



Analysis of the Effectiveness of Learning Models against Students' Innovative Behaviour

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Abstract

Practicum becomes an appropriate method to give provisions in empirical experience especially for a college student of Biology Education. Practicum was believed could show university students' innovative behavior. The concrete form from using practicum method is learning model application that includes learning syntax from the beginning to the end. Therefore, a research was done to analyze the relation between practicum method towards innovative behaviour and the effectivity of it. Based on the result of the regression analysis, all models gives significance value $p < 0.05$ so could be known that every learning model give significant influence toward the formation of university students' innovative behavior. Based on correlation coefficient analysis could be known that PJBL learning model gives contribution value of 86.2% followed by the guided inquiry of 85.4%, experimental model of 76.3% and observation model with contribution value of 64.7% toward the formation of university students' innovative behavior. Based on the results of variance similarity analysis could be known that PJBL model is the most effective model to form innovative behavior with the difference value of 17.80 compared with other learning models. The results of research showing that all of the learning models when used on practicum relating to the formation of innovative behavior. Project based learning model gave contribution most effective towards the innovative behavior of the college students in Biology Education study program.

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INTRODUCTION

Biology as one of a science discussing living things and their lives is expected to provide experience to the students in investigating the phenomena of life of living things (Saptono, 2003). The Department of Biology Unnes has implemented practicum method to solve the phenomena or problems occurring in nature. The practicum method has a major role for biology education's students, since through this method students have the opportunities to develop and apply scientific process skills and scientific attitudes in order to reach learning goals. According to Woolnough & Allsop (1985) practicum needs to be implemented in the science learning because (1) practicum can arouse students' motivation in learning, (2) practicum can develop students' basic skills in conducting a research, (3) practicum is as the media for learning a scientific approach, and (4) practicum can support the learning materials. Practicum becomes an excellent method that can provide an empirical experience to build students' confidence and interest in learning. Thus through the practicum, learning objectives are expected can be achieved optimally (Berg, 1991). There are three kinds of practicum based on its goals. They are the practicum for developing students' basic skill, practicum for solving the problem, and practicum for enhancing student's understanding and comprehending (Woolnough, 1985).

The Faculty of Mathematics and Natural Sciences (FMIPA) Unnes have a responsibility to develop innovative value. The innovative behaviours are as the realization of Unnes conservation as the sources of knowledge and as the realization of the purpose of the Biology Education Study Program, so those need to be implemented thoroughly in order to achieve the goals. Based on Salaman & Storey (2002) the innovative behavior becomes the main factor for the existence of an organization. Almost 80% of innovative ideas are from individuals, while 20 is % based on the initiative of an organization (Getz & Robinson, 2003). The implementation of innovative behaviour can be organized in the education process systematically through the application of an educational learning model as a concrete form of the implementation of the practicum method includes learning syntax. The research focuses on the observational learning model (Purnomo, 2008), experimental model (Sanjaya, 2008), inquiry guided model (Sanjaya, 2007) and project based learning model (George Lucas Foundation, 2005). The learning model has been already applied are based on the students' need and the characteristic of the course.

The indicators of innovative behaviour that need to be developed during the biology learning process are the challenge status quo, curiosity, self motivation, visionary, entertains the fantastic, takes risks, peripatetic, playful, self accepting, flexibility, makes new connections, reflective, recognize patterns, tolerates ambiguity, committed to learning, formally articulate, and preventing (FMIPA Unnes, 2016). The future teachers need to build those innovative behaviours in order to create a meaningful learning that can improve the quality and quantity of education.

However, until now there has not been students' innovative behaviour based on the learning model which can be used as the parameter to maintain and improve the existing program to achieve the goals of Biology Education Study Program. Because of those matters above, a research "The Analysis of the Effectiveness of Learning Models against Students' Innovative Behaviour" was conducted to find out the profile of students' innovative behavior based on the learning model used during practicum so that can give a picture of the success of the learning model that bridged the achievement of Biological Education Department goal.

Based on the description above, the hypothesis in this study is the use of practicum methods which is actualized in the form of application of the learning model has a significant influence towards the formation of students' innovative behaviour and each model gives the contribution value > 61% towards the formation of student innovative behaviour. Thus it indicated that effective learning model can form students' innovative behaviour.

RESEARCH METHOD

This study was conducted from June to August 2017 in the Department of Biology, Faculty of Mathematics and Natural Sciences, Unnes. The population in this study was all students of Biology Education Program in the term of two, four, six and eight, in which the second semester student taking biochemistry courses, fourth semester students taking courses in animal physiology, ecology and plant anatomy, and sixth semester students taking micro technical courses are as the research samples. This study used sequential mixed methods with explanatory sequential strategies. The quantitative data was taken by using probability sampling technique type of proportionate stratified random sampling, while qualitative data was taken by using purposive sampling technique. The quantitative data then was analyzed by using parametric statistical analysis that is simple linear regression test and equality test of variance. Besides, the qualitative data were analyzed by using guidelines from Miles & Hurbeman (2014) in obtaining the description related to the implementation of learning model with practicum methods to form student's innovative behaviour.

The research procedure consisted of the preparation stages and the implementation stages. The preparation stages were (1) compiling the questionnaire of innovative behaviour and the questionnaire of the implementation on each learning model, the sheet observation, and interview sheets; (2) conducting empirical and construct validity test to make sure if the items were valid and reliable, and (3) asking the expert to validate the instrument. The implementation stages were (1) distributing questionnaire of innovative behaviour and questionnaires after implementing the model to the respondent, (2) observing the participant while the practicum process (3) conducting in-depth interviews to support the observation data and (4) recapitulating the questionnaire, observation and interview data. The data obtained then was analyzed using (1) a *simple linear regression test* that includes the test of linearity and the significance test for analyzing the relationship between learning model to determine the formation of student innovative behaviour as well as the effectiveness contribution of each learning model, and (2) the variance similarity test to analyze the model learning that has the most effective contribution to the formation of students' innovative behaviour.

RESULT AND DISCUSSION

Based on the research results, profiles of students' the innovative behaviour based on the learning model used during the practicum activity were obtained. The first hypothesis was tested by using *simple linear regression analysis* to find out if there was a positive influence between the use of learning models toward the formation of innovative behaviour of students. Based on the results of the regression test using SPSS 16.0 program, all learning models have sig. value of 0.00 or $\rho < 0.05$ so that it can be formulated that each learning model has an influence positive toward the formation of student innovative behaviour. Table 1 shows the equation of regression for each learning model.

Table 1 The Regression Equation Of The Use Of Learning Model Toward The Formation Of Innovative Behaviour

| Learning Model | Regression Equation |
|-----------------------|----------------------------|
| Observation | $Y = 134,825 + 3,027 X$ |
| Eksperiment | $Y = 133,762 + 2,994 X$ |
| Guided inquiry | $Y = 120,870 + 4,535 X$ |
| PJBL | $Y = 125,295 + 4,4 X$ |

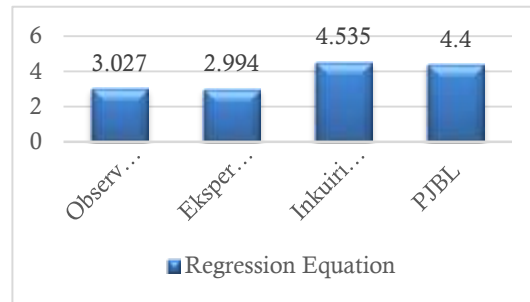


Figure 1 The Improvement Of *Dependent Variabel* with Higher *Independent Intensity Variable*

Based on Table 1 and Figure 1 the intensity of application of the use each learning model is increased in which the highest level of student's innovative behaviour was in the guided inquiry model 4,535. The enhancement in PJBL model was not significantly different in which the level of innovative behaviour students increased by 4.4. While the least level of student's innovative behaviour was in the experimental model that is equal to 2,994. It was not significantly different when using an observation model that is equal to 3,027.

The second hypothesis was tested by using ANOVA to find out if there was any influence significant between the user of learning models toward the students' innovative behaviour. If the significance value $p < 0.05$, it meant the learning model used had a significant effect on the formation of innovative behaviour that needs to be further tested to know the contribution the effectiveness of each learning model toward the formation of innovative behaviour using R square test. Table 2 shows the results of the ANOVA analysis as follows.

Table 2 The Test Results Hypothesis 2 using ANOVA Test

| Learning Models | Sig. Result | F result | Influence |
|-----------------|-------------|----------|-----------|
| Observation | 0.00 | 78,839 | Positive |
| Eksperiment | 0.00 | 187,035 | Positive |
| Guided inquiry | 0.00 | 157,774 | Positive |
| PJBL | 0.00 | 219,377 | Positive |

Based on Table 2, all learning models had a significance value of 0.00 it can be concluded that each learning model gave a significant influence on the formation student's innovative behaviour. Based on the value of F, PJBL model has the highest F value that was 219,377 it meant that the PJBL model has the highest significant influence on its formation student's innovative behaviour compared to other models. According to Sugiyono (2016), a greater F value gives the most significant effect. To determine the value of contribution and the effectiveness level of each learning model, the furthered hypothesis test using R2 was carried out. The determination of effectiveness level used the guidance by Ridwan (2013).

Table 3 The Results of R Square Test Using Learning Models on Innovative Behaviour

| Learning Models | R ² result | Contribution (%) | Category |
|-----------------|-----------------------|------------------|----------------|
| Observation | 0,647 | 64,7 | Effective |
| Eksperiment | 0,763 | 76,3 | Effective |
| Guided inquiry | 0,854 | 85,4 | Very Effective |
| PJBL | 0,862 | 86,2 | Very Effective |

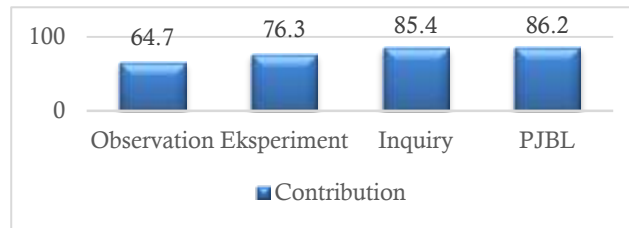


Figure 2 The Value of Contribution Each Models towards Innovative Behaviour

Based on Table 3, the observational and experimental learning model was effective, while the guided PJBL and inquiry model was very effective in generating innovative behaviour college student. Based on Figure 2, PJBL model had the highest level of effectiveness towards the formation of students' innovative behaviour with a contribution value of 86.2%. The third hypothesis was tested using an *equation analysis of variance* to determine the effectiveness of each learning model against others so that it can be formulated which one was the most effective to form students' innovative behaviour.

Table 4 The Results of Differential Test of Variances between Each Learning Model

| Sample Variance | Class | Mean Difference | Sig. | Hasil |
|-----------------|-------|-----------------|-------|-----------------|
| 4 > 3 | | 1,55 | 0,944 | Not Significant |
| 4 > 2 | | 13,45 | 0,000 | Significant |
| 4 > 1 | | 17,80 | 0,000 | Significant |
| 3 > 2 | | 15,00 | 0,000 | Significant |
| 3 > 1 | | 19,35 | 0,000 | Significant |
| 2 > 1 | | 4,35 | 0,198 | Not Significant |

Based on the result of variance similarity test, it can be seen that the project based learning model gives the most effective contribution to shape the students' innovative behaviour then followed by a guided inquiry model, in which both of models had no significant difference contribution values that is only 1.55. Learning models with the highest significant difference between grades comparison with other classes using different learning models was a guided inquiry model with an observation model that was 19,35. Its value was not significantly different if used project based learning model that was 17,80. The higher the mean difference value meant that the greater the gap between the used of comparative class learning models with other classes that use different learning models for students' innovative behaviour.

Table 5 below shows the scores of innovative behaviors that students acquire based on innovative behavioral indicators compiled by the faculty team of FMIPA Unnes. The analysis is used to determine the advantages of each model of learning towards the formation of innovative behavior.

Table 5 Innovative Behavioral Score Analysis Based on Behavioral Indicators

| Indikator | Observasi | Eksperimen | Inkuiri | PJBL |
|---------------------------------|-----------|------------|---------|------|
| <i>Challenge status quo</i> | 11 | 11 | 11 | 11 |
| <i>Curious</i> | 11 | 10 | 11 | 11 |
| <i>Self motivated</i> | 8 | 8 | 9 | 8 |
| <i>Visionary</i> | 14 | 14 | 15 | 15 |
| <i>Entertains the fantastic</i> | 10 | 9 | 11 | 11 |
| <i>Takes risks</i> | 10 | 9 | 10 | 10 |
| <i>Peripatic</i> | 10 | 9 | 10 | 11 |

| Indikator | Observasi | Eksperimen | Inkuiri | PJBL |
|------------------------------|-----------|------------|---------|------|
| <i>Playful/humorous</i> | 10 | 10 | 11 | 10 |
| <i>Self accepting</i> | 6 | 6 | 7 | 7 |
| <i>Flexible/adaptive</i> | 6 | 6 | 6 | 6 |
| <i>Makes new connection</i> | 12 | 12 | 13 | 14 |
| <i>Reflective</i> | 6 | 7 | 7 | 7 |
| <i>Recognize patterns</i> | 12 | 14 | 15 | 15 |
| <i>Tolerance ambiguity</i> | 9 | 10 | 11 | 11 |
| <i>Committed to learning</i> | 7 | 7 | 8 | 8 |
| <i>Formally articulate</i> | 10 | 11 | 11 | 12 |
| <i>Persevering</i> | 13 | 13 | 15 | 15 |

One of the factors causing a large difference contribution or effectiveness of each learning model toward the students' innovative behaviour was the use of different learning models. Based on the quantitative analysis data, the PJBL model was the most effective model to shape students innovative behaviour. Those results obtained than were supported by qualitative data in the form of observation and interview. According to the results of interviews with students in six and eight semesters who had participated in all practicum activities with different models argued that PJBL model was the most effective learning model to form students' innovative behaviour.

Based on the observation, PJBL learning model is a practicum for enhancing student's understanding and comprehending The results of observation, students of Biology Education Program Unnes particularly who take the course animal physiology had applied the model of PJBL according to the guidelines of The George Lucas Educational Foundation (2005). Students were given fully of opportunity and freedom to determine the working steps, tools, and materials to achieve optimal lab work objectives. College students were given the opportunity to prove the truth of a theory from various references. The lecturer as the facilitator was in charge of supervising and guiding student who faces the problems. Proving a theory was students' responsibility and obligations. It was used to train students' innovative behaviour, where students must have curiosity toward a particular thing, wide insight, good communication with lecturers and other scientific attitudes. Therefore the use of the PJBL model gave the biggest contribution in forming students' innovative behaviour.

Table 5 shows that the indicator *peripatetic*, *makes a new connection* and *formally articulate* are the excellent indicator in PJBL learning model. Those are closely related to the project assignment from the lecturer. Lecturer commonly gives a matter based on the learning materials to the students, in which it should be developed into a mini research to find a conclusion related to the certain theory. Students have wide opportunity to use all the references as the guidance in arranging tools, materials, and work steps in order to achieve the learning goal. Students are required to be able to convey ideas effectively and be able to choose tools, materials and appropriate work steps for reaching the purpose of learning. Students also must be able to determine another alternative step. Those processes are the advantage of the PJBL model compared with other models in order to improve students' innovative behavior, the sense of creativity will be more seen when students are in the unexpected condition.

These results were in line with Thomas (2000) PJBL model can improve learning outcomes in the form of knowledge and creativity of learners, because the model PJBL learning more emphasizes on the real situation for learners to gain permanent knowledge and ability to improve the learners' memory. According to Movahedzadeh *et al.* (2012), project-based learning allows students to work more active during practicum because they have to combine prior-skills with actual knowledge based issues so that students are able to think more critically. In the project-based

learning, the student must really understand every activities step, if the first step is not done correctly, the next step can-not be performed appropriately. Thus project-based learning was believed can provide more conceptual understanding for students and can enhance the students' enthusiasm for learning and believe in students' ability. Meanwhile, according to Bell (2010), project-based learning provides critical strategies for dealing with technology in the 21st century through the process of investigation and research.

Bell (2010), believed project-based learning can improve learning motivation that becomes the major key to learners' willingness to access new challenging knowledge. Based on the survey results at the school in Washington DC, both schools applying PJBL model on the learning process and applying traditional learning model can answer a procedural question using a formula, yet students treated using project-based learning can easily answer and apply learning concepts. Based on the research result above, there was a difference in terms of knowledge acquisition among learners treated using traditional model and PJBL.

Another learning model that contributes very effective effect in forming students' innovative behaviour is a guided inquiry model. In this model, students were not only passive as recipients of concept but they active finding a concept. Based on the data obtained, as much as 93% of students treated using guided inquiry model achieved learning objectives. The process of seeking and processing of data was a characteristic for this model and it was proven very effective to form students' innovative behaviour. There was 97% of students argued that lecturers support the formation of students' innovative behaviour so that the goal of Biology Education Study Program to produce innovative bachelor through the use of learning models in accordance with the needs of students can be easily achieved because there was a synergy between lecturers and students.

Based on observation result, guided inquiry model was a form of implementation independent lab work to sharpen innovative skill. According to 80% of students treated using guided inquiry model, information delivery and problem formulation implied during the of practicum, inquiry model was able to increase students' curiosity, develop students' mindset and increase students' spirit in solving the problem. According to the observation, learning in nature can foster the spirit and the enthusiasm of student in learning because it can overcome the saturation of learning. In addition, the students are more proactive when given a new task, even still there were some of the students cannot solve difficult matters.

The results of the analysis related to the use of inquiry learning model guided toward the formation of students' innovative behaviour in line with the results of research conducted by Daniah (2014) related usage guided inquiry model can improve students' scientific attitude UIN PGMI aspects of curiosity as much as to 88,33%. Curiosity is one of the indicators of innovative behaviour. Based on the research conducted by Dewi (2013) the use of guided inquiry model can improve students' scientific attitude that is the curiosity of learners up to 83.33%, a sense of care to environmental condition up to 74,51%, critical thinking attitude up to 82,15%, and creativity attitude and discovery learning up to 83.33% and open attitude to cooperate up to 82,57%.

According to Uzezi & Zainab (2017), learners who apply guided inquiry models have scientific thinking skills better than learners who apply the traditional model. It was proven from the results of post-test and pre-test. In addition, learners who apply guided inquiry model also have more sharp memory and show better learning achievement competence than the traditional class, because in traditional classrooms students are not required to analyze the interrelation between experimental results with theory, while in the classroom using guided inquiry model students are trained to link between experimental results with the theory so that the ability to think scientifically. Those scientific attitudes are the indicator of innovative behaviour, so it can be inferred the use of guided inquiry model is effective to be used to improve students' innovative behaviour.

Table 5 also shows that the indicator *self motivated* and *playful or humorous* are the excellent indicator in guided inquiry models in which can increase the spirit of work and create fun activities.

Those were proven from the result of observation and interview. Almost 70% of learning activities using guided inquiry model in ecology subject uses nature and its surroundings as learning sources, as a result, students are not bored and tired. The use of nature as a learning resource is believed creating a fun learning process that can increase students' curiosity and students' innovative skill. The guided inquiry model requires students to have a high spirit of work. Since the learning outcomes deals with nature so that students should be able to put nature as friends and collaborate with nature to get the best results. Those processes are expected can train students' mental and creativity to face *unpredictable situations* so that the sense of innovation will arise together with the acquisition of knowledge and enhancement of students' understanding and intellectual.

The principle of guided inquiry model is almost the same with PJBL model however on the guided inquiry model lecturers still intervene in the work steps preparations for solving a problem. On the PJBL model, students are given a full opportunity to innovate creativity. On the guided inquiry model, the problem is solved together with the lecturer so that it reduces the students' opportunity to innovate.

The Biology Department also apply experiments and observation models to realize the mission of the Biology Education Study Program to build innovative outcome and support the realization of an innovative character. Observational learning model contributes the least up to 64,73%. Based on the analysis result of the similarity of variance, the influence between the observation model and the experimental model is not significantly different, the mean difference value only as much as 4.35. Although both observation models and experimental are not given a significant effect, yet those models can be used to form a student's innovative behaviour.

Based on the observation, the use of the experimental model and observation did not give students the freedom to set their own steps activities to be done to achieve optimal learning objectives. Students use the type of prescription laboratory where all the tools and materials are available and the work steps are arranged systematically on the dictates of practicum, so that the students cannot develop the creativity and the ability to innovate. Student curiosity is reduced due to activity-related information practicum is available all in handbook.

The use of the experimental model is more effective than the inner observation model framework to form the students' innovative behaviour because student just did observation and record what happened to experiment variable, changes in variables occur naturally. This is in line with the results of research, where 55% of respondents treating observation models agree that students only act as an observer during practicum activities so it reduces student's creativity. In addition, based on observations and questionnaire of learning model implementation, 74% of respondents said that the activities steps are readily available and complete in practice dictates thereby lowering the student's interest to seek other reference sources as a learning resource. On the experimental models, students were still given the opportunity to perform an prove the activity and observing the changes that occur in experiment variables, the changes occur in the experimental variables due to the treatment of the students and it was a part of the research process, so the student's curiosity increased because of the changes occurred to answer why it can happen.

According to Zaare (2012), the application of experimental learning model requires lecturer not only utilizing the classroom as a source of learning but at least one school became a source of learning for learners so as to develop at once describe the true state of a theory being studied.

Based on table 5, the experimental model is more excellent than the observation model typically on the indicator *reflective, recognize patterns, tolerance ambiguity dan formally articulate*. The experimental model gives a greater chance for students to re-identify the principles taught during learning theory in a different form and able to relate it to the experimental results to obtain a conclusion related to the truth of a theory. It is in line with the indicator number of 13 stating that innovative students are able to recognize patterns that were once known and able to differentiate and coordinate it. Students are required to be able to develop problem-solving ideas to minimize errors during working due to

the use inappropriate variables to obtain optimal learning results according to the purpose of the practicum; it is in accordance with the indicator innovative behaviors of *reflective and tolerance ambiguity*.

However, in the observational model students are only required to be able to work on procedures in accordance with the diktat and lab work errors will not occur if the respondent does the steps work carefully and thoroughly. Students must have the skills to convey ideas effectively so that the results of the practicum are stated the truth of a theory can be well received by other respondents, in this process students are required to have the skills to link and communicate between the results of the lab and the theory being tested. Students who are applying observation models have the lowest skills in conveying ideas effectively compared to other models because of the use of the observations model on student is not required to relate between theories with the result of the lab because the error is completely from the respondent and variable changes occur due to natural factors, so the skills of the conveying ideas is low.

Although the observation model and experimental model did not give significant effect to form students' innovative behaviour, yet both models can increase student activity. The use of experimental and observational models can minimize the students' fatigue in the learning activities class. The use of both learning models provides an opportunity for students to prove a theory gained during classroom learning activities. The use of experimental models and observation models require students to be able to link between knowledge that has been obtained with the results of the practicum so that the learning becomes more meaningful (Suparno, 1997). The linking process becomes important because of students even the opportunity to think further about why a change may occur variables due to a given treatment, so the theory used can be proven. Information obtained through the meaningful learning can be longer remembered in the long-term memory so if in the long term information is not used and will be reused, students still remember those information without re-open the book (Ausubel, 1963).

Both students applying observation model and the experiment have a lower score on indicators of *visionary, entertains the fantastic, self accepting, makes a new connection, committed to learning* and *persevering* compared to the scores of students applying guided inquiry models and model of PJBL. Implementation of indicators *visionary, entertains the fantastic* dan *committed to learning* are closely related to the use of resources learn. Students applying guided inquiry model and PJBL model have wide opportunity to utilize technology in order to fulfill source of learning because the lecturer does not provide diktat practicum so that insight students become more knowledgeable because the source of learning is not fixated on diktat lab but rather journal and articles that are more *updated* than a handbook.

Students are required to read a lot and explore knowledge continuously because information to achieve learning objectives is only delivered on a continuous basis implied by lecturers and practicum assistants. Students who apply observation models and experimental models are less in utilizing learning resources because it has been provided from diktat lab that contains tools, materials, work steps, questions and guidance of data retrieval to an obtained conclusion. According to students who take practicum courses, the use of diktat in practice is less varied because from year to year which means and leads to the bad habits of students to cheat seniors' practicum reports. The habit of cheating bands students' creativity, as a result, it is difficult to bring new innovation to find the right solving idea.

These three indicators are closely related to the type of practicum used. Practicum using observation model and experimental model are not required students to develop innovative ideas due to the purpose of those models is to develop basic skills and solve the problem without improving students' understanding and knowledge. The work steps and the objectives on both models have been written expressly in the diktat lab, so that students have less opportunity to achieve the practical objectives by using other means which is more effective and efficient. Besides

the above-mentioned factors, the limited time of practicum becomes one of the obstacles for students to make an innovation related material being studied.

While in the application of inquiry model guided and model PJBL, students have wide opportunities to determine the effective and efficient working steps in order to achieve the purposes of learning. Thus, the student's innovative skill more developed. Students are required to be able to think logically and critically in taking the action for minimizing the occurrence of errors during working. In addition, an unlimited time of practicum in both guided inquiry model and PJBL model let the student explore more in doing the experiment so students' creativity is more developed.

CONCLUSION

Based on the study results, there was a significant influence between the uses of learning models when practicum towards the formation of students' innovative behaviour. Each learning model contributes different effectiveness to students' innovative behavior.

Observation learning model contributed 64.7%, experimental learning model was 76.3%, guided inquiry model contributed 85.8% of and PJBL model contributed 86.2% towards the students' innovative behavior. The project-based learning model provides the most effective contribution to form the students' innovative behavior with a contribution value of 86.2%.

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