Preparing Prospective Teachers in Integrating Science and Local Wisdom through Practicing Open Inquiry

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ABSTRACT

This research aims to determine the ability of prospective teachers in integrating science and local wisdom measured by their ability of preparing teaching materials and learning outcomes. This study used one group pre test-post test design and the participants were 36 prospective science teachers who joined ethno science course. The open inquiry model required prospective science teachers to design and conduct investigations of local wisdom independently. Normality test results indicated that participants were normally distributed. Assessment of the teaching material prepared by participants received average score of 3.6 out of maximum score of 4, so it can be said that the teaching material was in good criteria. The result of t test of pre test and post test indicated that there was difference of pre test and post test result or it can be said that post test result was better than pre test. The research findings consisting of the assessment of teaching materials quality and post test result showed that the preparation of prospective science teacher in integrating science and local knowledge was effective after implementing the open inquiry.

Keywords: Prospective Teacher; Local Wisdom; Open Inquiry.

INTRODUCTION

Education holds a very significant role in assisting students to achieve the required knowledge and skills while it grows and innovates within the curriculum boundaries, in order to obtain previously targeted goals (Topaloglu and Kiyici, 2015). Science learning in primary education curriculum in Indonesia changed the way of its material presentation, from specific material division (biology, physics, chemistry, earth and space) into integrated material. Science learning is presented integratedly because it relates to everyday life. The ideas born from society activities form the basis for integrating knowledge in order to learn to be meaningful (Hewitt, Lyons, Suchocki and Yeh, 2013).

Students are encouraged individually or in groups to actively seek, explore and discover concept. The need to present the science learning integratedly, requires adjustments in preparing prospective science teachers in college. Students as prospective science teachers, need to be trained with the ability to integrate scientific knowledge and indigenous society

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knowledge in the form of local wisdom. Kidman, Yen and Abrams, 2013) recommends to integrate local wisdom with science curriculum, to strengthen students' nationalism sense. Local wisdom in the context of science, is restricted to something that has been applied as a tradition in the community that can be scientifically tested so it can be used as teaching materials.

The diversity of physical and social environments has some potential varieties that can be explored and developed as learning discussion. Physical environment has the potential based on the diversity of flora, fauna and simple application of technology in society that have not been used in learning process. While, society has variety of tradition, habit and value of life that has been used for generations, even in the past it was proven to be able to maintain the environmental balance. Some habits and values sustainably exist and with stand. The encouragement to integrate local wisdom through science learning is implemented because the globalization has significantly shifted the values of indigenous local knowledge in Indonesia. The reality of knowledge value shift shows that local knowledge values might be forgotten. According Baynes and Austin (2012) incorporating cultural knowledge into school curriculum is useful in maintaining citizen identity in a nation.

Prospective science teachers in Indonesia have been prepared to integrate scientific knowledge and local wisdom. A study of the teachers performance in integrating scientific knowledge and local wisdom in the science learning was conducted in 12 schools located in Semarang city, Wonosobo regency and Jepara regency. Those three regions have different characteristics, for example Semarang as metropolitan city has more various cultural backgrounds of students, compared to Wonosobo that is mountainous region with majority of students parents work as farmers, while Jepara is coastal region with most of student parents work as fishermen. Study results showed that science teachers in those regions experienced similar difficulties in linking science as scientific knowledge with local wisdom. Meanwhile analysis of teachers lesson plan documents also showed that they did not have plan to integrate science with local wisdom in teaching activity. The deeper interview of teachers was conducted to discover the root problem and then it was found out that teachers had limited knowledge of integrating science learning and local wisdom but based on the interview teachers were eager to improve their knowledge.

Based on the description of the background, the main problem that can be formulated in this research is How was preparing prospective science teachers in junior high school, to be able to integrate science and local wisdom?. The main problems were then divided into some sub-problems of 1) how was the learning activities of prospective science teachers in Ethno science course through the implementation of open inquiry model ?, 2) how is preparing prospective science teachers, in order to develop science teaching materials that integrate local wisdom after applying the open inquiry model ?; 3) how was prospective science teachers' response regarding open inquiry model ? and 4) was there any differences of pretest and posttest result in Ethno science learning? Therefore the goal of this research was preparing prospective science teachers who will teach in secondary school level, in order to have the ability to prepare teaching materials that integrate science and local wisdom.

Learning activity that aims to integrate the science with local knowledge is important to prepare prospective science teacher, they should experience to conduct authentic and open investigations of local wisdom. Based on Hsu, Roth and Mazumber (2009) finding, scientific inquiry as an authentic experience that shows the involvement of students, has similarities with inquiry method done by scientists. According to Buck, Bretz and Towns, (2008) open inquiry can be applied practically in school or university level. Learning with open inquiry is done by doing investigation, the instructor starts by giving question or problem and background. Open inquiry is appropriate to apply in preparing prospective Science teachers, because the main competencies that should be mastered are research ability to develop

teaching materials and strategies. Application of open inquiry for prospective science teachers can develop the independent investigation ability to result in the local wisdom that is scientifically tested. Most of local wisdom in Indonesian society have not proved scientifically and it is resulted the difficulties to integrate it in science learning activity.

Open investigation to test the local wisdom can develop creative thinking skills for prospective science teachers, so they can design and implement it in learning activity. Chinn and Malhotra (2002) said open investigation is needed to develop creative thinking as used by scientists. This is supported by Lee and Butler (2003) that said students involvement and motivation can be improved in science learning after applying open inquiry. According to Zion (2008), learning activities in university level should be able to train students in searching scientific information, finding experimental techniques or procedures and conducting independent scientific testing. Lecturer only needs to direct students to make a tentative conclusion and creates learning activity to be more similar as experts research activities. According to Sadeh and Zion (2012) in an open inquiry, the most complex level is the investigation part because students should formulate their own activities.

Local wisdom in this study is limited to area that become a tradition in the community and deal with to the concept of science that can potentially be tested scientifically. Scientific testing is conducted as a series of investigations. Investigation of local wisdom through experiments is conducted as part of open inquiry stage. The ability of each prospective science teacher in integrating science as scientific knowledge and local wisdom as the original knowledge of the society is measured in this research after applying open inquiry in experimental activity. This activity is meant to test each local wisdom so that it can be adopted as scientific knowledge. The prospective teacher are not only able to investigate the phenomenon, but also capable of designing their own teaching material. According to Gormally, Brickman, Hallar and Armstrong (2009) open inquiry stages consist of; formulating problems, designing, conducting experiments and analyzing experimental results to determine the actions taken independently by the students. Open inquiry gives freedom to students to develop their own discovery procedures, analyze, communicate and draw conclusions. Students might have a chance not only being competent in conducting research, but also deepening their scientific concepts and attitudes. According to Rees, Pardo and Parker (2013) scientific activities for prospective teachers bring impact on the ability of designing to analyzing independently through open inquiry.

The investigation is designed independently, based on the principles of adult learning, while education students or prospective teachers can determine strategy to conduct investigations independently. Students ability to learn is determined by their ability to choose a strategy for comprehending the teaching material, based on the awareness of knowledge that has not been perceived. Tosun and Taskesenligil (2011) said the increasing of students learning outcomes happened because they have strategy to comprehend the materials. Information or materials often used in everyday life are easier to comprehend (Cimer, 2007; Schonborn and Bogeholz, 2009). The information used as study materials, should be able to be scientifically proven through investigation. Investigation activities provide authentic and open experience referring to scientists' work that includes the activity of observing, thinking, investigating and validating. According to Hsu, Roth and Mazumber (2009) scientific inquiry as authentic experience that shows students involvement, has similarities to scientist activity. Experimental activities for prospective teachers bring impact on their understanding and skill to design, implement and evaluate student scientific work. Experience revealed by Lee, Yen and Aikenhead (2012) in ethnographic study of indigenous knowledge recommends that in order to encourage students in conducting investigation that involves a wide range of knowledge, teachers should use students world view as basis for integrating local knowledge and western science.

Science investigation is necessary in order to gain knowledge that is consistent to the scientists method. Analysis stage in scientific investigation can reveal integration between knowledge to improve students learning outcomes, according to of Han, Capraro and Capraro (2014) opinion scientific activities to connect science application is important factor for improving learning achievement. According to Ameyaw (2011) Science integration requires the ability of students to choose the most comfortable learning environment. Students tend to prefer scientific activities that reveal the integration of knowledge, as challenging learning activities. Ankiewicz and Vries (2006) said that teaching science cannot be separated from the societies environments and lives, integrating science and society life requires an organized learning procedure.

The procedure to transform from the indigenous science of society to the scientific knowledge needs conceptualization and reconstruction of new knowledge (Duit and Treagust, 2003). The new knowledge can be obtained through testing the indigenous science, so the truth found is proven as scientific knowledge. The findings of the indigenous science in the form of local knowledge can be formalized into scientific knowledge to enrich science through systematic investigation. Hereditary tradition in society, as source of learning can be used as potential reconceptualization of scientific knowledge. Reconstructed scientific knowledge based on local wisdom is needed, because it has not been scientifically conceptualized textually in teaching materials. According to Meyer and Crawford (2011) Science learning is part of multicultural education because students can be part of daily life that is associated with Science. Society habits provide relevant materials in teaching activity to briefly establishment the assumption facts.

Science learning that integrates local wisdom is considered on the recognition of knowledge as a part of life. Local wisdom revelation for prospective teachers according to science curriculum is learned through learning ethno science course in university level. The objectives of Ethno science course for prospective teachers are important, because it can train them to design and implement learning-oriented to maintain the sustainability of science application to protect the earth and universe. Ethno science is the embodiment of durability and ability that is manifested through a philosophy of life, knowledge and life strategy. If activities undertaken by local society are integrated in the learning of Science, it can answer the problems fulfillment of human life wisely. Modernization in fact can shift the values of local wisdom by foreign knowledge developed so rapidly in the lives Indonesian, both of urban and rural life. The reality is value shift of knowledge frequently results values of local wisdom in order to be forgotten, even in urban areas it has been degraded so the society as knowledge user, is no longer recognize societies indigenous knowledge.

METHODOLOGY

This research applied quantitative method since the required instruments were being tested of their validity and reliability. There was no control variable and the samples were not randomly chosen. After that, the results of operating variables measurement were discoverd by analyzing them statistically using the instruments.

a) Participants

There were 36 participants who intentionally selected from prospective science teachers of Science Education Study Program Semarang State University who joined Ethno Science Course. It was in line with Sugiyono's statement (2013) that when a research was not intended to generalize certain situation, the researcher can apply the specific and limited sampling technique. There were 36 students joined Ethno science course consisted of 22 females and 14 males and all were targeted as the samples. The amount of participants could

not be taken from other places since this course was an exclusive education program of science teacher candidates in Universitas Negeri Semarang.

b) Instruments

The study used five different instruments to collect the data related with the effectiveness of open inquiry model, assessment of teaching materials and activeness in learning, learning results in the form of pre test and post test and student responses. Test material consisted of 25 multiple choice question items with 5 possible answers. The reliability of test was calculated by using KR-20 formula. Teaching material prepared by students was assessed by using assessment instrument with four categories: excellent, good, fair and poor. Student feedback questionnaire consists of 6 statements of Likert scale with four choices of; strongly agree, agree, slightly disagree and disagree. All instruments were self-developed, including the process of deciding the rubrics and constructing the instruments.

c) Research Procedures

This research used one group pre test-post test design Sugiyono (2013). Pre test was given in the beginning of meeting and post test was given in the end of learning process. The design was determined based on the achieved objectives of finding out prospective science teachers' ability to integrate science and local wisdom measured by the ability of compiling teaching materials and learning outcomes. The design can be seen in Table 1.

Table 1. *One Group Pre test-Post test Design*

Pretest	Treatment	Posttest
O_1	X	O_2

The pre test was conducted before the lesson started, while the post test was given right after the learning finished. The course was held using open inquiry model

d) Validity and Reliability Test of Instrument

Open inquiry model has five stages of learning, the reliability and validity instruments were tested. The result indicated that it was reliable because the value of Crombach Alpha was 0.863 and the value of R11 = 0.863> 0.7. The validity of the instrument is presented in Table 2.

Table 2. *Instrument Validity*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
F1	13.1250	3.983	.660	.541	.828
F2	13.1250	3.850	.721	.595	.811
F3	12.9375	4.329	.582	.508	.847
F4	12.8125	4.296	.598	.475	.843
F5	13.5000	4.267	.839	.708	.794

The correlation of Item-Total Correlation in 5 item stages of open inquiry model obtained the value of > 0, 497. Overall Correlated Value of Item-Total Correlation was > 0.497, so the instrument can be said as valid and can be used for research. Open inquiry model was reliable and valid so it can be used in this research.

Ethno science learning by using open inquiry model was started by choosing and determining the problem by describing general phenomena found in the society based on the concept of science being studied and then it was continued by determining the problems. The

information that has been identified was independently used by prospective teachers to design activities of scientific testing through laboratory experiments. Experiments were performed by using simple tools, in order to give them experience of modifying tools because in fact most schools in Indonesia have limited availability of laboratory facility. Students individually designed their own experiment plan in their practice worksheets. The experiment results were analyzed especially of the integration of science and local wisdom, because the result was used as teaching material.

e) Analysis of the Data

The reliability of the data of open inquiry model was analyzed to find out the Crombach Alpha and the value of r_{11}. The validity of the model was measured by finding the value of Correlated Item-Total Correlation. Students' activeness in learning was analyzed by counting active and very active students. The analysis of the ability of science prospective teacher in designing learning material was conducted by measuring the aspect of conformity, depth, broadness and attraction. The learning result was evaluated by comparing the score of pre test with the score of post test, while students' responses were rendered by summing up agree and highly agree answers.

FINDINGS

Learning Activity

Each student individually made observations of general phenomena found in the society to obtain directly the application fact of local wisdom. Students determined the form of local wisdom that was continued to the laboratory testing through experiment. The experiment results was a form of scientific test results, so it was used as teaching materials after being adjusted by science study in school curriculum. Local wisdom that has been tested through experimentation is presented in Table 3.

Table 3. *Test Result of Ethno Science found by Prospective Teachers*

Science	Local Wisdom found by Prospective Teachers	Test Result
Natural Mask	Finger root rice composition has been used from generation to generation as natural mask to protect facial skin.	Rice contains 63% Na to maintain facial skin permeability
Natural Flavoring	Ginger is used to reduce fishy smell in fish and meat.	Mashed ginger produces the aroma to reduce fishy smell.
Pesticide	When the rice turns yellow, pagupon or birdcage is placed in the middle of rice field to scare rats as rice pests.	The effective space of pagupon in rice field to scare rats is between 200-500 m.
Natural dye	Turmeric extract, suji leaf and pandan leaf is used as natural dye in some traditional foods.	Turmeric extract gives yellow color, suji and pandan leaves give natural green color.
Natural Pesticide	Papaya leaves extract can be used as insecticides.	Papaya leaves extract contains papain compound that acts as toxic in caterpillar.
Skin healthy	Rice bran is used as shampoo to cure dandruff problem.	Rice bran contains carbon 1,33%; hydrogen 1,54%; silica 16,98%; and oxygen 33,64% to clean death cell in scalp.

Society tradition phenomena that have been tested scientifically through experiment activities by prospective teachers have resulted on a shift of untested local wisdom to be scientific knowledge. Experiment was done by using simple tools and materials that were easily found in the environment and usable so they can realize that the local wisdom test can

be done simply and cheaply. The test results showed that hereditary habit in society is unconsciously seen as a scientific knowledge that can be tested. Prospective teachers can get new and valuable experience through experiment to find the science secret of the endangered past knowledge that have become tradition.

After conducting experiment prospective teachers should present their experiment result. They revealed their steps of experiment started from identifying local wisdom in the society, planning experiments independently, analyzing and compiling reports. They were enthusiastic during the presentation and discussion activity, student assessment results showed 92% of students were very active and 8% were not. Prospective teachers' activeness was in high category, when the learning was conducted through independent and open investigation.

The investigation findings then were adjusted into teaching materials that is suitable for teaching science. Prospective teachers should compile teaching materials and present science material in more contextual way because it was obtained from the result of local wisdom test through experiment by using simple tools and materials. Assessment of teaching materials is shown in Figure 1.
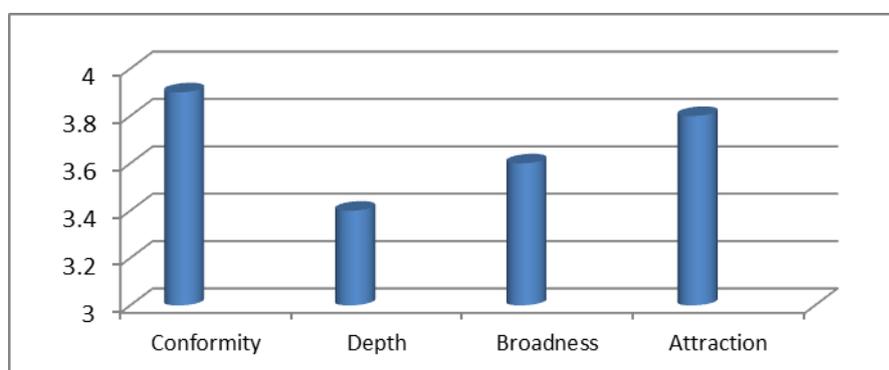

Figure 1. *Assessment of teaching materials*

Compiled teaching materials were assessed by an expert of science. Aspects of suitability was measured based on the basic competencies of students in the curriculum of secondary schools, the level of suitability got a score of 3.8 of maximum score of 4. Description of teaching materials was predicted to reach targeted learning science competencies in school curriculum. Prospective teachers were seen to be able to prepare teaching materials. Aspects of material depth obtained score of 3.3 so the teaching material was considered good to give the knowledge of science for students. Experiment analysis can be well expressed by prospective teachers, so it resulted score of 3.5 in material depth aspect. Teaching materials that provide information of local wisdom obtain score of 3.7 in attraction aspect. Prospective teachers were seen to be able to develop teaching material independently that integrated local knowledge and science through the implementation of open inquiry model.

Students Response

Students response of open inquiry implementation can be seen in Table 4.

Table 4. *Students response of open inquiry implementation in Ethno Science Course*

Statements	Percentage (%)			
	Strongly Agree	Agree	Slightly Disagree	Disagree
Revealing hereditary tradition is important to do in science learning.	94	6	-	-
Science is necessary to be integrated with local wisdom.	81	19	-	-
Prospective teachers need to have ability to design experiment independently.	88	12	-	-
Experiment is needed to test local wisdom scientifically.	94	6	-	-
Test result of local wisdom can be used as teaching material.	81	19	-	-
Integrating science and local wisdom can grow students' nationalism character.	81	19	-	-

All students gave positive responses that stated Ethno science learning is suitable by implementing open inquiry model. The application of that model was proven to be able to train scientific work of prospective teachers, they felt that they had the experience of developing teaching materials after conducting the experiment. Integration problem between science and local wisdom have been overcome.

Pre Test and Post Test Result

Normality test results of pre test data obtained statistical value of 0.973 with sig of 0.880, while post test data obtained statistical values of 0. with sig of 0.993, because the value of sig> 0.05; then it can be said that both the data were normally distributed. Test result of pre test and post test difference test is presented in Table 5.

Table 5. *Pre Test and Post Difference Test*

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pre Test-Post test	-23.81250	8.32842	2.08210	-28.25	-19.37	-11.437	15	.000

The result of difference test of pre test and post test obtained t value of 11.437 with the sig of 0.000; because sig = 0.000 <0.05, then it can be said that there was difference in the results of the pre test and post test, or posttest result was better than pretest. Comparison of the average score of pre test and post test is presented in Figure 2.
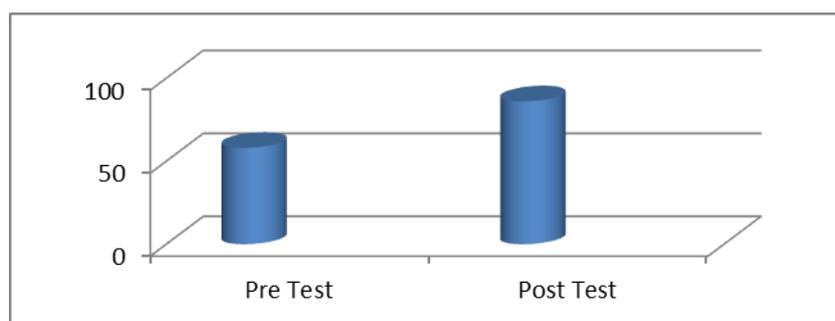
Figure 2. *Comparison of the average score of pre test and post test*

The average of pre test score was 58 and post test was 86, it can be said that the improvement was 28 points. The higher result of post test indicates that prospective teachers have comprehended the learning material of Ethno science. Prospective teachers' understanding of learning material is related to the revelation of local wisdom test in laboratory. Local wisdom or tradition, that was initially difficult to prove scientifically, finally can be tested in the learning process. This finding is parallel to the results of Meij, Meij and Harmsen (2015) when he found interesting learning resources from the environment that can encourage students to learn.

DISCUSSION and CONCLUSION

Prospective science teachers were given the opportunity to carry out scientific investigations on local wisdom. Results of investigation of various traditions in the society have been scientifically tested so it can be used as teaching materials in the science learning. Prospective science teachers looked enthusiastic when presenting their investigation result therefore the results of their activeness assessment showed that 92% was active and 8% was not. Learning environment that applied open inquiry has resulted prospective teachers to have knowledge of the relation between science and local wisdom. The ability to communicate the results of the investigation indicated that prospective science teachers have improved their knowledge based on their investigation findings. Based on Nantawanit, Panijpan and Ruenwongsa (2012) opinion when students are active to present their investigation finding, so it means the findings gave students better understanding of knowledge that is being studied.

Learning by applying open inquiry model has given authentic experience for prospective science teachers. This finding is in line with the finding of Hsu, Roth and Mazumber (2009) that stated scientific inquiry as experience showing the involvement of students has similarities with scientists' activity. According Figure 1, prospective teachers have been able to compile science teaching materials that integrate local wisdom based on the result of investigation that has been carried out. Prospective teachers can be said to have creativity to produce science teaching materials, this finding is consistent with the opinion of Chinn and Malhotra (2002) that said open investigation is needed to develop the students' creativity. Learning activities led to improve the knowledge of prospective science teachers. According to Table 5, the results of the t test value was 11.437 with the sig of 0.000, because the value of sig = 0.000> 0.05, so it can be said that posttest result was better than pretest.

Based on the results of this study it can be concluded that the application of open inquiry model was proven effective to be applied as learning strategy in preparing prospective science teachers to be able to integrate Science and local wisdom. Open inquiry activity has changed the perception of the local wisdom that is previously limited to tradition, become scientific knowledge than can be improved as teaching materials. The conclusion of this research based on Sun and Chee (2013) finding said that when learning model is effective to be applied, it indicates that it is suitable to students' learning styles and characteristics.

The application of open inquiry method invoked self-learning for the prospective science teacher. The preparation of prospective science teacher with a demand of willingness to conduct research was proven to affect the skill of designing learning material. Various local wisdoms were able to be adopted as scientific knowledge through experimental activities. Based on the the research result, the researcher recommend for each science teacher candidates educator to apply open inquiry model because it gives precious experience to students to explore their own knowledge. The self-finding was proven to be able to help students to construct their own integrated science material well.

REFERENCES

Ankiewicz, P., Swardt, E. D., & Vries, M. D. (2006). Some Implications of the Philosophy of Technology for Science, Technology and Society (STS) Studies. *International Journal of Technology and Design Education*, 16(2), 117-141. doi:10.1007/s10798-005-3595-x

Ameyaw, Y. (2011). Environmental Pedagogies that Promote Students Understanding of Integrated Science (Biology Aspect). *Journal of Education*, 1(1), 10-15.

Baynes, R., & Austin, J. (2012). *Indigenous Knowledge in the Australian National Curriculum for Science: from Conjecture to Classroom Practice*. Paper Presented at the 5th Biennial International Indigenous Development Research Conference. Auckland: New Zealand.

Buck, L. B., Bretz, S. L., & Towns, M. H. (2008). Characterizing the Level of Inquiry in the Undergraduate Laboratory. *Journal of College Science Teaching*, 38(1), 52-58.

Cimer, A. (2007). Effective Teaching in Science: A Review of Literature. *Journal of Turkish Science Education*, 4(1), 20-44.

Chinn, C. A., & Malhotra, B. A. (2002). Epistemologically Authentic Inquiry in Schools: A Theoretical Framework for Evaluating Inquiry Tasks. *Science Education*, 86(2), 175-218.

Duit, R., & Treagust, D. F. (2003). Conceptual Change a Powerful Framework for Improving Science Teaching and Learning. *International Journals of Science Education*, 25(6), 671-688.

Gormally, C., Brickman, P., Hallar, B., & Armstrong, N. (2009). Effects of Inquirybased Learning on Students' Science Literacy Skills and Confidence. *International Journal for the Scholarship of Teaching and Learning*, 3(2). Retrieved from http://digitalcommons.georgiasouthern.edu

Han, S., Capraro, R., & Capraro, M. M. (2014). How Science, Technology, Engineering and Mathematics (STEM) Project Based Learning (PBL) Affects High, Middle and Low Achievers Differently: The Impact of Student Factors on Achievement. *International Journal of Science and Mathematics Education*. Retrieved from doi:10.1007/s10763-014-9526-0.

Hewitt, P. G., Lyons, S., Suchocki, J. A., & Yeh, J. (2013). *Conceptual Integrated Science*. Addison-Wesley.

Hsu, P., Roth, W., & Mazumber, A. (2009). Natural Pedagogical Conversations in High School Students' Internship. *Journal of Research in Science Teaching*, 46(5), 481-505.

Kidman, J., Yen, C., & Abrams, E. (2013). Indegenous Student Experiences of the Hidden Curriculum in Science Education: A Cross National Study in New Zealand and Taiwan. *International Journal of Science and Mathematics Education,* 11(1), 43-64.

Lee, H., & Butler, N. (2003). Making Authentic Science Accessible to Students. *International Journal of Science Education*, 25(8), 923-948.

Lee, H., Yen, C., & Aikenhead, G. S. (2012). Indigenous Elementary Students' Science Instruction in Taiwan: Indigenous Knowledge and Western Science. *Research in Science Education*, 42(6), 1183-1199.

Meyer, X., & Crawford, B. A. (2011). Teaching Science as a Cultural Way of Knowing: Merging Authentic Inquiry, Nature of Science and Multicultural Strategies. *Cult Stud of Sci Educ*, 6, 525-547.

Meij, H., Meij, J., & Harmsen, R. (2015). Animated Pedagogical Agents Effects on Enhancing Student Motivation and Learning in a Science Inquiry Learning Environment. *Education Tech Research Dev*, 63(3), 381-403.

Nantawanit, N., Panijpan, B., & Ruenwongsa, P. (2012). Promoting Students' Conceptual Understanding of Plant Defense Responses Using the Fighting Plant learning Unit

(FPLU). *International Journal of Science and Mathematics Education*, 10(2), 827-864.

Rees, C., Pardo, R., & Parker, J. (2013). Steps to Opening Scientific Inquiry: Pre-Service Teachers' Practicum Experiences with a New Support Framework. *Journal of Science Teacher Education*, 24(3), 475-496.

Sadeh, I., & Zion, M. (2012). Which Type of Inquiry Project Do High School Biology Students Prefer: Open or Guided?. *Research in Science Education*, 42(5), 831-848.

Schonborn, K. J., & Bogeholz, S. (2009). Knowledge Tranfer in Biology & Translation Across External Representations: Experts' Views and Challenges for Learning. *International Journal of Science and Mathematics Education,* 7(5), 931-955.

Sen, A. Z., & Nakiboglu, C. (2014). Comparison of 9th Grade Chemistry, Physics and Biology Textbooks in Terms of Science Process Skills. *Journal of Turkish Science Education,* 11(4), 63-80.

Sun D., & Cee, K., L. (2013). Designing a Web-Based Science Learning Environment for Model-Based Collaborative Inquiry. *Journal of Science Education and Technology*, 22(1), 73-89.

Sugiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif dan R & D*. Bandung: Alfabeta.

Topaloglu, M. Y., & Kiyici, F. B. (2015). The Opinions of Science and Technology Teachers Regarding the Usage of Out-Of-School Learning Environments in Science Teaching. *Journal of Turkish Science Education,* 12(3), 31-50.

Tosun, C., & Taskesenligil,Y. (2011). The Effect of Problem Based Learning on Student Motivation Toward Chemistry Classes and on Learning Strategies. *Journal of Turkish Science Education,* 9(1), 104-125.

Zion, M. (2008). On Line Forums as a "Rescue Net" in an Open Inquary Process. *International Journal of Science and Mathematics Education*, 6(2), 351-375.