotional. Thus, ethics and values of the variables are select to complement and fulfill the aspirations to be achieved during the learning process. Referring to the SSI strategy, students are exposed by making decisions based on facts, theories on religion belief. According Comstock, (2001) and Shuell, (1986), students will make decisions based on considerations of ethics and morality depends on the facts and evidence available.

Material and Method

Data collection techniques in this study is a quantitative survey. Selection of 500 respondents, using a stratified random sampling in two stages. The first stage is to use simple random sampling of a state based on four zones (north, central, east and south), researchers determine the state of each zone using a simple random one state, The state finally selected were Kedah, Perak, Terengganu and Johor. As for the second stage was a simple random to determine the number of students in each state were selected in proportion to the size (Saunders, Lewis and Thornhill, 2012).

Table 1: Ttechnique's to determine the number of respondents in this study

Number of respondent	Number of students selected
North Zone (Kedah) 5,057	108
Central Zone (Perak) 7,168	153
East Zone(Terengganu) 2,462	53
South Zone (Johor) 8,761	186
TOTAL : (Four Zones) 23,448	500

Development of questionnaire items that have high validity and reliability to measure and assess the data collected and perfect. For the questionnaire, which is based on theory, selected scale is starting with '1' to '5' and the others with scale of '1' to '7'. The selection is wide scale to generate more accurate statistical analysis (Sekaran, 2010).

Table 2: Types of variables in the instruments

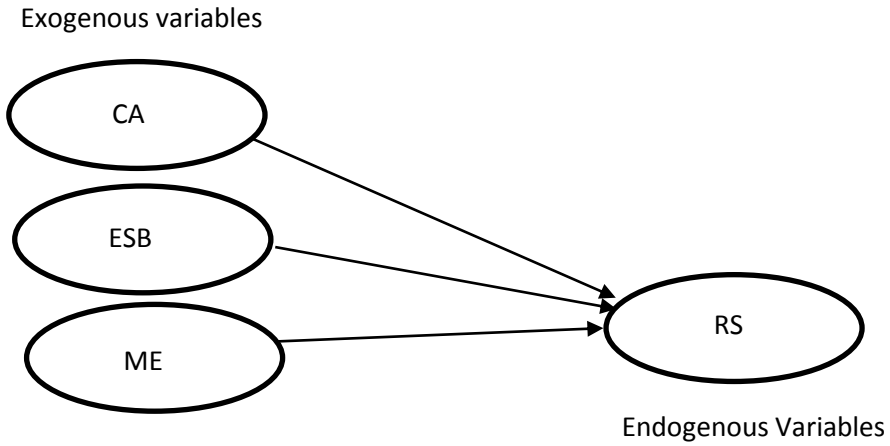
Variables	Scales	Items	Measurement types
Reasoning Skills (RS)	Test questions	11	ratio
Content Acquisition (CA)	Test questions	4	ratio
Epistemology Scientific Belief (ESB)	1 to 5	15	interval
Adhered moral and ethics (ME)	1 to 7	6	interval

Structural Equation Modeling (SEM) was chosen because of its benefits to develop a model that can connect between three independent variables with dependent variable simultaneously (Kline, 2011). SEM is better than the path analysis because it can produce a measure of value both accurate validity and reliability but depending on the number of respondents (Chua Yan Piaw, 2014). In addition, it is also possible to test the hypothesis model highlighted in the study (Zainudin, 2015). Data were analyzed using AMOS and SPSS version 21.

Results and Discussion

On my current stage study, after the data were analyzed, the results will show which of these variables will affect and cause higher on scientific reasoning among science students in Malaysia. In other hand, we can measured the level of reasoning skills and content acquisition pattern. Bell and Lederman, (2002) suggests that biology students use SSI strategy has a high level scientific reasoning. Similarly, studies that have been done by Tal and Hochberg, (2003); Sadler and Zeidler, 2005; Walker and Zeidler, (2007) states that students are exposed to the SSI strategy has proven to increase the reflection during the discussion. Past studies also show content competence affect the outcome of the debate on scientific reasoning that goes on in the classroom (Sadler & Donnelly, 2006). According to Sadler and Zeidler, 2005, in setting decisions on values and ethics, while carrying out scientific reasoning, this strategy has allowed students of all ages can be assessed by using reasoning and religious influence in decision-

making by high school (Hogan, 2002), secondary education (Zeidler et al., 2009), college (Sadler, 2011) and children (Morris, 2014)..



CA : Content Acquisition
ESB : Epistemology Scientific Belief
ME : Adhered Moral Ethics
RS : Reasoning Skills

Figure 1: Shows the causes and effects towards reasoning skill

Conclusion

It is hoped that the SSI strategy is consistent and accurate to implemented in the education system in Malaysia as teaching and learning strategies. Directly can be as a country which implements discipline of Science, Technology, Engineering and Mathematics (STEM). As a result of this model, researchers were able to detect factors that contribute to the scientific reasoning science students. This model is based on the theory of cognitive development that has to do and can achieve the goals of the National Development Plan of Higher Education 2013-2015. The study is also expected to contribute towards the development of policies and guidelines to improve biological subjects in the education system in Malaysia.

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