



STEM and Bioentrepreneurship Oriented Project Learning Model to Improve the Senior High School Students' Soft Skills, Entrepreneurial Interest and Learning Outcome

Abdul Latif✉, Sigit Saptono, Amin Retnoningsih

Pascasarjana, Universitas Negeri Semarang, Indonesia

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Abstract

Soft skills and entrepreneurial interest are kinds of skills that must be owned by the students to face Indonesian demographic peak bonus (2020-2035). The objective of this research was to analyze the students' soft skills improvement, entrepreneurial interest and learning outcomes by STEM and bioentrepreneurship oriented project learning model implementation. The method of this research used quasi experimental design with the form one group pretest and posttest design. The subjects of this research were tenth grade of SMA Negeri 1 Wedung with the total students was 64. The instruments used were questionnaire and test. The questionnaire was used to measure the students' soft skills and entrepreneurial interest meanwhile the test was used to measure the students' learning outcomes. The data analysis technique used criteria standard and N-gain. Criteria standard was to measure the soft skills and entrepreneurial interest meanwhile the N-gain was used to measure the improvement of learning outcomes. The result of the research found that average percentage score of students' soft skills of X MIPA 1 and X MIPA 2 in high category, it was 71,19% meanwhile percentage score of entrepreneurial interest in category of high enough, it was 60%. The average of index gain the students of experiment class was 0,6382 it meant experiment class had high improvement of learning outcomes. It could be concluded that the implementation of STEM and bioentrepreneurship oriented project learning model could improve soft skills, entrepreneurial interest and learning outcomes of tenth grade students of SMA Negeri 1 Wedung Demak Regency.

✉ correspondence :
Jalan Kelud Utara III No.37, Kota Semarang, Jawa Tengah,
Indonesia 50237
E-mail: abdullatif64@guru.sma.belajar.id

INTRODUCTION

Entering the peak of the demographic bonus faced by Indonesia in period 2020-2035, the Government need to prepare qualified human source earlier by education program, health, providing employment and investment in all fields. One of preparations done in education field is improvement of human source quality which has competitiveness (Wasisto, 2015). Competitive human source can change every challenge to be economic value opportunities. That skills can be done by entrepreneurial character building.

Based on the regulation of the Minister of education and culture number 20 about competency standard for senior high school graduates, implementation curriculum 2013 is hoped that it can create competitive graduates, having skills independently, creative, productive and ready to work, but the regulation of the ministry hasn't given maximum effect to open unemployment rate. It is showed by statistic centre (BPS, 2019) that open unemployment rate for senior high school for the last two years is high enough. (Table 1)

Table 1. Open unemployment rate on February 2018 and 2019

No.	Highest education	2018 (%)	2019 (%)
1	Senior high School	7.19	6.78
2	Vocational High School	8.92	8.63

Unemployment has closed relationship with the high criminal (Tang, 2009). The number of criminal from 2015-2017 gets fluctuation and it is high. It needs real step from the government to press number of the unemployment that can give effect to the increasing of criminal. One of the solutions to overcome the unemployment for senior high school graduates is creating skilled entrepreneurial senior high school graduates. There are many unemployment senior high school, it is because they don't have skills to fullfill the qualification needed, so entrepreneurial spirit for the young people must be grown.

Based on the Ministry of Education and Culture (2013) students' learning process is hoped able to increase and balance between hard skills and

soft skills. One of the seven soft skills main components that is needed by the students is entrepreneurial skill (Sharma, 2009). One of the approaches can be used to reach competency curriculum 2013 is learning that is integrated with Science, Technology, Engineering and Mathematic (STEM). STEM integrated project learning model can improve students' learning outcomes and ability to solve daily problem related with STEM (Sunyoung et al., 2006).

One of suitable learning models can be integrated to reach the purpose of STEM learning is Project Based Learning (PBL). The use of this model is suggested because the students can produce problem based work (The Ministry of Education and Culture, 2013). Mulyani (2014) shows that there is increasing attitude, interest and entrepreneurial behaviour in vocational high school after project based learning. STEM based Biology learning oriented to bioentrepreneurship can be one of alternative contextual Biological learning approaches, inovative and can improve the students' soft skills and entrepreneurial interest. It is hoped that after using STEM approach oriented to bioentrepreneurship, the graduates can expand entrepreneurship in Biology field, so it can be alternative solution that can solve unemployment problem.

METHODS

The type of this research was experimental. Experimental research methods was a research method that was used to find out the influence of certain treatments on other under controlled conditions (Sugiyono, 2013) This research used quasi experimental design with the form one group pretest and posttest design.

Group	Pretest	Treatment	Posttest
Eksperimen	O ₁	X	O ₂

Information :

- O₁ : The experimental group *pretest*
- O₂ : The experimental group *posttest*
- X : Treatment STEM approach oriented to *bioentrepreneurship*

Figure 1. Research design one group pretest and posttest design (Sugiyono, 2013)

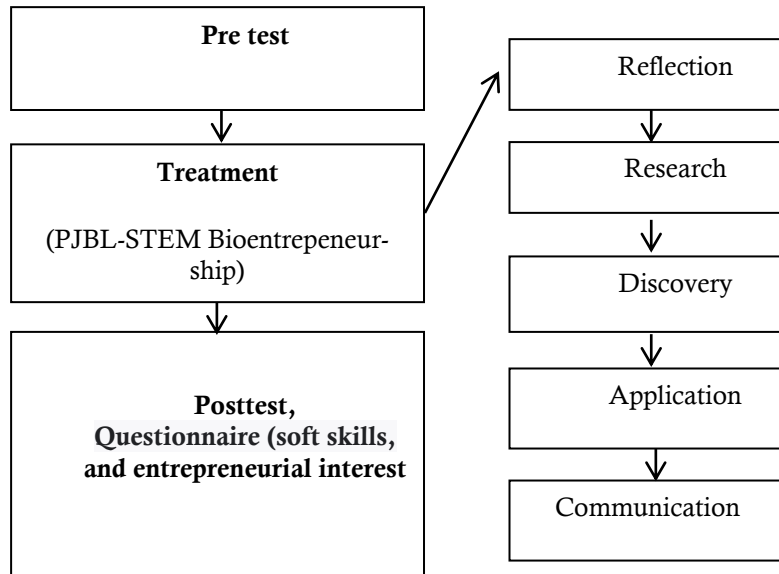


Figure 2. Research design

This research was conducted in SMA Negeri 1 Wedun, the subjects of the research are X.1 and X.2 (Experimental class) with the number students was 64. The instrument used are questionnaire and test. The questionnaire was used to measure the students’ soft skills and entrepreneurial interest meanwhile the test was used to measure the students’ learning outcomes. Data analysis technique used standard criteria and N gain. Criteria standard was to measure the soft skills and entrepreneurial interest meanwhile the N-gain was used to measure the improvement of learning outcomes.

RESULTS AND DISCUSSION

PBJL-STEM learning and bioentrepreneurship improve soft skills

The results of the research that had been carried out, the conclusion that could be drawn was the integrated STEM and Bioentrepreneurship project based learning model which was applied to tenth grade students of SMA Negeri 1 Wedung in the high category. The magnitude of the influence of PBJL-STEM on student Soft Skills was 51.67%. (See Table 2)

Table 2. Categories of Soft Skills.

No	Range Score	Category	Frequency	Percentage (%)
1	$X \geq 77$	Very high	9	15.00
2	$68,35 \geq X < 77$	High	31	51.67
3	$59,65 \geq X < 68,35$	Enough	19	31.67
4	$51 \geq X < 59,65$	Less	1	1.67
5	$X < 51$	Low	0	0.0
Total			60	100

Soft skills that were measured in this research were the ability to solve problems, the ability to work in teams and verbal communication skills. The increase in the soft skills studied was caused by the implementation of PBJL STEM Laboy-Rush learning with 5 phases, namely: (1) *reflection*, (2) *research*, (3) *discovery*, (4) *application*, and (5)

communication. In *reflection* phase, the students were directed into the context of the problem and provided inspiration to students so they could immediately started investigating. So that students get used to face problems and looked for solutions. In the *research* phase, students conducted research, dug information from various relevant sources to

develop conceptuals as well as student learning progress to concrete abstract understanding of the problem. As Desmayanti's research (2017) stated that students who were given problems related to conditions in the surrounding community were then directed to think and found solutions to these problems would cause students to be directly trained to think flowing continuously, so as to improve students' ability to solve problems.

In the aspect of the ability to work together in teams, it could increase. In the *Discovery* phase, this phase divided students into small groups to present problem solutions, collaborate, and build cooperation between friends in the group. As well as the aspect of verbal ability increased due to the final phase of the PJBL-STEM Laboy rush model, namely *Communication*, the final stage of project learning in making products or solutions by communicating between friends and the scope of the class. Presentation was an important step in the learning process for developing verbal communication and collaboration skills as well as the ability to receive and apply constructive feedback.

Project-based learning in studies and research conducted by Musa stated that, successfully completed project learning could develop

experiences in the field of soft skills which included collaboration, responsibility, and individual or personal skills (Musa et al., 2012). Lou et al. (2016) stated that project-based learning in Science, technology, engineering and mathematics (PJBL-STEM) was a teaching and learning model based on the connotation of STEM education and was integrated with the PJBL curriculum design. Tseng et al. (2013) revealed that STEM integrated project-based learning could increase student interest in learning, made learning more meaningful, helped students solved real life problems, and support future careers. In addition, STEM in project-based learning poses challenged and motivated students to practice critical thinking, analysis and improve higher order thinking skills (Capraro et al., 2013). Based on learning activities that involved students, it could improve students' soft skills.

PJBL-STEM learning increases students' entrepreneurial interest

The results of the research that had been carried out, the conclusion that could be drawn was the integrated STEM and Bioentrepreneurship project-based learning model which was applied to class X students at SMA Negeri 1 Wedung in the quite high category (see Table 3).

Table 3. Categories of Entrepreneurial Interest.

No	Range Score	Category	Frequency	Percentage
1	$X \geq 77$	Very high	2	3.33
2	$68,35 \geq X < 77$	High	6	10.00
3	$59,65 \geq X < 68,35$	Enough	27	45.00
4	$51 \geq X < 59,65$	Less	16	26.67
5	$X < 51$	Low	9	15.00
Total			60	100

Thus, PBJL-STEM learning and Bioentrepreneurship affect students' entrepreneurial interests. This was due to the implementation of learning using the STEM approach to the material concept of utilizing the concept of waste through five learning stages, namely: 1) reflection, 2) research, 3) discovery, 4) application, and 5) communication at each stage provides an opportunity for each participant students to participate actively. Learning

with the STEM approach provided opportunities for every student to develop their potential in the form of critical and creative thinking skills that were inseparable and train to work together. The role of the teacher in learning here was as a facilitator and mediator to direct and develop the potential thinking of students to generate ideas in a project design to a product that had economic value and was

competitive. Entrepreneurial interest was awakened in this learning.

In accordance with research conducted by Triastuti (2020), PBJL-STEM required creative thinking skills, therefore it would show student creativity and entrepreneurial spirit. Research on STEM integration in learning had been carried out before by Backer in Hafizan which stated that, the integration between science, mathematics, technology and techniques had a positive impact on students in increasing motivation and learning achievement, besides that the STEM learning experience could prepare students to face challenges. global 21st century (Shahali et al., 2017).

PJBL-STEM learning improves students' learning outcomes

Cognitive learning outcomes were generated from the pre-test and post-test scores. The validated pre-test and post-test questions were given to the PPA-STEM class students as an experimental class. The pre-test was carried out at the beginning of the first lesson, while the post-test was given at the end of the lesson.

The PJBL-STEM class had an average gain index value obtained by the experimental class students of 0.6382, it meant that the experimental class had a relatively high increase in learning outcomes. Thus, PBJL-STEM learning and bioentrepreneurship had an effect on student learning outcomes. There was an increase in learning outcomes which was reflected in the mastery of the concept because of the factors that influence, including internal factors of students in the form of high interest in the material being taught. Students were actively involved and innovative when designing projects, had good cooperation for problem solving, external factors in the form of an attractive environment to study and learning models, used of learning models that lead students to achieve expected goals.

Project Based Learning and STEM (Science, Technology, Engineering, and Mathematics) have advantages. In project based learning, students are able to understand the concept by making products, there was a design and redesign process (engineering design process) so that students produce their best products. The integration of STEM aspects had a positive impact on the teaching and learning process, especially in terms of improving student

learning outcomes in the fields of science and technology (Becker & Park, 2011), with this STEM-based PJBL affects the mastery of student concepts and student activities are strengthened by research results. Ferdiansyah (2015) stated that the integrated STEM PJBL learning model could significantly improve concept mastery of the subjects being taught. PJBL-STEM provided challenges and motivates students because it trained students to think critically, analyze and improve high-order thinking skills (Capraro et al., 2013).

CONCLUSION

Based on the results of the research and discussion, it could be concluded that the implementation of the STEM-oriented project learning model and bioentrepreneurship to improve soft skills with high criteria, was able to grow entrepreneurial interest in a fairly high category and a significant increase in student learning outcomes, this could be proven by 31 students (51.67%) stated that they had a high increase in soft skills, 27 students (45%) stated that they had increased interest in entrepreneurship and the average gain index obtained by the experimental class students was 0.6382, it meant that the experimental class had a relatively high increase in learning outcomes.

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