The Contribution Of Biological Practicum Learning Model Based On Creative Research Projects In Forming Scientific Creativity Of High School Students

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Submission date: 04-May-2023 11:02AM (UTC-0500)
Submission ID: 2084181306
File name: 46._Full_Paper_Sukarso.pdf (467.88K)
Word count: 3809
Character count: 21623

1st International Seminar
STEMEIF (Science, Technology, Engineering and Mathematics Learning International Forum)
Purwokerto April 25th 2019
ISBN: 978-602-6697-36-3

The Contribution Of Biological Practicum Learning Model Based On Creative Research Projects In Forming Scientific Creativity Of High School Students

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Abstract. Anticipating the demands of 21st-century life Biology learning must generate creative students using Biological knowledge to solve problems. Research has been conducted with the aim of investigating the contribution of Biology practicum models based on creative research projects in shaping the scientific creativity of high school students. The study was conducted at 66 MIPA grade X high school students in Mataram, West Nusa Tenggara. Data from the research were collected using the Biology creative disposition questionnaire, Biological creative thinking skills tests and creative product assessments. The results showed that the creative disposition of Biology students in the experimental class and control class belonged to the medium category. Creative research-based Biology practicum model can improve creative thinking skills at n-gain 0.6 including medium category, also produce creative products in good categories. The results of the statistical test using a t-test, the experimental class Biology creative thinking skills were higher and significantly different than the control class. Thus the Biology practicum model based on creative research projects needs to be developed in high school because it contributes to fostering students' scientific creativity.

1. Introduction

Responding to the challenges of 21st-century life, the world of education is faced with how students become creative. Mastery of scientific fields is not enough to be productive. Future scientific advancements and achievements require citizens who have a strong foundation of knowledge and have creative thinking skills [1,2]. The trend towards globalization with technological development requires productive energy products and innovative people in all walks of life [3].

Scientific creativity is an important aspect to master the development of science. Creativity is a key element in building science [4,5]. Education plays an important role in shaping human resources that are able to compete in this era of globalization. Education is also an important medium in

ISBN: 978-602-6697-36-3

shaping a generation of creative minds. The curriculum taught in educational institutions must be required with subjects that can improve the quality of students in order to become skilled at solving problems, innovative and creative in producing new things.

Among the challenges faced in developing Biology students 'creativity is still the lack of students' desire to show their creativity. Each student has their own innate creative disposition, but that character can be improved through classroom teaching. A teacher has the task of arousing students' creativity through creative teaching conditioning. Every science classroom must encourage and become a place for developing creativity [6]. Thus a Biology teacher must be creative in designing learning activities that can encourage students' creativity without putting aside their duties to help students learn Biological content. Therefore, important creativity is integrated into the science curriculum [7], through the 2013 curriculum the Indonesian government has clearly seen the importance of this.

Practical activities in science learning still show many weaknesses, a practicum is only intended to complete practical activities, not to understand the theories given [8]. This fact shows a little contradiction with the demands of the science curriculum. The science curriculum encourages and provides opportunities for teachers and students to plan to develop skills and understand the practice of open scientific inquiry [9,10] and authentic investigation [11]. However, such opportunities are still very rare in the classroom [12]. The project-based practicum model is an innovative way to correct the weaknesses of conventional practicums. It is expected that the development of innovative practicum models can improve research capabilities. Content mastery and creative development of knowledge allow students to apply what they have learned to solve problems in new situations and differ from the initial information they learned [13]. Capacity in using knowledge to find better solutions enables students to excel in class, in careers and become lifelong learners.

2. Method

2.1. Subject and implementation of research

The subject of this study consisted of 66 students of Class X MIPA in one of the Public High Schools in Mataram Lombok West Nusa Tenggara, Academic Year 2018/2019. Subjects were divided into 2 classes, each as an experimental and control class. The steps of the study were carried out as follows: Conducting a pretest of creative thinking skills and giving a creative disposition questionnaire to the experimental class and the control class; the experimental class and control students were divided into 7 small groups (4-5 people); The experimental class conducts practicum using a biology practicum model based on creative research projects while the conventional practicum control class. Practicum- based creative research projects begin with preparing a practical plan of the problems presented in the Student Worksheet; The practicum plan that has been prepared is presented in front of the class; Furthermore, the implementation of plans that have been made in the form of practical activities; the implementation stage can be carried out outside the lesson hours but with teacher supervision and guidance; The final step is the presentation of results and preparation of reports. Meanwhile, for the control class, the practicum was carried out during the lesson using practical instructions made by the teacher.

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2.2. The instrument for data research and processing

Students' measured scientific creativity includes the creative disposition of Biology, creative thinking skills, and creative products. Measuring the creative disposition of Biology, Biological creative thinking skills was carried out before and after practicum in the experimental class and the control class, then the n-gain was searched. Biological creative disposition measurement instruments using questionnaires containing student statements related to inquisitive indicators, persistent, imaginative, collaborative, and disciplined [14] are presented in the checklist. Questionnaire assessments use a Likert scale, answers are numbered 1 to 5. The questionnaire score is converted to a percentage value and grouped into five categories [15]. The instrument of Biology's creative thinking skills is in the form of essay tests on Mushroom Basic Competencies, developed by researchers covering four aspects: fluency, flexibility, originality, and elaboration [16], acquisition scores converted to quantitative values on a scale of 1-100 and the percentage achievement categorized according to Arikunto [15] Students' creative product assessments are assessed using real products produced by students in groups. The assessment of creative products includes indicators of novelty, resolution, elaboration, and synthesis [17] and the acquisition score is converted into 5 categories [15]. The statistical test using the t-test assisted by the SPSS version 22 program at a significance level of 5% was used to process quantitative data to see the effect of treatment on the formation of students' scientific creativity.

3. Result and Discussion

3.1. Creative Biological Disposition of students

Creative Disposition Biology of students is seen from the level of frequent or not indicators appearing from the answers to student questionnaires, then converted into very high, high, average, low, and very low categories [10]. The results of the study are simplified in the form of Figure 1.

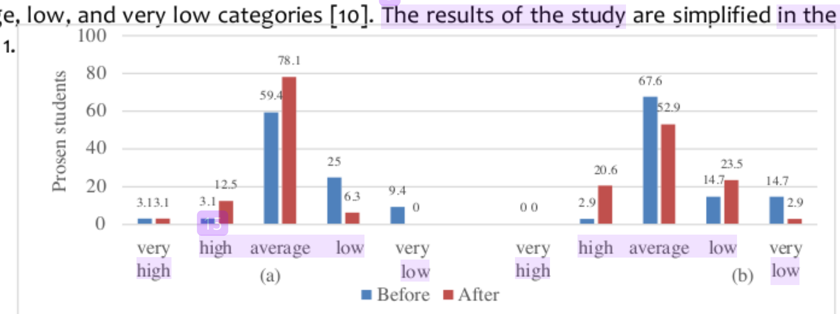

Figure 1. Average disposition of Biology creative thinking experimental class (a) and control class (b) before and after practicum.

The creative disposition average of the experimental class and control class students before and after learning is in the average category. In the experimental class, there were 3.1% of students classified as very high categories and 12.5% belonging to the high category after practicum learning based on creative research projects. In the other hand in the control class, the creative disposition level was 20.6% high category after conventional lab work. The conventional practice led to changes

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in students' creative dispositions in the experimental class towards increasing (higher categories) and decreasing (low categories). Practical activities based on creative research projects and conventional practicums can change (increase) students' creative disposition categories. Changes in creative thinking ability arise because of factors that can be manipulated directly in the class whereas other changes come from increased cognitive function capacity [18].

Practicum requires students to understand various things such as mastery of material, cooperation, foster resilient work, and others. Developing a practical project plan and its implementation also triggers student creativity. Creative disposition varies among people and in different fields of discipline.

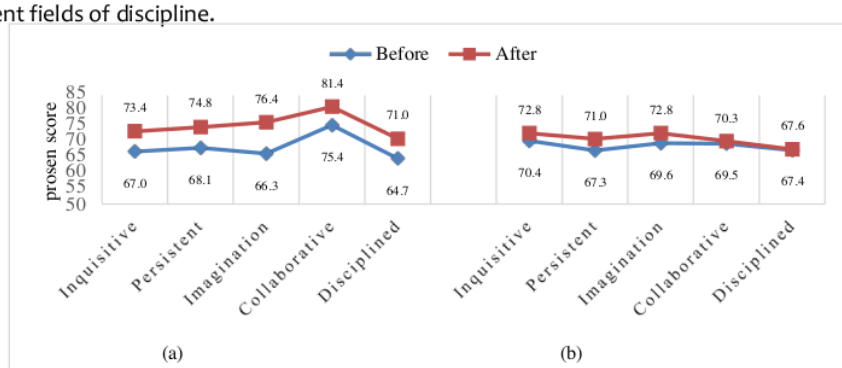

Figure 2. Percentage of achievement of indicators of the creative disposition of Biology students; (a) experimental class, and (b) control class before and after learning.

Based on creative disposition indicators, the results of this study indicate that each creative disposition indicator before learning is at the level of frequency appearing almost the same (Figure 2) on all indicators in the experimental class. Meanwhile, in the control class, there is only an increase in inquisitive indicators, persistent and imagination. A quite striking increase occurred in the indicators of imagination, collaboration and disciplined occurring in the experimental class. Initiating and compiling a project plan is the development of imagination skills. Each student will make a combination of the knowledge they have beforehand from the one that becomes real. Collaborative skills require students to work together to solve problems, complete tasks, or make products. Project-based learning is an effective way to produce a number of concepts [19]. Beres and Turcsanyi-Szabo [20] recommend the use of project-based learning, inquiry-based learning, multimedia for collaborative learning purposes. Each student shows responsibility for the task and its contribution to the group. Students report collaborative experiences resulting in benefits in learning that are not found if students work individually [21]. On the other hand, most conventional laboratory activities only require students to follow instructions without much demanding to find clear ideas for the purpose of their investigation, so that they do not cause much change in students' creative dispositions.

3.2. Students' creative thinking skills

Creative thinking is a way of thinking that is built by many different ideas from existing ideas. The measurement of Biological creative thinking skills in this study resulted in the average values of pretest and posttest and n-gain as shown in Figures 3 and 4.

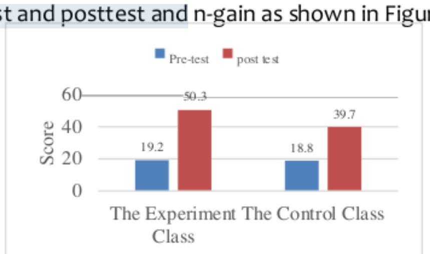

Figure 3. Comparison of the percentage of the initial test and the final test of Biology's creative thinking skills.

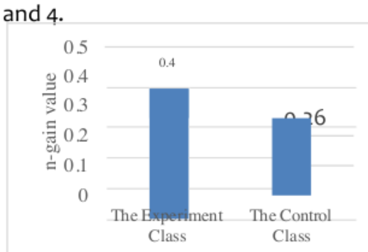

Figure 4. Comparison of n-gain normalized tests of Biological creative thinking skills.

Figure 3 shows an increase in the score of creative thinking skills in the experimental class and the control class. This increase in scores resulted in the average n-gain 0.41 in the medium category for the experimental class and the average n-gain 0.26 including the low category for the control class (Figure 4).

Table 1. Average gain-normalized values on indicators of creative thinking skills

The indicators of creative thinking	Class of experiment			Class of control		
	Average of pre test	Average of posttest	<g> (%)	Average of pre test	Average of post test	<g> (%)
Fluency	23.5	56.0	42.5	23.9	40.6	21.9
Flexibility	21.9	60.4	49.3	21.0	42.2	26.8
Elaboration	17.9	48.3	37.1	16.3	28.8	15.0
Originality	13.3	36.3	26.4	10.8	27.5	18.7

Table 1 shows an increase in all indicators of creative thinking as indicated by positive n-gain prices. The practicum model based on creative research projects produces the largest average posttest value of 60.4 for the fluency indicator which produces the largest n-gain of 49.3%. The smallest posttest value of 36.3 on the originality indicator produces n-gain 26.4%. This can be interpreted that the experimental class students experienced an increase in creative thinking skills in the medium category for indicators of fluency, flexibility and elaboration and an increase in the low category on the originality indicator. The finding of a low indicator of originality supports the

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results of previous research by Mednick [22] who found that original ideas tended to emerge later in a series of responses. In the control class changes or improvements also occur for each indicator, but very small are classified as low categories. Indicators of flexibility in creative thinking are shown by the many new thoughts of students from existing old thoughts. This creative idea is generated when students discard preconceived assumptions and try new methods that others don't think. Obtaining a higher value on the indicator flexibility in students' creative thinking skills, previously found the results of Chumo's research [23]; and Pink [24].

The results of the t-test for differences in the average score of improvement in the creative thinking skills of the experimental class and the control class resulted in the Sig. 0,000 <α value of 0.05. This means that creative research project-based practicum is better at improving creative thinking skills from the control class. This result is in line with the results of previous studies which stated that project-based learning is an effective way to improve achievement, logical and creative thinking skills, creativity and the number of concepts produced [19]. The practical investigative laboratory approach enhances the scientific creativity of the biology of middle school students [23]. Student involvement in scientific investigations causes students to understand the role of creative activities in constructing knowledge [25]. Biological investigation activities with open (open-ended) problems can foster student creativity [26]. Creative thinking can be improved by studying scientific knowledge and participating in scientific investigations [18]. Experimental studies from Bakir and Oztekin [27] show that active learning techniques such as project-based learning and problem-based learning have a positive influence on the ability to think creatively. There is a correlation between scientific ability and scientific creativity [4]. Creative thinking can be improved by learning scientific knowledge and participating in scientific investigations. Creativity can be nurtured and enhanced through the use of intentional tools and strategies designed. We hope this strategy serves as a practical tool for teachers who want to incorporate creativity into their science curriculum.

3.3. Creative Biology Products

The assessment of creative products as a product of practical activities based on students' creative research projects is only given to the experimental class. Practical activities in the control class are only justifying the theory so that the product is not produced. All products produced are related to fermented food products from Mushroom from Lombok's local food raw materials. The mean score of the assessment of creative products for each group is known to be 70.6 classified as a good category.

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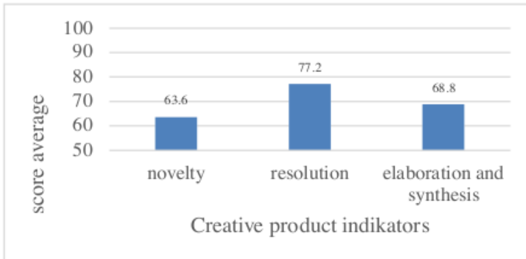

Figure 5. Average score class for each creative product indicators.

The result in Figure 5 shows the result of students' creative product after the implementation of practicum based on creative research projects for experiment classes. The result showed that it was categorized as sufficient, while resolution and collaboration & synthesis were categorized as well based on Arikunto of 63.61% for novelty, 77.24% for resolution and 68.8% for elaboration & synthesis. There are three criteria of novelty that are original, germinal, and surprising and those criteria are found in the students' product. Most Novelty dimension in creativity must be considered from the experience of the creator [28]. In the scientific context, novelty and relevance are related to an understanding of the natural world. The percentage of resolution of experiment class is 77.24% and it is seen that most of the students' products have fulfilled resolution dimensions and this dimension has three criteria which are logic, valuable and useful. Students' creative products can answer needs, provide solutions, and can be accepted according to the Biology disciplines students are studying. The
elaboration & synthesis dimension enabled students to improve their ability to combine various elements showed good skill and done carefully [28].

Practical learning based on creative research projects gives autonomy to students to construct their own knowledge, and reach its peak by producing tangible products. Scientific creativity produces new products, expands and changes understanding that is natural in nature. New products relate to the conception of scientific inquiry, a reflection of understanding, divergent thinking, and convergent thinking [29].

4. Conclusion

Biology scientific creativity can be built through practical learning based on creative research projects. Practical activities have an impact on increasing creative dispositions in a better direction even though students are still in the average category. A significant increase occurred in creative thinking skills, the class with a practical research-based practicum model had a higher average skill than the control class. The application of practicum models based on creative research projects can also produce fermented products in the good category. The creative products produced meet the elements of novels and are relevant in real problems of students. The recommendations of this study are the flexible time and place for students.

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5. Acknowledgments

This research was supported by the Indonesian Education University and the University of Mataram. Thank you to SMA Negeri 5 Mataram Indonesia, which has given permission for this research.

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