

## Effect of Bioentrepreneurship on Biology Learning Achievement, Creativity, and Entrepreneurial Interest

Putri Prihatiningrum<sup>✉</sup>, Sri Mulyani Endang Susilowati, Andreas Priyono Budi Prasetyo

Universitas Negeri Semarang, Indonesia

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### Abstract

Indonesia is the second-largest plastic waste producer in the world. This situation provides an entrepreneurship opportunity to process plastic wastes into useful and valuable goods. The integration of two different disciplines science, biology and entrepreneurship, is called bio-entrepreneurship (BEP). The aims of this study were 1) to describe BEP implementation in the learning topic of Environmental Changes at Senior High School (SHS) 3 Slawi, 2) to analyze the effect of BEP implementation on students' learning achievement, 3) to analyze the effect of BEP implementation on students' creativity, 4) to analyze the effect of BEP implementation on students' entrepreneurial interests. BEP was implemented on the Environmental Change topic at SHS 3 Slawi. The population in this study were all 10<sup>th</sup>-grade students and the sample was fifth tenth-grade science students. The study design used was Time Series Design with one group. Findings showed that there were increases in students learning achievement, creativity, and entrepreneurial interest. BEP had a positive effect on improving biology learning achievement, creativity, and entrepreneurial interest. BEP was also suitable for biology learning to increase learning achievement, creativity, and entrepreneurial interest.

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<sup>✉</sup> Alamat korespondensi:  
Kampus Unnes Kelud Utara III, Semarang, 50237  
E-mail: [putriprihatiningrum@gmail.com](mailto:putriprihatiningrum@gmail.com)

## INTRODUCTION

Indonesia has a target of economic independence in 2015-2085 (Kementerian PPN, 2017). To achieve this target, Indonesia needs qualified and strong young human resources (HR) in entrepreneurship. It can be seen from the Ministry of Communication and Information data (2017) which stated that the percentage of entrepreneurs in Indonesia is still low, at only 3.1%. This figure is below Singapore (7%), Malaysia (5%), Thailand (4.5%), Vietnam (3.3%), Japan (10%), China (10%), and America (12%).

Entrepreneurship can be learned in several ways. An easy way to learn it is by applying entrepreneurship to relevant subjects. The entrepreneurship approach has been developed in learning in schools in some countries. Latvia has developed entrepreneurship learning in Mathematics and Natural Sciences (Bikse & Riemere, 2013). Nigeria has also developed entrepreneurship learning in Biology (Ejilibe, 2012).

Biology is one of the subjects that can be associated with entrepreneurship. One of biology topics in senior high school is Environmental Change. This topic is learned by the tenth grade of senior high school. Students can associate this topic with their environment to conduct entrepreneurship activities.

An environmental problems that becomes the world's attention today is the announcement of Indonesia as the second-largest plastic wastes producer in the world (Jambeck *et al.*, 2015). Data from the Indonesian Plastic Industry Association and the Central Statistics Agency show that plastic wastes in Indonesia reach 64 million tons per year. As many as 3.2 million tons are plastic wastes that are dumped into the sea (Kaligis, 2019).

Plastic wastes are difficult to be decomposed by microorganisms. Plastic wastes in the sea can split into microplastics. Microplastics are easy to be consumed by sea animals. When humans consume these sea animals, microplastics will move to the human body. Therefore, wastes management is very

important to be taught to students. Wastes can be processed into useful products and can be sold. In addition to improve the community's economy, this activity also can reduce environmental pollution.

Learning that applies entrepreneurship to biological concepts is called bio-entrepreneurship (BEP). BEP can be used to equip individuals with entrepreneurial abilities (Ejilibe, 2012). Entrepreneurial skills are prepared to face the labor market challenges in the future. This is in line with the direction of Kemenristekdikti for the nation's next generation to change the mindset from job seeker to be job creator (Kemenristekdikti, 2015). Therefore, BEP is important to be applied since at school.

Biology learning in Senior High School (SHS) 3 Slawi had not used BEP approach. The linkage of biological concepts to daily life and how the material can be used to solve life's problems were still lacking in attention. Therefore, it is necessary to apply education principle that not only learns theory but also practices it to solve daily problems.

The problems that were examined in this study were how the effect of BEP on biology students' learning achievements, creativity, and entrepreneurial interest. The aims of this study were 1) to describe BEP implementation in environmental changes material learning in SHS 3 Slawi, 2) to analyze the effect of BEP implementation on students' learning achievement, 3) to analyze the effect of BEP implementation on students' creativity, 4) to analyze the effect of BEP implementation on students' entrepreneurial interests.

## METHODS

This study was conducted at SHS 3 Slawi. The population in this study were all of the 10<sup>th</sup>-grade students and the sample was the fifth tenth-grade science students of SHS 3 Slawi. The study design used was Time Series Design with one group. This study procedures consisted of three stages, namely: preparation, implementation, and final stage. Preparation stages consist of 1) initial observation, 2) discussion with teacher, 3) develop learning media, and 4) learning media validation and

item analysis. The implementation stage was the data collection stage. The final stage was data analysis and its discussion to obtain conclusions.

## RESULTS AND DISCUSSION

To identify the effect of *BEP* application, data that were presented were: 1) *BEP* description, 2) learning achievements, 3) creativity, and 4) entrepreneurial interest.

### BEP Description

*BEP* stages that were conducted in this study in accordance with Heinonen and Poikkijoki (2006). *BEP* learning consists of three principles, namely: 1) knowledge: students understand the concept; 2) experience: students experience an entrepreneurial process; and 3) action: students learn to read opportunities. These principles teach students to apply biological concepts to overcome environmental problems. The use of this biology concept makes learning more fun and meaningful.

In *BEP* learning, students were required to produce products. Products were made using wastes in the student's environment. Wastes that were chosen by students include plastic bottles, corn husks, plastic spoons, cardboard boxes, plastic coffee wrappers, plastic straws, and plastic jars. Products were made in groups. With this task, students felt encouraged to learn because they can apply their knowledge directly.

The task of making products can train students' entrepreneurial skills. It was supported by the study result of Sulistyowati (2014) that *BEP* provided opportunities for students to form and develop entrepreneurial attitudes and skills that were oriented towards the increase of productivity, hard work, and creativity. Entrepreneurial skills are students' supplies to become entrepreneurs, which can decrease the number of unemployed people in Indonesia. It was the reason of bio-entrepreneurship approach implementation in biology learning.

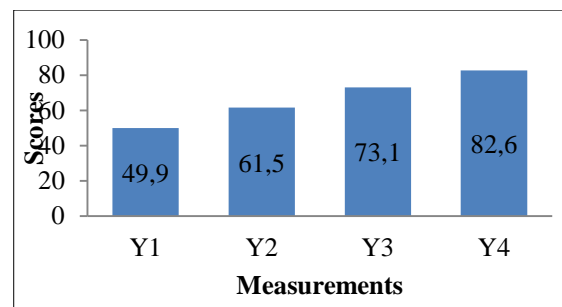
Based on students' responses data, the most favorite activities were making product and playing video. Environmental pollution video made students realized that plastic wastes were

damaging the environment, even disrupting the organ's health in living things, including humans. This video also made students aware that humans had an important role to protect nature by reducing or not adding plastic wastes. This students' awareness made them interested in recycling plastic waste.

The second video was a video about entrepreneurship. This video was about recycled products with high enough sale value. This video made students aware that wastes that had no sale value can be turned into a high-value item. In addition, a video about successful young entrepreneurs in Indonesia was also played. The purpose of playing video was to grow students' entrepreneurial interest. Students as a young generation are productive resources with creative ideas that can open a business (to be an entrepreneur). It will help the government reduce the unemployment rate in productive age.

### Learning Achievement

The test scores data were taken four times at regular intervals. The averages of students test scores for each measurement are shown in Figure 1.



**Figure 1.** The Averages of Students Test Scores

Figure 1 shows that there were increases of students' scores averages in each measurement. The results of normality and homogeneity of test score data can be seen in Table 1.

**Table 1.** The Result of Normality and Homogeneity for Test Score Data

Test	D f	S i g	Ta bel Va lue	Calc ulate Valu e	Result	Concl usion
Norm ality (Lillief ors Test)	1 0 0	5 %	$L_{ta}$ ble =	$L_{calcul}$ ated= 0,06 4	$L_{calculated}$ < $L_{table}$ , $H_0$ accepte d	Norm al Distrib ution
Homo geneit y (Bartle t Test)	9 6	5 %	$\chi^2_{ta}$ ble =	$\chi^2_{calcu}$ lated= 4,43 7	$\chi^2_{hcalculated}$ ed< $\chi^2_{tabl}$ e, $H_0$ accepte d	Homo geneo us
			7,8 15			

Table 1 shows that test score data were normally distributed and homogeneous. The results of N-Gain test for test score data are shown in Table 2.

**Table 2.** The Results of N-Gain Test for Test Score Data

	1 <sup>st</sup> and 2 <sup>nd</sup>		2 <sup>nd</sup> and 3 <sup>rd</sup>		3 <sup>rd</sup> and 4 <sup>th</sup>		1 <sup>st</sup> and 4 <sup>th</sup>	
Meas urem ent (Y)	Measur ements Y	Y	Measur ements Y	Y	Measur ements Y	Y	Measur ements Y	Y
	1	2	2	3	3	4	1	4
Avera ge N- Gain (g)	49 ,9 0,22	61 ,5	61 ,5 0,31	73 ,1	73 ,1 0,35	82 ,6	49 ,9 0,65	82 ,6
Categ ory	Low		Mediu m		Mediu m		Mediu m	

Table 2 shows that there were increases in test score averages of each measurement. These increases were a positive impact of the BEP approach. BEP is an approach in biology learning that is associated with real objects as a learning source. In addition to give biology science information, BEP also trains skills (hands-on) through product making activities. Based on the study results by Rifai *et al.* (2015),

hands-on activities can improve students' minds-on.

BEP directly involves students to do something (learning by doing) so it gives opportunities to be creative. Making product also make students feel that science is not just learned but also applied in daily life. Knowledge associated with daily life makes learning more meaningful. Meaningful learning can improve learning process quality at school (Sukaesih & Alimah, 2012).

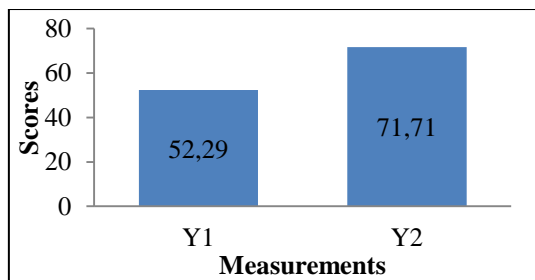
BEP is contextual learning. Contextual learning is a strategy based on active and cooperative student learning (Ridlo & Alimah, 2013). Contextual learning makes students gain real learning experiences. This learning experience will be felt again by the environment because students will return to their environment.

The task of making product aimed to make students aware that wastes can be useful through certain processing. This activity made students impressed in learning. This was consistent with the study result by Aini *et al.* (2018) that products making activity in learning can improve student learning achievements. Study results by Prabowo (2012) and Na'imah *et al.* (2015) also stated that product making activities can improve students' understanding and learning achievements both psychomotor, affective, and cognitive. In addition, the task of making product can improve cooperative skills, innovation ability to create new things, and utilize learning resources in students' environments.

BEP learning created a pleasant learning climate. It can be seen from students' responses which stated that they were happy with BEP learning. Students felt happy to learn biology concepts that were associated with environmental problems. A pleasant learning climate can optimize students' understanding (Mintasih, 2016). In addition, a pleasant learning climate also creates a positive impression of students then can increase student motivation and learning achievements.

### Creativity

Creativity assessment was based on some creativity main components (Suryana, 2016), namely: (1) thinking activities; (2) finding or creating; (3) new or original nature; and (4) useful or valuable products. Creativity assessment was taken twice, before and after treatment. Student creativity was assessed through student entrepreneurship proposals. The averages of creativity scores can be seen in Figure 2.



**Figure 2.** The Averages of Students Creativity Scores

Figure 2 shows the increase of students' creativity scores averages. The results of normality and homogeneity test of students' creativity data are shown in Table 3.

**Table 3.** The Result of Normality and Homogeneity Test for Creativity Score

Test	D	S	Ta	Calc	Result	Concl
	f	i	ble	ulate		usion
		g	Va	d		
			lue	Valu		
			e			
Norm	1	5	$L_{ta}$	$L_{calcul}$	$L_{calculate}$	Not
ality	0	%	$ble =$	$ated$	$d > L_{table},$	normal
(Lillief	0		0,1	0,19	$H_0$	distrib
ors			25	1	rejecte	ution
Test)					d	
Homo	9	5	$\chi^2_{ta}$	$\chi^2_{calcu}$	$\chi^2_{calculate}$	Homo
geneit	6	%	$ble =$	$lated =$	$d < \chi^2_{table}$	geneou
y			=	1,15	$H_0$	s
(Bartle			5,9	9	receive	
t Test)			91		d	

Table 3 shows that data were homogeneous and not normally distributed. The

results of N-Gain test for creativity data are shown in Table 4.

**Table 4.** The Results of N-Gain Test for Creativity Data

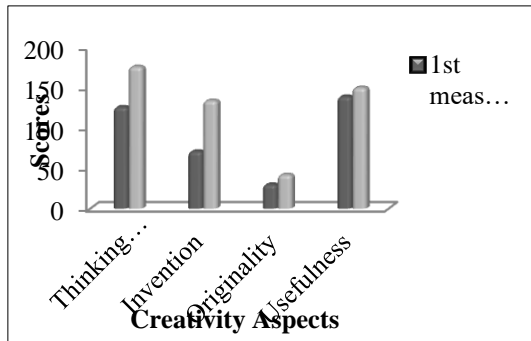
Measurement (Y)	1 <sup>st</sup> and 2 <sup>nd</sup> Measurements	
	Y1	Y2
Average	52,29	71,71
N-Gain (g)	0,41	
Category	Medium	

Table 4 shows an increase in students' creativity scores in the medium category. The average score of students' creativity before BEP learning was lower than after BEP learning. At the beginning of learning, students had not been able to write their creativity on their entrepreneurial proposals. Students had not had experience to make entrepreneurial proposals. After learning biology used BEP approach, there was an increase in creativity. All creativity components scores in the second measurement were higher than the first.

BEP contributed to increase students' creativity. In BEP, students learned contextually with the existence of products making task. Students' products were adapted to their environmental conditions. Study result by Asikin & Junaedi (2013) stated that contextual assignments can improve students' creativity and communication skills. In addition to students able to express ideas, BEP also teaches students to be able to solve environmental problems.

Products making tasks give students a freedom to determine solutions for a problem, build their own knowledge, and make real work. In addition, in this BEP, students were also challenged to solve problems about how to make recycled products from wastes in students' environments. Their product must be unique, innovative, environmentally friendly, and selling value. According to Ridlo & Irsadi (2012), the best way to bring effective learning is to provide experiences that empower students by giving them a challenge to think.

Creativity measurements were based on some creativity aspects. The total score of each aspect can be seen in Figure 3.



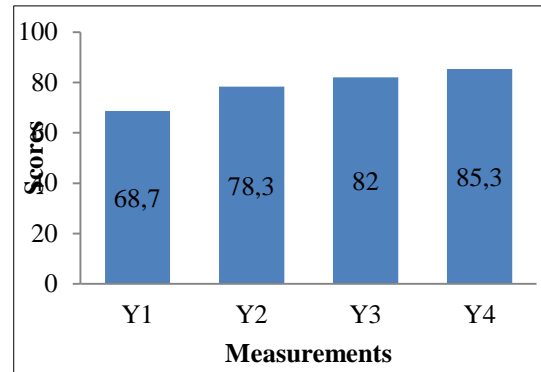
**Figure 3.** Score of Each Creativity Assessment Aspects

Figure 3 shows that in this study, the originality aspect had the lowest scores than the others. It can be due to the students' entrepreneurship insights that had not broad. According to the Ministry of Education and Culture (2017), the originality of ideas, thoughts, and decisions can be obtained by extensive insight and ability to see opportunities. While the entrepreneurship knowledge provided in this study was only basic knowledge in general. Therefore, the way to achieve maximum originality value is by implementing entrepreneurship learning continuously.

To maximize the originality scores, students can also be given freedom to determine the desired product according to their expertise. In addition, the experience to try new things can also increase student's originality. It is because originality arises from the ability to always express imagination, desire to be different or always take advantage of differences, have a positive mental attitude, and creative thinking (Kementerian Pendidikan dan Kebudayaan, 2017).

#### Entrepreneurial Interest

Entrepreneurial interest data was obtained using an entrepreneurial interest rating scale, which was measured four times periodically. The averages of entrepreneurial interest scores are shown in Figure 4



**Figure 4.** The Average of Students Entrepreneurial Interest Scores

Figure 4 shows that there were increases of students' entrepreneurial interest score averages. The results of normality and homogeneity tests for entrepreneurial interest data are shown in Table 5.

**Table 5.** The Results of Normality and Homogeneity Tests for Entrepreneurial Interest Data

Test	D f	S i g	Ta ble Va lue	Calc ulate d Valu e	Result	Concl usion
Norm ality (Lillief ors Test)	1 0 0	5 %	$L_{ta}$ ble= 0,0 89	$L_{calcul}$ ated 0,06 1	$L_{calculate}$ $d < L_{table}$ , $H_0$ receive d	Norma l Distrib ution
Homo geneit y (Bartle t Test)	9 6	5 %	$\chi^2_{ta}$ ble = 7,8 15	$\chi^2_{calcu}$ lated= 3,25 7	$\chi^2_{calculate}$ $d < \chi^2_{table}$ , $H_0$ receive d	Homo geneou s

Table 5 shows that entrepreneurial interest data were normally distributed and homogeneous. N-Gain test results for entrepreneurial interest are shown in Table 6.

**Table 6.** The Results of N-Gain Test for Entrepreneurial Interest Data

Measurement (Y)	1 <sup>st</sup> and 2 <sup>nd</sup>		2 <sup>nd</sup> and 3 <sup>rd</sup>		3 <sup>rd</sup> and 4 <sup>th</sup>		1 <sup>st</sup> and 4 <sup>th</sup>	
	Measurement		Measurement		Measurement		Measurement	
	Y	Y	Y	Y	Y	Y	Y	Y
	1	2	2	3	3	4	1	4
Average	68,7	78,3	78,3	82,0	82,0	85,3	68,7	85,2
N-Gain	0,29		0,18		0,16		0,51	
Category	Low		Low		Low		Medium	

Table 6 shows that there were increases in entrepreneurial interest scores averages in each measurement. This was in line with the study results by Idris *et al.* (2018) that through learning entrepreneurship, entrepreneurial interest increased and became stronger for students choosing entrepreneurship as their career. The increases of entrepreneurial interest were due to the learning that applied entrepreneurial practices directly. This was consistent with the study result by Amalia & Laily (2016) that learning that emphasized entrepreneurial practices made a big contribution to entrepreneurial interest.

The increase of entrepreneurial interest can also be caused by the existence of entrepreneurial video playing. Video of successful young Indonesian entrepreneurs aimed to change students' perceptions of entrepreneurship. It was in line with the study results by Fellnhöfer (2017) that the profile of successful entrepreneurs can increase entrepreneurial interest and a person's confidence in entrepreneurship.

This study obtained data that students with high entrepreneurial interests, most already had desire and plan to develop entrepreneurial activities that have been run by their parents. Some students also want to open a new different entrepreneurial activity. It was consistent with the study result by Kurniawan *et al.* (2016) that the family environment has a significant influence to student entrepreneurial interest.

In an entrepreneurial family environment, there is an entrepreneurship habituating process. Therefore, the habituation in entrepreneurship world happens by itself. It makes the child encouraged to continue the family business and inspired to open their own business. This result was also in line with the study result by Indriyani & Margunani (2018) that in addition to personality factors and entrepreneurship education, family environmental factors also can influence student entrepreneurial interest.

This study obtained data that the increases of each entrepreneurial interest indicator score were different. Scores of each entrepreneurial interest indicator can be seen in Table 7.

**Table 7.** Scores of each Entrepreneurial Interest Indicator

No	Entrepreneurial Interest Indicator	Measurement Scores (Y)				Y <sub>4</sub> -Y <sub>1</sub>
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	
1	Self Confidence	63	73	78	83	20
2	Can take risks	69	77	83	86	17
3	Creative and innovative	65	76	80	81	16
4	Discipline and hard work	70	80	82	84	14
5	Future oriented	75	83	86	90	15
6	Curiosity	65	76	79	83	18
7	Honest and independent	80	91	92	95	15

Table 7 shows that the highest increase of entrepreneurial interest indicator score was found in the self-confidence indicator. It indicates that self-confidence has an important role in entrepreneurship. It was supported by study result of Garaika & Margahana (2019) that self-confidence had a positive influence on entrepreneurial interest. Study result by Ermawati & Widodo (2015) also stated that students' self-confidence can foster entrepreneurial interest. The increase of entrepreneurial knowledge can affect students' confidence in entrepreneurship. It is because entrepreneurship knowledge is the basic capital for entrepreneurial success and resilience. It is

also consistent with the study result by Yulianingsih *et al.* (2013) that there was a positive and significant relationship between entrepreneurial knowledge and entrepreneurial interest.

Table 7 also shows that the highest increase of all entrepreneurial interest indicators was in the first increase. It was because, in the first measurement, the teacher had not provided Environmental Changes knowledge and entrepreneurial motivation. Whereas in the second measurement, students had gained knowledge about environmental changes and entrepreneurship. This knowledge made students aware of the dangers of environmental pollution, entrepreneurship benefits, and the importance of entrepreneurship to the environment and the country's economy. Students become motivated to overcome environmental problems with their knowledge. Their awareness made the score increase of first entrepreneurial interest was the highest than in subsequent measurements.

In addition to the advantages, this study also found several deficiencies of BEP. Learning biology using BEP approach can't be maximized in just nine hours. BEP learning needs a long time and integrated into the student's subject. It is in accordance with the entrepreneurship education principles for senior high school students, namely: (1) entrepreneurial values development requires a long and continuous process from the beginning of the student's entry until they finish from an education unit, (2) entrepreneurship values are integrated into every subject through materials, methods and assessments, (3) in learning implementation in classroom, teacher uses the subject material that is available to develop entrepreneurship values, and (4) use active and fun learning methods (Mulyani, 2010).

Group tasks also have several limitations, including (1) individual ability is less observable, (2) need a long time to complete the task, and (3) individuals in groups cannot express their abilities fully. Therefore, in addition to group tasks, tasks can also be given individually to

know each student's abilities and to teach responsibilities.

This study implies that biology learning should always be linked to students' environment so they are able to solve problems in their environment using their knowledge. This study obtained data that biology learning that links knowledge to the environment improved students learning achievements and creativity. One approach in biology learning that links knowledge to the environment is bio-entrepreneurship (BEP). BEP integrates entrepreneurship into biology material. This study result also showed that BEP increased student entrepreneurial interest. To maximize students learning achievements, creativity, and entrepreneurial interest, entrepreneurial learning that is integrated into each subject is need to be applied continuously.

## CONCLUSION

BEP learning in this study had fulfilled three BEP principles, namely: knowledge, experience, and action. BEP learning in this study had characteristics: students oriented, integrated with practices and real-world issues, and there were activities to produce products as solutions of environmental problems. BEP learning had a positive effect to improve learning achievements, creativity, and entrepreneurial interest. This study results indicated that BEP was suitable for biology learning, especially to improve learning achievements, creativity, and entrepreneurial interest.

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