PLANT ANATOMY LEARNING ON BASED PRACTICES THROUGH THE INQUIRY STRATEGY: EFFORTS TO EQUIP THE ABILITY OF THE SCIENCE PROCESS AND SKILLS OF THE USE OF MICROSCOPE EQUIPMENT STUDENT OF BIOLOGY EDUCATION

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Abstract

Ability of Biology students in Teaching Education organization (In-Service) in science process and the ability to use microscope are in state of disappointment. A lot of research have been done to take care these problems, however it has not given a maximum effect. Plant anatomy is the most suitable subject that can be used to equip the student with science process learning and the ability to use microscope through inquiry strategy learning implementation. The purpose of this research is to answer the questions of how inquiry learning implementation affects the students' ability of both science process and to use microscope. The method of this research is One-Shot Case Study Design, with 30 students as research subject. The research is conducted for three months (October to December 2017) at Faculty of Teacher Training and Education, Universitas Syiah Kuala. The aspect that is observed in this research is the ability in practicum planning, ability to use microscope and the ability to report the result. The result of the research showed that (1). Planning ability of the students to conduct practicum increased 48% from the previous result, 76% of the core maximum standard. Maximum score and minimum score are 97% and 55% respectively. (2) The ability to use microscope achieve 67% from basic score and 87% from the expected maximum result. (3) The ability to report the practicum result increase to 53% from the basic ability of 80% from maximum standard score. From the research result, it can be concluded that inquiry strategy implementation at plant anatomy subject has given a significant improvement toward students' science process and the ability use microscope.

Keywords: Learning, plant anatomy, practicum, inquiry

1. INTRODUCTION

Plant anatomy is one of the science subjects that the learning that obey to the science nature as a process and a product. That's mean to learn plant anatomy; it cannot simply have done by giving out all the information about the concepts and basic principles. Students must understand the process of learning through lots of direct practices. Students need to actively observe, discuss among students and lectures that

famously known as hands-on and minds-on activity. Through plant anatomy learning, biology students is claimed to understand plant anatomy concepts and the relationship of the concepts in building the plant body. Those abilities are important to bridging basic biology concepts with other advance biology concepts such as plant physiology, plant taxonomy, genetics and ecology. The ability to analyze advance micrograph structure figures such as graphs obtained from inner biology research using scanning electron microscope (SEM), transmission electron microscope (TEM) and computer-enhanced light microscope (CELM), also the ability to constructs three dimension figures from two dimension figures. Two dimension, three dimension and other micrograph figures produced by SEM, TEM and CELM is research from concepts that published at various modern biology literature (Wandersee, 2004, pp.161-176). Besides the main reason written above, through plant anatomy, students are expected to have science process ability including: observation, asking questions. Read literature books and other resources to seek available information, planning observation, to conclude what they have conducted, to use lab tools, to collect and analyze data, data interpretation, explanation, prediction and communicate the result (NRC, 2003, p.300; Depdiknas, 2003, p.232).

Plant anatomy is essential for the students, however there is still lots of problems faced by the students during the learning process. Evaluation result from plant anatomy practicum from the last four years (2012 to 2016) on students of third semester of Faculty of teacher training and science UNSYIAH in Aceh, Indonesia showed that (1) students lacks skills of using laboratorial tools such as microscope, (2) lacks skills in preparing specimen, (3) difficulty in analyzing object using microscope, (4) low quality report, (5) inability to prepare a proper practicum planning. Low level ability of biology students is expected due to conventional practicum activity. This conventional activity asked students only to conduct practicum, limited guidance and lack of science process training (Muhibbuddin, 2016, pp.1-26). The low grade biology students related to both science process and using laboratorial tools in plant anatomy learning need an urgent improvement through the implementation of effective strategy.

Inquiry is one of the methods of learning strategy that suitable to be implemented in plant anatomy subject. Through inquiry, students can be equipping with science process skills and psychometric during learning process. Through inquiry students can build their knowledge independently with proves and new ideas they acquired. (Adair & Chiaverina, 2003). NSTA & AETS (2003, pp.1-9) confirmed there is relation between inquirers and inquired. If they are related to learning process, inquirers refer to students as a knowledge inventor and inquired is refer to what are invented (knowledge). One of the inquiry principle is students can construct their understanding independently by conducting hands-on and minds-on activity during learning. Inquiry can also be used to trigger the students' ideas in investigating what they are doing (Henrichsen & Jarrett, 1999, p.138).

There are three level of inquiry; First, discovery learning level, the main role of teacher in this level is to identify problems and process, while students identify result alternative. Second, inquiry guided level, the main role of the teacher at this level is to propose problems, while students select the process and problem solver. Third, open inquiry, the main role of teacher is to explain problems context, while students identify and solve them (NSTA &AETS, 2003, pp.1-9).

Research related to inquiry learning process have been published by several authors including (Capps & Crawford, 2017, pp.497-526; Sahyar & Hastini, 2017, pp.120-126; Hannasari at al., 2017, pp.48-52; Yusrizal et al., 2017, pp.88-93; Philip & Taber, 2016, pp.207-226; Hairida, 2016, pp.209-215; Kuhn, 2015, pp.37-50; Siew Li & Arshad, 2015,pp. 151-175; Baseya at al., 2010; Baseya & Francis, 2011,pp. 241-255; Campo & Garcia-Vazquez, 2010,pp. 15-20; Crawford, 2007; Schwartz at all., 2004,pp. 610-645; Buxeda & Moore, 1999,pp. 159-164; Switzer & Shriner, 2000,pp. 157-162; Jones et al., 2000,pp. 139-159; Windschitl & Buttemer, 2000,pp. 346-350; Marbach-Ad & Claassen, 2001; Marbach-Ad et al., 2001,pp. 434-438; Anderson, 2002,pp. 1-12). However, those research tend to explain more on understanding science/biology concepts for senior high school students. Research related to plant anatomy subject, practicum based through inquiry strategy as the efforts to equip students with science process skills and giving proper knowledge on how to use laboratorial tools (Pre-Service) is still limited.

2. RESEARCH METHOD

Method used in this research is experiment method with design one-shot case study (Gall et al., 2003). Research design is as below.

Table-1: One-Shot Case Study Design

Group	Treatment	Post Test
Treatment Class	X	O

X = Learning with strategy inquiry
O = Post Test (after treatment)

Research is done with three steps; first, conducting evaluation toward student basic ability about: (1) ability on using microscope, (2) ability on planning a practicum and (3) ability on reporting practicum result. At this step, student is asked to plan a practicum by observing one of the objects with microscope and reporting the analysis result. Data obtained from this step is used as basic skills value of the students before inquiry strategy implementation. Second, conducting learning process with inquiry strategy with several steps (1) guiding students in using practicum manual, (2) demonstrate ways to use microscope, to prepare a fresh specimen and observing objects below the specimen, (3) guiding students on how to report practicum result and (4) guiding students on practicum planning. Third, students are asked to do practicum activity independently with guidance refer to practicum manual. At the end of the activity, students are asked to report the result of practicum in written report. Fourth, conduct evaluation on students' latest skills after learning process. Evaluation is conducted during learning process (for practicum activity and microscope usage skills) and after learning process (result report and practicum planning activity).

Instrument used in this research is consist of (1) Practicum working manual, (2) evaluation instrument on skills of how to use microscope in a proper way which again consist of 12 skills, each of it having three and four indicators. Each of the indicator is given a minimum score of 1 and maximum of 4. Total score maximum Is 156 and minimum score is 39, (3) evaluation instrument on practicum planning, consist on ten components, each of it consist of 2-4 items. Score minimum is 10 and maximum score is 87, (4) evaluation instrument of practicum report, consist of 11 components, each of it have 2-6 items. Minimum score of 11 and maximum score is 100. The research is done on biology students at third semester of teacher training and science Faculty, Universitas Syiah Kuala, Banda Aceh, Indonesia. The duration of the research is three months (October to December 201). Total students involved in this research is 43 participants.

3. DATA AND ANALYSIS

The research result data is score from basic skills evaluation (Initial ability) and ending skills how to use microscope, reporting practicum result, practicum planning process. Data analysis is conducted by comparing initial skills and ending skills, also comparing both initial and ending skills with expected standard skills.

4. RESEARCH RESULT

4.1 Skill to use Microscope

Result of the analysis on skills to use microscope during practicum activity (Figure 1) showed that initial skills (pre-test) students average score on using microscope was 30 (19%). Maximum and minimum score achieved were 37 (24%) and 26(17%) respectively. Latest skills measured from eight times practicum activity has an average score of 135 (87%). Maximum score of post-test is 138(88%) and the minimum is 133(85%).

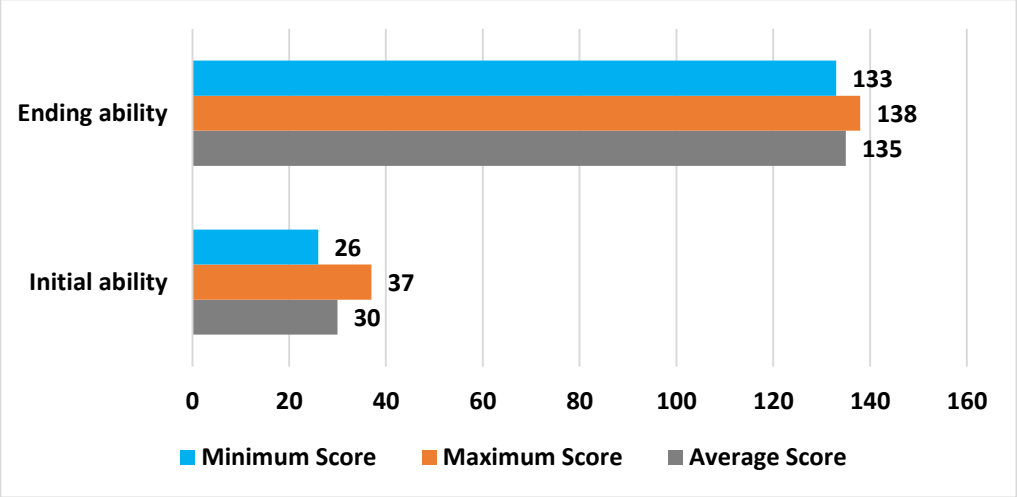

Figure 1. Score of Initial and ending ability skills using microscope.

At early practicum activity (Figure 2), student skills in using microscope still low, only achieve an average of95 (61% of expected maximum score). Student skills is increasing at the next several activities (P-2 to P-5).At practicum activity step 5 (P-5), the average score achieved 150 (96% of the expected maximum score).

At the next practicum activities (P-6 to P-8) student's skill has achieved maximum, with average score of 152 (97%).

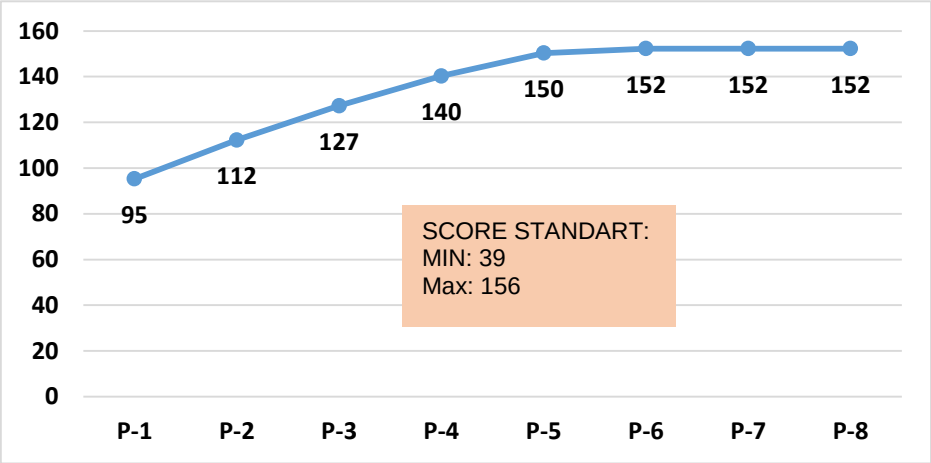

Figure 2. Average Score of student skill in using microscope during practicum activity (P-1: Activity -1 to P-8: Activity-8).

4.2 Skill to use Microscope

Analysis result of initial skill of students in practicum planning compared to expected standard (Figure 3) showed that 21 students with initial skill score 31 (average score), two students score 52 (maximum score) and the other 8 students score 32 (minimum score). Compared with expected standard score, these result is still too low. Student skill only 35% (average), 60% (maximum score) and 24% (minimum score) that achieved from the expected standard score. After implementing inquiry strategy, student skill in practicum planning is higher compared to initial skill and expected skill. The average of ending skill score increase 48% from initial score and 76% from maximum score. Maximums core achieved 97% and minimum score is 55% from standard score.

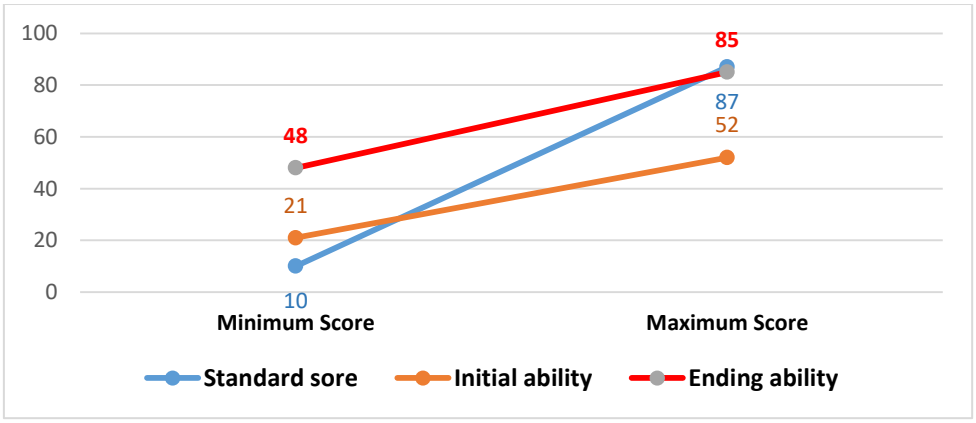

Figure 3. Comparison between Initial and Ending Skill Score with Standard Score

In Practicum Planning Activity

Looking at each component of rpacticum planning (Table 2) the average score of each component generally has fullfill the criteria of standard score (100%). Only table of content construction that achieve 71%. This result indicate that student already has the skill in planning a proper practicum according to agreed criteria.

Table 2. Comparison standard score with ending skill score per component of Practicum Planning

No.	Research Report Component	Standard Score	Students' Average Score	Student Score Achievement (%)
1	Report Completeness	4	4,00	100
2	Tittle Formulation	6	6,00	100
3	Background	9	9,00	100
4	Problem Statement	9	9,00	100
5	Purpose Statement	6	6,00	100
6	Literature Review	9	9,00	100

7	Activity Steps	10	10,0	100
8	Result and Discussion	6	6,00	100
9	Conclusion and Recommendation	8	5,67	71
10	Reference	20	20,00	100
	Total	**87**	**84,67**	**97**

4.3 Reporting Skill

Result analysis of initial and ending skill of students in reporting practicum result and compared with expected standard skill (Figure 4) showed that 23 students that have the initial ability achieved score of 41 (average score).

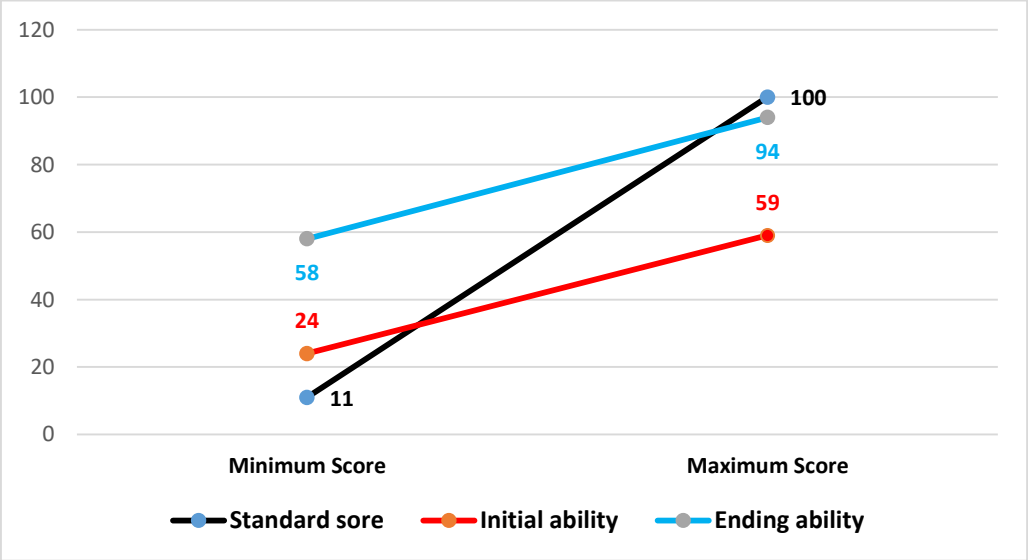

Figure 4. Comparison of Initial and Ending skill score with standard score in reporting practicum activity

Three students achieved score of 59 (maximum score) and four students achieve score 24 (minimum score). Compared with expected standard score, students' skill in reporting practicum result is still low. Student skill only achieve an average of 41% (average score), 59% (maximum score) and 24% (maximum score) from expected standard score. Meanwhile ending skill improves compared to initial skill and expected standard skill. The average of ending skill score increase 53% from initial skill and 80% from maximum standard score. Maximum score achieves 92% and minimum score achieve 58% from standard score.

Ending skill in reporting practicum activity has achieved expected standard score (100%) from each expected component within the report (Table 3), except background component (67%), result and discussion part (83%) and table of content construction (88%). Compared to expected criteria, it is showed that students already have the skill in proper reporting practicum activity.

Low score on writing table of content component is due to students only put list of references of the text books, while on standard criteria it insists to obtain from various possible sources including internet. The low average score of research report compared to standard also occurred on the way students presented the practicum result where they only used either table or figures. Nevertheless, what have been included within the report already fulfill the agreed criteria and the report is communicative.

Table 3. Comparison between Standard Score and Ending Skill per Component of Pracicum Acticity Report

No.	Research Report Component	Standard Score	Students' Average Score	Student Score Achievement (%)
1	Report Completeness	4	4,00	100
2	Tittle Formulation	6	6,00	100
3	Background	9	6,00	67
4	Problem Statement	6	6,00	100
5	Purpose Statement	4	4,00	100
6	Literature Review	9	9,00	100
7	Activity Steps	8	8,00	100

8	Result and Discussion	10	8,33	83
9	Conclusion and Recommendation	6	6,00	100
10	Reference	8	7,00	88
11	Research report component relationship	30	30,00	100
	Total	**100**	**94,33**	**94**

The analysis result of using microscope skills and practicum work during eight times classes showed there is consistent improvement and has reached maximum at the fifth class. The analysis result of practicum planning activity and reporting practicum activities properly according to expected standard criteria. Implementation of inquiry learning strategy is capable to equip student to have proper skills in using microscope during practicum.

This skill is essential for students because most of biology subjects especially plant anatomy that need students to use microscope during the learning process. Students as future teachers must be able to teach the student in a proper way through practicum activity by using microscope. Therefore, Shulman (in Wandersee, 2004, pp.161-176) insisted that biology teacher need to know the fundamental and understand the advance microscopic structure as well as to able to construct knowledge obtained from observation result through microscope at laboratory and interpret the analyze result.

McDermott (1998, pp.734-742) also stated that in preparing a well-rounded science teacher is not enough by giving them the fundamental aspect of the subjects. Other aspects such as skill in using microscope in details, science process skills (observing, clarify, interpret, predict and asking question), generic skills (critical thinking, problem solving, communicate, obtain and use of knowledge and information) need to be improve.

5. CONCLUSION

From the research result obtained it can be concluded that implementation of inquiry learning strategy in plan anatomy subject is effective to equip and improve students' science process skill including practicum planning, reporting practicum result and skill to use microscope.

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