

The Study of Used Socio-Scientific issues (SSI) in Biology

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Abstract

Using socio-scientific issues (SSI) in science lesson especially biology is an approach for students to understand and empower the science concept. Students are given the opportunity to argue the issues and will improve the process of reasoning. Using this approach indirectly can create awareness of ethics and problem solving to students. From the literature review hopefully can develop reasoning skills model based on SSI. Structural Equation Model (SEM) approach is used for measure and identify the variables that contribute students' reasoning skills. From trends of literature reviews, three independents variables were identified, Content Acquisition, Epistemology Science Belief, Adhered values and ethics towards Reasoning Skills as a dependent variable. Hoped this study will help to improve the empowering of science concepts and Higher Order Thinking Skills (HOTS). In another hand, it also can produce a holistic students and increase creative and critical thinking skill while using the model of reasoning as a guideline.

Keywords: Socio-Scientific Issues (SSI), Content Acquisition, Epistemology Science Belief, Adherence to the values and ethics, Reasoning Skills

Introduction

21st century education requires students to compete globally, especially students who embrace science, technology, engineering and mathematics (STEM). Science aims to make the association of ideas and understanding of natural phenomena. While the technology used to produce tools to solve the problem. Conception students to the phenomenon of science is based on observation and experience a day (Lewis & Leach, 2006). Thus the characteristics of students who are able to reasoning, problem solvers, argue, communicate, creative, critical and collaboration by anyone is an aspect that should be emphasized as well as the priority of the school (Böttcher & Meisert, 2013). One effective strategy and recognized by previous studies is the SSI approach in teaching and learning, particularly in biology. SSI is a scientific issue that is happening around the students such as environmental issues, medical, nutritional, and genetic engineering. This issue is more sensitive and controversial when it was first being debated in social media after causing negative effects and harm to society although there are some issues

that are beneficial to human life (D. L. Zeidler, Florida, & Nichols, 2009). The scientific issues are not only able to test students cognitive level, but can also measure students spiritual and emotional perception (Sadler, 2004).

SSI that touch on the subject of biology can improve their students to master concepts that are taught in a more clear (Reiss, 2006). Case studies conducted by (Reis, 2009) through observation and interviews found the approach to social issues in biology able to increase students' motivation, however, the effectiveness of this approach is dependent on the expertise of teachers in implementing it. In the study Klosterman, Sadler, & Brown, (2012), states that one of the ways to learn science is to introduce approach scientific issues because of very significant problems and issues especially related to natural phenomena. Indirectly, these activities have been revealed to the students how to start a good practice before they face the real people in the community in the future.

In Malaysia, according to (Husin, Hamidah Abd Hamid, & Siti Hajar Abdul, 2006), before that, discussion of current issues related to socio-scientific issues only occurs in the electronic media. From the using internet, people talked about the issue and found no evidence any of their submissions whether they like it or not. It is better to be exposed to these skills as students in the classroom and Indirectly, this will improve skills such as reasoning level students (Chung, Yoo, Kim, Lee, & Zeidler, 2014).

In this research, researchers need to conduct an investigation and refer to theory and previous findings for the findings of this research are more meaningful and have a high validity and reliability. In this study, the purpose of the model is to assist policy makers, especially the Ministry of Education in order to provide a clear picture of the level of reasoning of scientific students and the issue of declining student achievement Malaysia in tests Trends in Mathematics and Science Studies (TIMSS) and the Programmed for International Student assessment (PISA), which measures the subject of science

Literature Review

SSI and Reasoning

Reasoning skills is synonymous with well-planned strategy in the classroom (Pegg, 2006). Reasoning skills based on SSI often used to ensure that the teaching and learning of science went perfectly and can motivate students (Zeidler et al., 2009). Apart from learning strategies that are run, the plans made by the teacher plays an important role in achieving the learning objectives through the existing curriculum. Accordingly, in Malaysia, there are a variety of teaching strategies that have been introduced in the education system to help to meet the needs of the curriculum in schools, especially in the subject of biology. Among the strategies used in the classroom is a learning strategy that is students centered, as a problem-based learning and project-based learning. To diversify strategies for teachers, and meet TIMSS and PISA domain question, the strategy of scientific issues must be implemented.

In the meantime, the socio-scientific issues in caring, teaching and learning in the classroom is basically to help students develop the skills to understand scientific terms, make a decision, make an assessment, give evidence and conclude issue’s discussions involving science concepts (Yoon, 2008). With the attention and concentration of students on subject content will continue to increase and facilitate teachers in conveying information. Thus, this strategy can help teachers when they tried to emphasize science concepts (Sampson, Simon, Amos, & Evagorou, 2011). (Tal & Kedmi, 2006) has listed the characteristics of the socio-scientific issues that need to be brought into the teaching of biology is as follows:

- Has to do with the biology curriculum standard
- Supported by current data
- The real issue
- Contemporary issues relevant to the subject
- Be controversial
- Natural character and have the scientific process
- Need to discuss moral and ethical

SSI Review

To facilitate researchers across the gap in the case studies, systematic literature review were used to analyze the results of previous studies related to the issues of socio-scientific. The table 1 shows the studies that have been done.

Table 1 : SSI in review

Studies	Purpose of studies	Variables	Conclusions
(Zeidler, Sadler, Applebaum, & Callahan, 2009)	To investigate the effects of SSI on student reflective	Reflective judgments	SSI can increase the reflective student of science concepts
(Sadler & Zeidler, 2005)	To identify the significance of scientific reasoning and motivation	Knowledge Content Scientific Reasoning	Positive significant and increasing student motivation
Studies	Purpose of studies	Variables	Conclusions
(Zeidler, Sadler, Simmons, & Howes, 2005)	Identify literacy in science and belief in science	Epistemology science belief	Attitude and epistemology of science
(Mueller & Zeidler, 2010)	Associate morals and ethics of science	Moral and ethical	Using moral and ethics during the discussion
(Albe, 2008)	Theory and practice of SSI	epistemology of science	Raising awareness during discussions
(Sadler & Donnelly, 2006)	Debate on the SSI	Acquisition content, Moral and ethical	Has a relationship during the process of debate towards moral

			issues
(D. L. Zeidler & Keefer, 2003)	The role of the moral of the SSI	moral reasoning	Students are able to perform moral reasoning while arguing
(Acar, Turkmen, & Roychoudhury, 2010)	Using debate to identify problem towards SSI	Making the decision	Students can create a framework for decision-making through debate
(Klosterman, Sadler, & Brown, 2012)	Assessing the impact of the SSI in the curriculum content knowledge using mass media	Content Knowledge and Information Technology	Multi-level assessment of scientific content knowledge gains associated with SSI based instruction
(Siew Fong Yap, 2014)	Review of the SSI elements of science	Moral and ethical	SSI plays an important role in the social and political dimensions
(Gerber, Cavallo, & Marek, 2001)	Relationships among informal learning environments, teaching procedures and scientific reasoning ability	Scientific reasoning	informal learning environments and classroom science teaching procedures showed significant main effects on students' scientific reasoning abilities.
(Chung et al., 2014)	Enhancing Students' Communication Skills in the Science Classroom Through SSI	Communication and Reasoning	SSI instruction could bring about a moderately large impact on students' ability to understand.

The proposed framework under review

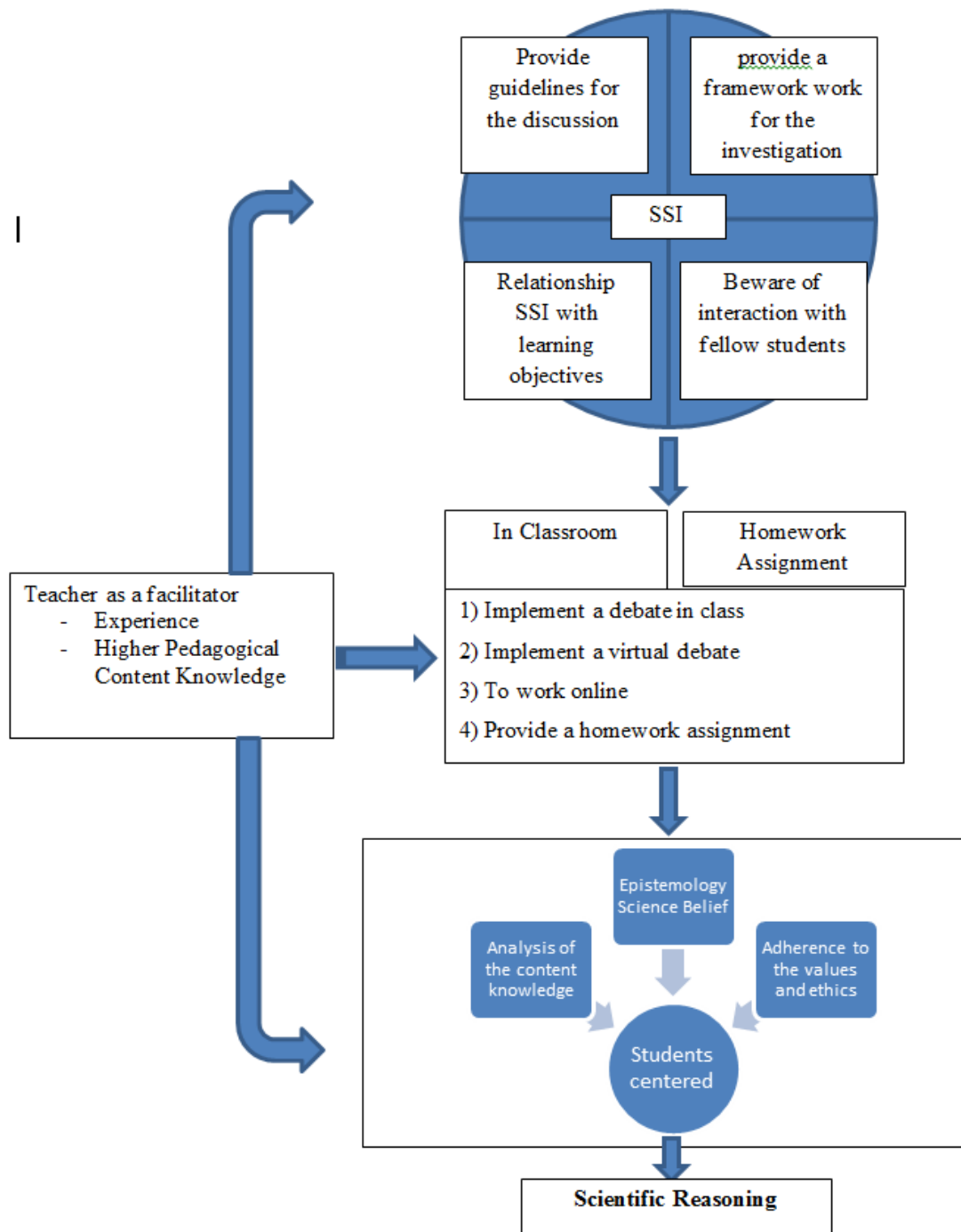


Figure 1 shows the overall framework involving SSI strategy when applied in teaching and learning.

This framework then makes a recommendation to study after identifying the variables to be tested. Here are the proposed objectives in this study.

- a) Develop and validate the measurement model of reasoning skills, content acquisition, epistemological scientific beliefs and adhered values-ethics based on socio-scientific issues.
- b) Identifying the effect content acquisition, epistemological scientific beliefs, adhered values and ethics towards reasoning skills.
- c) Propose a model of reasoning skills is significant and positively to the study data.

Conclusion

After conducting systematic literature review, the gap is obtained for the development of Structural Equation Modeling based on SSI through four variables; analysis of content knowledge (content acquisition), epistemology science belief, adhered values and ethics towards reasoning skills. By using Analysis of Moments Structural (AMOS), hopefully the selection of four variables have high factor loading and can identify which variables to contribute students' scientific reasoning. SSI issues should be a part of the science curriculum because students deserve the opportunity to explore important issues that challenge their understanding of science concepts. SSI also helps educators to further understand how students learn science and what factors are influence on their reasoning skills. It is directly can produce students with a holistic and fulfilling the philosophy of education.

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References

- Acar, O., Turkmen, L., & Roychoudhury, A. (2010). Student Difficulties in Socio-scientific Argumentation and Decision-making Research Findings: Crossing the borders of two research lines. *International Journal of Science Education*.
<https://doi.org/10.1080/09500690902991805>
- Albe, V. (2008). When scientific knowledge, daily life experience, epistemological and social considerations intersect: Students' argumentation in group discussions on a socio-scientific Issue. *Research in Science Education*, 38(1), 67–90. <https://doi.org/10.1007/s11165-007-9040-2>
- Böttcher, F., & Meisert, A. (2013). Effects of Direct and Indirect Instruction on Fostering Decision-Making Competence in Socioscientific Issues. *Research in Science Education*, 43(2). <https://doi.org/10.1007/s11165-011-9271-0>
- Chung, Y., Yoo, J., Kim, S.-W., Lee, H., & Zeidler, D. L. (2014). Enhancing Students'

- Communication Skills in the Science Classroom Through Socioscientific Issues. *International Journal of Science and Mathematics Education*, 1–27. <https://doi.org/10.1007/s10763-014-9557-6>
- Gerber, B. L., Cavallo, A. M. ., & Marek, E. A. (2001). Relationships among informal learning environments, teaching procedures and scientific reasoning ability. *International Journal of Science Education*. <https://doi.org/10.1080/095006901750162892>
- Husin, A., Hamidah Abd Hamid, & Siti Hajar Abdul. (2006). Media baru dan Wacana Sains: Isu Pengklonan melalui Blog dan Akhbar di Malaysia. *Kajian Malaysia*, XXIV(2), 97–128.
- Klosterman, M. L., Sadler, T. D., & Brown, J. (2012). Science Teachers' Use of Mass Media to Address Socio-Scientific and Sustainability Issues. *Research in Science Education*, 42, 51–74. <https://doi.org/10.1007/s11165-011-9256-z>
- Klosterman, M. L., Sadler, T. D., & Brown, J. (2012). Science Teachers' Use of Mass Media to Address Socio-Scientific and Sustainability Issues. *Research in Science Education*, 42(1), 51–74. <https://doi.org/10.1007/s11165-011-9256-z>
- Lewis, J., & Leach, J. (2006). Discussion of Socio-scientific Issues: The role of science knowledge. *International Journal of Science Education*. <https://doi.org/10.1080/09500690500439348>
- Mueller, M. P., & Zeidler, D. L. (2010). Moral – Ethical Character and Science Education : EcoJustice Ethics Through Socioscientific Issues (SSI). In D.J Tippins et. al. (Ed.), *Cultural Studies & Environmentalism* (Vol. 3, pp. 105–128). © Springer Science+Business Media B.V. 2010. <https://doi.org/10.1007/978-90-481-3929-3>
- Pegg, J. M. (2006). Developing explanations: student reasoning about science concepts during claims-evidence inquiry lessons. *Interpreting*. Retrieved from <http://ir.library.oregonstate.edu/xmlui/handle/1957/3190>
- Reis, P. (2009). Teaching Controversial Socio-Scientific Issues in Biology and Geology Classes : A Case Study. *Electronic Journal of Science Education*, 13, 1–24.
- Reiss, M. J. (2006). Teacher Education and the New Biology Teacher Education and the New Biology. *Teaching Education*, (April 2013), 37–41. <https://doi.org/10.1080/10476210600680325>
- Sadler, T. D. (2004). Moral sensitivity and its contribution to the resolution of socio-scientific issues. *Journal of Moral Education*, 33, 339–358. <https://doi.org/10.1080/0305724042000733091>
- Sadler, T. D., & Donnelly, L. a. (2006). Socioscientific Argumentation: The effects of content knowledge and morality. *International Journal of Science Education*, 28(12), 1463–1488. <https://doi.org/10.1080/09500690600708717>
- Sadler, T. D., & Zeidler, D. L. (2005). The significance of content knowledge for informal reasoning regarding socioscientific issues: Applying genetics knowledge to genetic engineering issues. *Science Education*, 89(1), 71–93. <https://doi.org/10.1002/sce.20023>
- Sampson, V., Simon, S., Amos, R., & Evagorou, M. (2011). Metalogue: Engaging Students in Scientific and Socio-scientific Argumentation BT - Socio-scientific Issues in In *Socio-scientific Issues in ...* (pp. 193–200). <https://doi.org/10.1007/978-94-007-1159-4>
- Siew Fong Yap. (2014). Beliefs, values, ethics and moral reasoning in socio-scientific education. *Issues in Educational Research*, 24(3), 2014, 24(24(3)), 21. Retrieved from

<http://www.iier.org.au/iier24/yap.pdf>

Tal, T., & Kedmi, Y. (2006). Teaching socioscientific issues: classroom culture and students' performances. *Cultural Studies of Science Education*, 1(4), 615–644.

<https://doi.org/10.1007/s11422-006-9026-9>

Yoon, S. (2008). Using memes and memetic processes to explain social and conceptual influences on student understanding about complex socio-scientific issues. *Journal of Research in Science Teaching*, 45, 900–921. <https://doi.org/10.1002/tea.20256>

Zeidler, D. L., Florida, S., & Nichols, B. H. (2009). Socioscientific Issues : Theory and Practice, 21(2), 49–58.

Zeidler, D. L., & Keefer, M. (2003). The Role of Moral Reasoning and the Status of Socioscientific Issues in Science Education. *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*, 7–38 TS–CrossRef. https://doi.org/10.1007/1-4020-4996-X_2_M4 - Citavi

Zeidler, D. L., Sadler, T. D., Applebaum, S., & Callahan, B. E. (2009). Advancing reflective judgment through Socioscientific Issues. *Journal of Research in Science Teaching*, 46(1), 74–101. <https://doi.org/10.1002/tea.20281>

Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: A research-based framework for socioscientific issues education. *Science Education*, 89(3), 357–377. <https://doi.org/10.1002/sce.20048>

Zeidler, M. D., Ph, D., Howes, E., Ph, D., Ferron, J., Ph, D., ... Ph, D. (2009). College Students " Use of Science Content During Socioscientific Issues Negotiation : Impact of Evolution Understanding and Acceptance by Samantha R . Fowler A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of P.