IMPLEMENTATION OF INQUIRY LEARNING STRATEGY IN PLANT ANATOMY LECTURE TO IMPROVE THE COMPREHENSION ABILITY AND CONCEPT RECONSTRUCTION FOR BIOLOGY TEACHER CANDIDATES

Muhibbuddin[1*] Safrida[2] Hasanuddin[3]

[1]Dr., University of Syiah Kuala, Banda Aceh, Indonesia, muhib.bio@gmail.com
[2]Dr., University of Syiah Kuala, Banda Aceh, Indonesia, saf_rida@unsyiah.ac.id
[3]Dr., University of Syiah Kuala, Banda Aceh, Indonesia, hasanuddin@fkip.unsyiah.ac.id
*Corresponding author

Abstract

The purpose of the research was to study the effect of inquiry learning strategy toward the comprehension ability and concept reconstruction of plant anatomy to the students. The subject of the analysis was students of biology education at 3rd semester Faculty of Education and Teaching, Syiah Kuala University. The method used in the research was experiment design of Pretest-Posttest Control-Group. Inquiry learning strategy was done by giving students structured task, question answers and discussion. Comprehension of the concept was measured by a written test, an objective test which has been validated. Concept reconstruction ability of students measured by comparing the ability of comprehension ability concept before and after lecture. Comprehension concept data obtained was then analyzed using normalization of gain calculation method. To compare comprehension ability and concept reconstruction between groups of student which were equipped with inquiry learning and control groups, they were tested with Independent Sample t-Test. The research finding shown that there was significant improvement toward concept comprehend of students equipped with inquiry learning compare to students not with inquiry learning. Concept reconstruction ability of students with inquiry learning was higher (62%) compare to students not with inquiry learning. Therefore, inquiry learning strategy was effective to improve comprehension ability and reconstruction concepts of plant anatomy.

Keywords: Learning strategy, inquiry, plant anatomy, concept reconstruction

1. INTRODUCTION

In preparation of teacher candidates at In-service step, a correct implementation of learning strategy is critical. Plant anatomy is one of the subjects that students must take upon completing study as Biology teacher candidates. The main target that is expected from the lecture of plant anatomy is to make sure students understand the concepts of plant anatomy also the connection between one concept with another that are compiled to understand the plant body. That ability is the basic that bridging basic Biology concepts with advance Biology concepts (physiology, taxonomy, genetics, ecology) or even for other discipline studies that are relevant (agriculture and forestry). Besides, plant anatomy provides students to master plant

anatomy concepts in deep at basic and medium education level.

Plant anatomy is a tool that was used to provide students with Science process reconstruction concept which include analyze, clarify, measure, communication, interpret, predict, plan, and conduct a test. Those abilities are critical for Science/Biology teacher and curriculum of Science school (Depdiknas, 2003, pp.1-102).

The importance of plant anatomy subject for the student is critical, however, the learning current learning condition was not satisfying enough. This was proven from the test result of pre-learning plant anatomy from the last four years (2012 to 2016) in Biology department of Education and Teaching Faculty of Syiah Kuala University, Aceh. It was shown that most of the students were having incorrect alternative conception toward subjects that were tested. Reproduction concept of cells, networks and organ was top of the list (78%) where the students understand the concepts through alternative concept (Muhibbuddin, 2016, pp.1-26).

Data mentioned earlier indicates that the high percentage application of alternative conception was the impact of learning result obtained at the past. The occurrence of alternative conception was also expected related with learning process that was used by Science/biology teachers at basic and medium learning level. One of the indicators that strengthened the conjecture was shown from the result of a research by Muhibbuddin (2015, pp.33-46) which mention that major part (more than 50%) of teachers were embedded with alternative conception in comprehension plant anatomy concepts including concept of cells, networks and organ.

Alternative concept couldn't remain any longer as it will mislead the students or teacher candidates which then will mislead their students. Therefore, it was necessary to improve the comprehension concept, eliminate alternative conception and provide students with ability of reconstruction concepts of plant anatomy.

Several research related to inquiry learning strategy has been done by (Capps & Crawford, 2017, pp. 497-526; Sahyar & Hastini, 2017, pp. 120-126; Hannasari at al., 2017, pp. 48-52; Philip & Taber, 2016, pp. 207-226; Hairida, 2016,pp. 209-215; Kuhn, M.A.,2015, pp. 37-50; Siew Li & Arshad, 2015, pp. 151-175; Basey at al., 2010, pp. 80-86; Baseya & Francwas, 2011,pp. 241-255; Campo & Garcia-Vazquez, 2010, pp. 15-20). However, those research tend to discuss the Science/Biology comprehension concepts for middle and higher school and efforts that have been done to repair learning strategy. Research that mainly discussed conceptual improvement to increase comprehension concept, decrease alternative comprehension conception and provides reconstruction concepts of plant anatomy for students for In-service level has never been studied. Therefore, it was necessary to analyze the implementation of inquiry learning strategy in plant anatomy subject to provide comprehension ability and concept reconstruction for Biology teacher candidates.

2. RESEARCH METHOD

Method used in this research was experiment method with Pretes-Post Tess Control Group Design (Gall et al., 2003). Research design was shown in Table-1 below.

Table 1. Pretes-Post Test Control Group Design

Sample	Group	Pretest	Treatment	Post Test
Random	experimental class	O1	X1	O2
Random	control class	O1	X2	O2

X1 = Learning with strategy inquiry

X2 = Learning non-inquiry (conventional)

O1 = Pretest (before treatment)

O2 = Post Test (after treatment)

Research was done toward Biology students at 3rd semester, Faculty of Eduction and teaching, Syiah Kuala University, Banda Aceh, Indonesia. Research duration was three months, from September to November 2017. Total of students involved in thwas research was 60 students. The students was separated into two groups, experimental class and contorl class with 30 students in each group. Grouping was done based on basic ability and comprehension of the same concept (data of pretest) and conducted randomly.

Experimental class was equiped with inquiry learning strategy, while control class was equiped with non-inquiry (conventional) strategy. Inquiry learning strategy was done through structured task toward students to study palnt anatomy concepts independently from vairous sources, with guidance of College Student Worksheet, then continue with discussion within the class. Discussion activity was throughoutly conducted by students, lecturers were only facilitator and lead the discussion. Discussion was lead toward each sub-subjects (i.e. cell wall). At the end of discussion, each student has to deliver conclussion toward the concept that has been dwascussed. Thwas method of learning was repeated for each and every sub-subjcest included in plant anatom subject. During the learning activity, students reconstruction and independent concept comprehension abilityies were being trained. Thwas process was asswasted by lecturer. At the of the learning process, postes was conducted to get to know the result of different learning method applied. Figure-1 below concluded inquiry learning strategy concept.

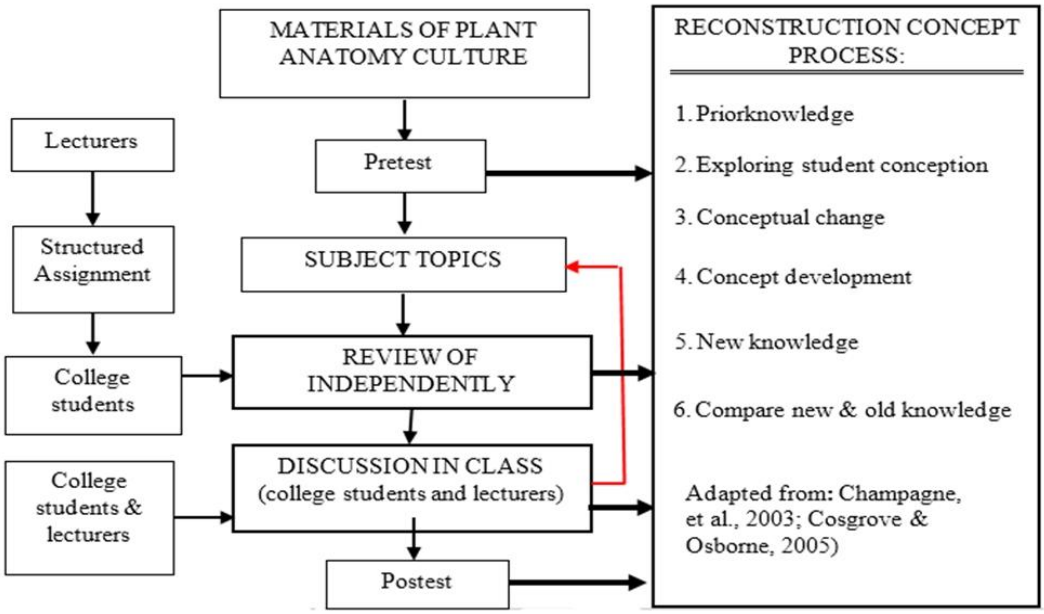

Fig. 1. Summary Stages of Inquiry Learning Strategy

3. DATA AND ANALYSWAS

Data obtained from research result was score of pretest and post-test for both classes (experimental and control classes). Pretest and post-test scores were tabulated and gain was calculated by seeking the gap between test score and pretest scores. Obtained gain was then normalized using a formula from Meltezer (2002) by finding the gap between post-test and pretest scores.

$$g = \frac{\text{post-test score} - \text{pretest score}}{\text{maximum possible score} - \text{pretest score}}$$

Reconstruction ability concept data was conducted by analyzing pretest and post test scores for each test item. Criteria used in analyze ability concept reconstruction was: First. Pretest-post test scores = 0-1 (reconstruction occurred). Second, pretest and posttest = 1-0 (do not understand). Third, pretest-posttest = 0-0 (alternative conventions).

To understand the effectiveness of inquiry learning implementation toward learning activity result of the students between experimental and control class, average gain data was used, and reconstruction concept data. Effectiveness test was conducted by comparing average gain scores and reconstruction concepts between experimental class and control class through t-test, Independent Sample t-test.

4. RESEARCH RESULT

4.1 Students Early Effect

Students initial knowledge about concept comprehension of plant anatomy has no significant difference between experimental and control class (Table-2). This result showed that students' comprehension toward

plant anatomy concepts before implementation of learning process for both experimental and control class were having the same level of comprehension.

Table 2. Pretest Average Difference Test Results Between Experimental and Control Class

Average Score	Group		Normality*		Homogeneity** (Exp-Control)	Significant
	Exp.	Control	Exp.	Control		
Pretest	28.13	28.03	Normal Sig.:0.200	Normal Sig.:0.200	homogeneous Sig.:0.718	Not significant $t\text{-}_{count.} = 0.074$; Sig.:0.470 > 0.025

*)Kolmogorov – Smirnov Test (Normal, Sig. > 0.05)

**) Levenes Test (Homogeneous, Sig. > 0,05)

4.2 Learning Process

4.2.1 Concept Comprehension

Students' comprehension concept after learning between experimental and control class shows there was improvement compare to before learning. Experimental class students achieve an average gain of 91.27 and control class 45.37. Increase in learning result of experimental class was higher compare to control class with an average gain gap of 45.90 (49.71%).

Increase in concept comprehension of plant anatomy shows a significant difference between experimental and control class (Table-3). A result of average gain shows a significant difference between experimental and control class. Therefore, it has shown that the implementation of inquiry learning strategy was effective and contributes a lot toward an improvement of plant anatomy concept for students.

4.2.2 Concept Reconstruction

Analysis result of pretest and post test scores shows that reconstruction concept ability of experimental class achieve an average of 58.68%, higher than control class with only 34.61%. The result of analysis also shows there was alternative concepts that were not well understood by both experimental and control class.

Table 3. Gain(g) Average Difference Test Results Between Experimental and Control Class

Average Score	Group		Normality*		Homogeneity** (Exp-Control)	Significant
	Exp.	Control	Exp.	Control		
Gain(g)	91.27	45.37	Normal Sig.:0.200	Normal Sig.:0.200	Homogeneous Sig.:0.680	Significant $t\text{-}_{count.} = 37.978$; Sig.:0.000 < 0.025

*) Kolmogorov – Smirnov Test (Normal, Sig. > 0.05)

**) Levine's Test (Homogeneous, Sig. > 0,05)

However, alternative concepts were felt at higher rate at control class (an average of 34.71%) compare to experimental class (an average of 10.32%). Control class has a higher percentage of concepts that were not understood compare to experimental class with an average of 6.78% and 2.94% respectively. A significant test result (Table-4) of average of reconstruction ability concept, alternative conceptions and concepts that were not understood between experimental and control class shows a significant difference. Based on significant test result, it was believed that reconstruction ability concept of experimental class was better than control class. Meanwhile alternative conceptions and do not understand concepts were lower in experimental class compared with control class. Therefore, the implementation of inquiry learning strategy was really effective and contributes toward the improvement of reconstruction ability concepts of plant anatomy which able to reduce the implementation of alternative conceptions and do not understand concepts by college student.

Table 4. Reconstruction, Alternative Conceptions, and Do Not Understand Average Difference Test Results Between Experimental and Control Class.

Level of comprehension	Group		Normality*		Homogeneity** (Exp-Control)	Significant
	Exp.	Control	Exp.	Control		
reconstruction	52.81	31.15	Normal Sig.:0.200	Normal Sig.:0.034	Homogeneous Sig.:0.002	Significant $t\text{-}_{count.}$ = 21.41; Sig.:0.001 < 0.025
alternative conceptions	9.29	31.23	Normal Sig.:0.200	Normal Sig.:0.200	Homogeneous Sig.:0.009	Significant $t\text{-}_{count.}$ = 25.16; Sig.:0.000 < 0.025
Fail to understand	2.65	6.08	Normal Sig.:0.200	Normal Sig.:0.021	Homogeneous Sig.:0.006	Significant $t\text{-}_{count.}$ = 16.13; Sig.:0.000 < 0.025

*) Kolmogorov – Smirnov Test (Normal, Sig. > 0.05)

**) Levine's Test (Homogeneous, Sig. > 0,05)

5. DISCUSSION

A good comprehension and concept reconstruction in experimental class was related toward the character of inquiry learning that put learning strategy through discussion as priority. Students was led to construct their knowledge independently, lecturer was acting as facilitators to lead the discussion.

Inquiry learning characteristic was based on positioning the students as a person that was studying, not as a person that was taught and conditioning a happy studying feeling. That condition can be achieved through the lecturer efforts in designing learning strategy by organizing several elements including time, method and environment or a happy class feeling (Costa, 2005, p.127). From a significant result obtained, it was believed that plant anatomy learning with inquiry learning strategy was effective to improve concept reconstruction ability independently. Inquiry learning strategy was effective to improve students' ability in learning process. A meaningful study was a process where new concepts were attached inside a person cognitive structure. Learning process was not only remembering concepts or facts (root learning) but also struggling to connect those concepts to produce a solid comprehension (meaningful learning). Hence, concepts being learnt can be well understood and not easily forgotten (Amir & Tamir, 2010,pp.111-117).

Knowledge provision of teacher candidates should be more toward good learning process such as how to get the knowledge, seek for information, read literature, do experiment correctly, how to do inference, interpretation, extrapolation or interpolation and communication so that receiving the knowledge become a happy session, a need and the way living and forced during their intellectual provision. One of the ways that can be chosen was through inquiry learning strategy (NRC, 2003. P.300). Inquiry has become an important standard in provisioning Science/Biology teacher candidates (NSTA & AETS, 2003,pp.1-9). Experience of experiment, analyzing and data interpretation, communication and discussion while building the concepts, maintain of criticize friends opinion and suggestion was an example of intellectual skill that can be developed through inquiry (NRC, 2003, p.300).

Comprehension about science and knowledge of how to learn science was important for teacher candidates to know. However, if the students only received basic science knowledge as a provision for their future will never be enough. Semiawan et al. (2003,p.286) suggested that a fast development of knowledge nowadays, impossible for the teacher to teach all the facts and concepts toward the students.

McDermott (1998, pp.734-742) stated that learning activity that provide teacher candidates must show several learning criteria which relevant for Science teacher, which were (1) teacher candidates were needed to be prepared to teach with correct method and strategy, (2) science learning was more effective if a concrete experience was used as a guideline of specific learning concepts, (3) in a process of learning a new concepts, it was necessary to give a chance to for an open-ended experiment in laboratories, hence, teacher

candidates were well aware with phenomenon that might appear during learning activity, (4) lecturer need to improve questioning skills of students that was expected to increase the critical thinking of the students as well as improve the ability of the students to ask question, (5) learning strategy for teacher candidates need to be led into a situation where they were well aware toward conception difficulties that might be appeared among the students. Those statements show that in preparing a Science teacher, it was not only by improving their knowledge element of the subjects only, but also others elements such as skills of using laboratories tools (accuracy) and science process skills (observing, clarifying, interpreting, predicting and asking questions) that need to be deeply improved.

A Biology teacher candidate should be prepared through involvement in research and laboratories activities that were substantive and significant which include active inquiry learning experience such as formulating questions, collecting and analyzing data, reporting and maintaining the result (NSTA & AETS, 2003, pp.1-9). Besides, if the teacher candidates learning science through a good process, then they already provided with a life-time learning skills (Carin, 2007, p.231).

In planning learning program, according to Uno (1999,p.320), several things need to be considered, first, the purpose of the learning program, both for lecturer and students, second, what kind of learning strategy will be used to help students to achieve those target, third, how to know that lecturer or students have achieved those target and the last was what was the assessment,

Learning target that was formulated should always related with cognitive process dimension which include various process; remembering, comprehension, the application, analyzing, evaluating and planning. Remembering process was recalling back knowledge that was relevant from long memories. Completed by identification or mentioned. Comprehension process was creating meaning from learning process that includes verbal communication, writing and figures through clarifying, recalling back, translating, imaging, categorizing, or restating with students' own way and sentences, abstracting, generalizing, extrapolating, interpolating, predicting, mapping, contrasting, fitting and building a model. Learning application process was using procedure or guideline in certain condition. Analyzing process was a process of elaborating certain product become pieces that explained how each of those pieces were related to each other and have the same core. Evaluating process was a marking process that was based on certain criteria and standard. Planning process was a compiling back process certain parts into an expected or new patters (Anderson & Krathwohl, 2001,p.37).

In inquiry learning process, students actively improving their comprehension about science and combining their knowledge with thinking skills. Students will add their knowledge as a result of experience and students will be effectively sought for a good growth of their knowledge. From pedagogy point of view, Science learning which was inquiry oriented tend to have a constructive learning model as an active student that was solidly applied nowadays by lecturers and teachers. In constructive learning model, learning was a mental change that occurred continuously toward students.

Constructive model can be achieved through cognitive conflict that was defined as imbalance situation of the students when they were faced with unexplainable situation through application of framework concept laid within the students (Shayer & Adey, 1992,pp. 81-92). This imbalance will produce conflict so that students become unsure with the concept that was attached in their cognitive structure. If the students can find a new concept, the changing concept phenomena occurred (Cwerey, 2008). If the new concept tends to be a better solution, then it will fix the misconception that exists within the students or it will make students having a stronger concept comprehension. For example, if the result of inquiry activity that was done by the students was not the same as the theory or concept that already exist, then a conflict will occur within the students that can trigger the students to seek the answer that satisfy them.

For instance, students comprehension about water movement in osmosis phenomena was from high concentration to low concentration, while the result of the experiment was vice versa, so that students will ask think and ask questions to seek for balance so that a satisfy answer obtained will be a new concept. Another example was when the students were asked to report their findings in searching of a connection between several variables involved in experiment and show it to the teacher. If the the method of student achieving the result was rejected by the teacher because of several variables were changed, then students will be motivated to rethink about the basic of their experiment. This condition produce conflict among the students, hence students tend to be more sure with the procedure that need to be followed in Science process (Hodson, 2008,pp. 85-142).

The heart of inquiry learning was the ability to ask questions. Considering the importance of questions in inquiry learning, teacher should be sensitive enough toward students question pattern. Teacher should analyze question from students in order to determine the strength and weakness of their questions (NSTA &

AETS, 2003, pp.1-9). Inquiry learning needs skills in collecting and analyzing data and also giving value toward the result to get a solid conclusion. Students should be given a chance to analyze data toward their preparation. They should obtain an acceptable level of proficiency in collecting and analyzing data from different format and can use those criteria to differentiate a valid and not valid conclusion. In planning laboratories activity, teacher use a small group to stimulate the discussion, increase student skills in using lab tools, distributing responsibilities, spreading skills within the class. From social point of view, inquiry collaboration was essential. Students whom teacher candidates must be given a chance to work in a team. Group work strategy that include working rules within a team must be part of the learning (NSTA & AETS, 2003, pp.1-9).

Inquiry learning strategy can be done through two orientations, deductive inquiry and inductive inquiry. Dahar (1985 p.128) stated that both of the orientation were difference at the finding the concept stage. Deductive inquiry tends to inquiry activity after the teacher deliver the concept or principles of the subject, while concept and principles findings in inductive inquiry were done by the students after they conducted inquiry activity.

Based on several philosophy and experiment result, inquiry learning includes; (1) inquiry learning facilitate students toward science comprehension as a process and products, (2) students learn to construct the knowledge that was accurate based on communication and dialog, (3) students learn science through critical comprehension, (4) students learn science as thing that was dynamic, cooperative and accumulative, (5) students learn material and science values as scientist work, (6) students learn the nature of science and knowledge of science interactively (NRC, 2003, p.300).

6. CONCLUSION

The research result showed that there was significant improvement of comprehension concept among students in the experimental class than in control class of a group of student who learn through inquiry learning strategy as compared to a group which did not. Reconstruction concept of ‘inquiry’ group was higher (62%) from ‘non-inquiry’ group. Therefore, inquiry learning strategy was very effective in increase students’ increase students’ comprehension and reconstruction concept of plant anatomy subject.

REFERENCE LIST

Amir, R. & Tamir, P. (2010). Proposition generating task [PGT]: a measure of meaningful learning and of conceptual chang. Journal of Biological Education, vol.29.

Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching, and Assessing: A Revwasion of Bloom's Taxonomy of Educational Objectives. New York: Addwason Wwasely Longman Inc.

Basey, J.M., Mendelow, T.N. & Ramos, C.N. (2010). Current Trends of Community College Lab Curricula in Biology: An Analyswas of Inquiry, Technology, and Content. Journal of Biological Education, vol.34.

Baseya, J.M. & Francwas, C.D. (2011). Design of Inquiry-Oriented Science Labs: Impacts On Students’ Attitudes. International Journal of Science Education, vol.29.

Campo, D. & Garcia-Vazquez, E. (2010). Inquiry-Based Learning of Molecular Phylogenetic. Journal of Biological Education, vol.43.

Capps, D.K. & Crawford, B.A. (2017). Inquiry-Based Instruction and Teaching About Nature of Science: Were They Happening? Journal of Science Teacher Education, vol.24.

Cwerey, S. (2008). Conceptual Change in Childhood. London: The MIT Press.

Carin, A.A. (2007). Teaching Modern Science. New Jersey: Prentice-Hall Inc.

Champagne, A. B., Gunstone, R. F., & Klopfer (2003). Effecting Changes in Cognitive Structures Among Physics student. In: L. West & A. Pines (Eds.) Cognitive Structure and Conceptual Change. Orlando: Academic Press.

Cosgrove, M. & Osborne, R. (2005). Lesson Framework for Teaching Children’s Ideas. In: R. Osborne & F. P. Freyberg (Eds.) Learning in Science: The Implication of Children’s Science. Portsmouth: Heinemann.

Costa, A. L. (2005). Teacher Behavior That Enable Student Thinking. In: Costa, A. L. (Ed.) Developing Mind: A Resource Book for Teaching Thinking. Alexandria: ASCD.

Dahar, R.W. (1985). Kesiapan Guru Mengajarkan Sains di Sekolah Dasar Ditinjau Dari Segi Pengembangan Keterampilan Proses Sains. Disertasi. Bandung: Fakultas Pascasarjana IKIP Bandung.

Depdiknas (2003). Standar Kompetensi Mata Pelajaran Biologi Sekolah Menengah Atas dan Madrasah Aliah. Jakarta: Direktorat Jenderal Pendidikan Dasar dan Menengah.

Duggan-Haas, D. (2000). A Proposed Introduction to the NSTA Standards for Science Teacher Preparation**.** Kalamazoo College.

Gabel, D. L. (1994). Handbook of Research on Science Teaching and Learning. A Project of the National Science Teachers Association. New York: Mc Millan Publishing Co.

Gall, M.D., Gall, J. P., & Borg, W. R. (2003). Educational Research an Introduction. Boston: Pearson Education Inc.

Hannasari R., Harahap, M.B., & Sinulingga, K. (2017). Effect of Scientific Inquiry Learning Model Using Scientific Concepts Map and Attitudes to Skills Process Science Students. Journal of Education and Practice, vol.8.

Hairida (2016). The Effectiveness Using Inquiry Based Natural Science Module With Authentic Assessment to Improve the Critical Thinking And Inquiry Skills of Junior High School Students. Jurnal Pendidikan IPA Indonesia. Vol.5.

Hodson, D. (2008). Re-thinking Old Ways: Towards A More Critical Approach To Practical Work In School Science. Studies in Science Education, vol.22

Kuhn, M.A. (2015) Using Student Knowledge to Enhance Inquiry: A Theoretical and Practical View of Negotiation in a Science Classroom. Journal of Educational Enquiry, vol.14.

A Student-Led Survey Gauging Course Effectiveness. Journal of College Science Teaching, vol.30.

McDermott, L. C. (1998). A Perspective On Teacher Preparation in Physics and Other Sciences: The Need for Special Sciences Course for Teacher. American Journal Physics, vol.58.

Meltezer, D.E. (2002). The Relationship Between Mathematics Preparation and Conceptual Learning Gains in Physics: A Possible ‘‘Hidden Variable’’ In Diagnostic Pretest Scores. American Journal Physics.vol.70.

Muhibbuddin (2015). Analisis Konsepsi Alternatif dan Miskonsepsi Konsep-Konsep Struktur Tumbuhan Terhadap Guru Sains dan Biologi. Serambi Akademika, vol.1.

Muhibbuddin (2016). Pemetaan Kemampuan Awal Pemahaman Konsep-Konsep Anatomi Tumbuhan Mahasiswa Pendidikan Biologi FKIP Unsyiah. Jurnal Biotik, vol.2.

Novak, J. D. & Gowin, D. B. (1984). Learning How to Learn. Cambridge: Cambridge University Press.

Novak, J. D. (1990). Concept Mapping: A Useful Tool for Science Education. Journal for Research in Science Teaching, vol.27.

National Research Council/NRC (2003). National Science Educational Standard. Washington: National Academy Press.

NSTA and AETS (2003). Standards for Science Teacher Preparation. National Science Teachers Association in Collaboration with the Association for Education of Teachers in Science.

Odom, A. L. & Kelly, P. V. (2001). Integrating Concept Mapping and The Learning Cycle to Teach Diffusion and Osmoses Concepts to High School Biology Students. Science Education, vol.85.

Philip, J.M.D. & Taber, K.S. (2016). Separating ‘Inquiry Questions’ and ‘Techniques’ to Help Learners Move Between the How and The Why of Biology Practical Work. Journal of Biological Education, vol.50.

Sahyar & Hastini, F. (2017). The Effect of Scientific Inquiry Learning Model Based on Conceptual Change on Physics Cognitive Competence and Science Process Skill (SPS) of Students at Senior High School. Journal of Education and Practice, vol.8.

Semiawan, C., Tangyong, F.A., Ballen, S., Mathelenual, Y., & Sudiloardjo, W. (2003). Pendekatan Keterampilan Proses. Jakarta: Gramedia Widiasuara Indonesia.

Shayer, M. & Adey, P.S. (1992). Accelerating The Development of Formal Thinking In Middle and High School Students II: Post project Effects On Science Achievement**.** Journal of Research in Science Teaching, vol.29.

Siew Li, W.S. & Arshad, M.Y. (2015). Inquiry Practices In Malaysian Secondary Classroom and Model of Inquiry Teaching Based on Verbal Interaction. Malaysian Journal of Learning and Instruction, vol.12.

Uno, G. E. (1999). Learning about learning through teaching about inquiry. In book: Student-Active Science. Model of Innovation in College Science Teaching. Mc Neal, A.P. & D'Avanzo, C. (Eds.). Philadelphia: Saunders College Publwashing.