

The Development of Integrated Biology-Entrepreneurship Learning Design Based STEAM

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Abstract

Biology learning design development is an important matter for teachers to be prepared. It is for the sake of realizing the 21st education for the learners. Learning biology also involves the technology role and its implications to obtain innovative and beneficial products for broader people. This research aims to examine the validity and effectiveness of the development of integrated biology-entrepreneurship based on STEAM learning design on a material about the environmental changes to improve critical thinking skills and the entrepreneurial interest of the learners. The applied development procedures were *ADDIE* model. The developed learning design consisted of syllabus, lesson plan, learning source, worksheet, critical thinking test, and entrepreneurial interest. The findings showed that (1) the validity of the learning was deemed valid and practical by the expert judgment; (2) the effectiveness of the learning design was proven able to improve the learners' critical thinking skills with a percentage of 84%, with a sufficient *N-Gain* category and high category of entrepreneurial interest average improvement with a score of 77. The *paired sample t-Test* shows that $t_{count} > t_{table}$. Thus, it could be concluded that there was a significant difference between the critical thinking skills and the entrepreneurial interest. Based on the findings, it could be concluded that the biology learning with a material about the environmental changes integrated by entrepreneurship based on STEAM had highly met the validity criteria. It could improve the critical thinking skill and the entrepreneurial interest of the learners.

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INTRODUCTION

The changes of 2013 curriculum, as seen in its core and basic competences, deal with the primary requirement for the learners to develop their skills in this digital era especially critical thinking and competitive skills for real working word as the demand of the 21th century-biology learning. The learners' skills in thinking and acting are not separated from the interaction of the individual and his environment as the source of learning (Aulia et al., 2018). Besides that, the ideal biology learning emphasizes on phenomenological review in biology context completely and meaningfully. It involves the roles of technology and their implicatures to produce innovative and beneficial products for broader people (Ardhiansyah et al., 2017).

The reality on the field about biology learning shows emphasis on the requirement for the learners to meet the cognitive target based on the Core Competence. It is also found the implementation of the existing learning source is not optimal. It leads to less optimal the critical thinking skills and creativity of the learners to solve problems about biology and to produce various products representing the entrepreneurial interest. Based on the latest data, Indonesia is in the 70th rank out of 78 participating countries in the fields of literacy, mathematics, and science (OECD, 2018).

The development of biology learning design with the integration of science-based entrepreneurship, technology, art, technique, and mathematics (STEAM) on the material about environmental changes is expected to provide the solution of biology learning challenges in 21th century. The development of project learning design is a learning model that requires active participation of the learners. It leads to *problem solving* and to develop the thinking skills and learning achievement of the learners (Annisa, 2018). The project based learning model could also be integrated through *STEM-Entrepreneur* approach. It could train the scientific literacy and entrepreneurial interest of the learners (Ardhiansya et al., 2019). It is in line with Aristantia (2017) that the implementation of *STEAM* could improve conceptual cognition and to find out the characteristics profiles of JHS learners. The implementation of *STEAM* in Indonesia's

curriculum could train the skills and talents of the learners to face challenges of 21st century (Danang, 2015). The *STEAM* conceptual application, by creating entrepreneurship-oriented product, makes specific characteristics by implementing *STEAM* based the worksheet. It was done by Septiani (2017) and Sulistiyowati et al. (2018). They focused on *STEM* integrated aspects in the learning materials without the existence of the applied products in daily lives.

METHOD

The applied developmental method in this research was ADDIE from McGriff (2000) modified by Aldoobie (2015). The method consisted analyzing the necessity, the teachers' designing performance, and the learners, learning instrument, developing or realizing the product design in the form of product to be tested, validated by the experts, practiced, and tested in a limited scope for the learners at XII-7 Science and Mathematics class of 11 Public JHS Semarang, implementing the learning design to be massively tested for the learners at 2 classes of X Science and Mathematics program taken by purposive sampling, and evaluating the assessment promotion by using the multiple choice test instrument to measure the critical thinking skills and the non-test in the form of questionnaire to measure the entrepreneurial interest. The data analysis in this research used *N-Gain* test and continued by *paired sample t-test*. The learning design development test is seen in Figure 1.

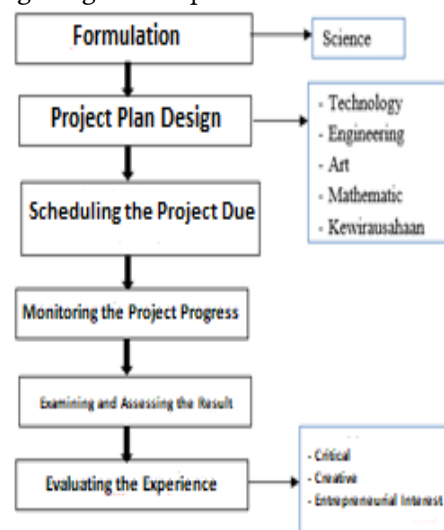


Figure 1. The Development of Integrated Biology-Entrepreneurship Learning Design based on STEAM

FINDINGS AND DISCUSSION

Learning Design Validity

The developed learning design consisted of syllabus, lesson plan, learning source, worksheet,

critical thinking test, and entrepreneurial interest. There were three main components in this validation. They were reliability, diction, and display. The validity was done by expert lecturers and practitioners as shown in Figure 1.

Table 1. The Validity of the Development of Integrated Biology-Entrepreneurship Learning Design based on STEAM by Experts and Practitioners.

Number	The Learning Design Development Components	Expert Validator	Practitioner Validator	Average	Criteria
1	Syllabus	96.0	96.0	96.0	Very valid
2	Lesson Plan	97.3	96.0	96.7	Extremely Valid
3	Learning Materials	95.6	96.7	96.1	Extremely Valid
4	Worksheet	97.8	95.6	96.7	Extremely Valid
5	Critical Thinking Skills	94.5	92.7	93.6	Extremely Valid
6	The entrepreneurial interest scale	98.0	98.0	98.0	Extremely Valid
7	The creativity measurmeent tools	98.0	98.0	98.0	Extremely Valid
	Average			96.4	Extremely Valid

In Table 1, it shows the internal validity result of the developed design. It was valid so it was reliable to be used as the guidance to implement biology learning with a material about environmental changes integrated by STEAM based entrepreneurship.

The external validity found in the critical thinking skill test was seen from the validity of each question item, the difference power, and the reliability. The data analysis applied product moment correlation of 40 question items that met the criteria of validity, power of the difference, and reliability.

The learning design development that obtained excellent validation was influenced by several factors. They were: (1) the applied indicators of the instrument validity that met the requirements of the developed learning design, (2) the appropriate content materials to the problem formulation principles, (3) the use of brief, simple, understandable, and practical language for the learners and the teachers, (4) the information content in the form of data display to be processed by the learners, (5) the opportunity to make learners able to process the content information about environmental changes. It is supported by Dewi (2016) and Wijayanti (2017). To obtain an excellent validity, then the developed products should meet the criteria off the validator judgments and to consider the complexity of the learners' reasoning skills and the teachers' competence skills who promoted the learning products.

The learning design was adjusted to the learner's environments. The quality of local potentials provided positive value for the learning instrument validity. It is also supported by Apriliana (2018) she found that a learning design could encourage learners to actively explore in overcoming daily life problems. The developed biology learning design is very important to realize the 21st century skills for the learners (Listianingrum et al., 2018 & Setiyadi, 2018).

The effectiveness of the learning design to improve the Critical Thinking Skills and the Entrepreneurial Interest.

The learning design effectiveness could be seen from the *Normalized Gain* of the critical thinking skill data and the entrepreneurial Interest between the pre- and post- intervention conditions of the biology learning with a material of integrated environment-entrepreneurship based on STEAM. It is shown in Table 2 and Table 3.

Table 2. Results Critical Thinking Skills

	Pretest	Post-test
Average	71	84
<i>N-gain</i>	0.44	
Categories	Sufficient	

Table 3. The Results of Entrepreneurial Interest

	Pre	Post
Average	64	77
<i>N-gain</i>	0.36	
Categories	Sufficient	

The, a paired sample t-test was conducted as seen in Table 4 and Table 5.

Table 4. Paired Sample T-test of the Critical Thinking Skill

Condition	Average	SD	t_{count}	dk	t_{table}
Pre-test	71	8.37	12.105	71	1.67
Post-test	84	8.37			

Table 5. Paired T-test of the Entrepreneurial Interest

Condition	Average	SD	t_{count}	dk	Sign
Pre	64	3.057	11.707	71	0.000
Post	77	4.649			

The analysis showed the developed learning design was effective to improve the critical thinking skills and entrepreneurial interest of the learners.

The improvement of the learners' critical thinking skills could be seen in Table 6.

Table 6. The Skill Improvement of Each Critical Thinking Aspect

Number	Aspects	Pre-test	Post-test	Gain	Categories
1	Elementary clarification	83	84	0.07	Low
2	The basis for the decision	90	91	0.17	Low
3	Inference	64	82	0.49	Sufficient
4	Advance clarification	79	88	0.41	Sufficient
5	Supposition and integration	65	83	0.50	Sufficient
	Total	71	84	0.44	Sufficient

The analysis of each indicator was used to find out the improvement of the critical thinking skill. It dealt with:

(1) The elementary clarification.

Its indicators were focusing on the questions, analyzing the arguments, answering the challenging questions. The learning design consisted of problems concerning with the environment and its impacts to daily lives. Then, they were given through worksheets that required the learners to solve the problems critically. This is supported by Apriliana (2018) that *STEAM* approach encourages learners to obtain more knowledge by actively explore the real world challenges and daily life problems.

(2) Giving opportunity to decide.

This indicator deals with the credible consideration of a source and consider the observation results. Dealing with worksheet, the learners were directed to understand a problem concerning with an environmental change so they could consider the observation results they obtained for the sake of problem-solving solution. The critical thinking skill covers accessing, analyzing, synthesizing, informing skills that could be taught, trained, and mastered (Hidayati, 2017).

(3) Concluding or Inferencing

It deals with making a deduction, induction, and conclusion. The provision of a structured environmental changing case and an understandable instruction for the learners in the

worksheet made them trained to make a conclusion from an on-going phenomenon. The *N-gain* analysis result of the normalized aspect concluded several categories had been sufficient. It showed that the developed learning design could improve the skills to make conclusion or inference. The statement is in line with Kowiyah (2013). She argues that critical thinking skill is a cognitive skill to obtain science and understanding to make a deductive, inductive, or evaluative decision comprehensively.

(4) Advance Clarification

This indicator identifies the term and refers on the unstated assumption. The learning design was created to direct and train learners to think critically on the material about the environmental changes. The accessing, analyzing, synthesizing, and informing skills were important to teach as the critical thinking skills to be mastered (Hidayati, 2017).

(5) Supposition and Integration.

This indicator is about consideration and reasoning of an assumption and an integration in making an action or decision. The project learning model that direct learners to produce a product could provide positive influence in making an action or decision. It is in line with the project-based learning concept. According to Sastrika et al. (2013), active learners who created innovative works to solve problems and take decision could improve their critical thinking skills.

The value of entrepreneurial interest should consider several typical criteria. By considering the external and internal factors, the entrepreneurial interest could be realized in the learning process and the recycling process of the learners' surrounding environments. The entrepreneurial interest of the learners could be seen in Table 7.

Table 7. The average of the entrepreneurial interest.

Aspects	Pre (%)		Post (%)	
	in score	Criteria	in score	Criteria
Interested	65	High	83	Very High
Motivation	61	Low	78	High
Enjoy	75	High	78	High
Expectation	59	Low	72	High
Total	64	High	77	High

The analysis of each aspect was used to find out the entrepreneurial interest improvements. They were:

(1). Interested

The collaborated-project learning design with biology and entrepreneurship courses had not been promoted previously. Thus, it made the learners interested. This interest in creating products could improve the learners' entrepreneurial interest. It is as proven by Sudarmin et al (2016); Sumarti et al., (2018); Sunarya et al., (2018) that chemoenterpreneurship-based learning by integrating entrepreneurship and chemistry courses in creating a competitive product with its local potential could improve the learners' care and interest to have entrepreneurship.

(2). Motivation

The interest of the learners in the project to create craft made them motivated. Thus, it led to entrepreneurial interest realization. The learning design trained the learners individually and independently to create the products with primary materials from their surrounding wastes. It is supported by Slameto (2010), Daryanto (2012), and Munawer et al. (2018). They stated that affection and attitudes concerning with entrepreneurship in the learning activity motivated them to do entrepreneurship.

(3). Enjoy

The products of the learners were offered online through Instagram. The uploaded products were *captioned* with an interesting description. Thus, it would attract and would be a promotion so that the products could be sold. The numbers of the *likes*

by the followers toward the offered products in Instagrams would be the assessment of the product. It would deem whether the products successfully attracted the buyers or not. This entrepreneurial interest in the learning activity, According to Anafiyah et al. (2015) and Suryana et al. (2018) did not only emphasize on the applicative skills of the entrepreneurial interest but also communication skills to broader people about the entrepreneurial activity scope done by the learners.

(4) Intention.

The developed learning design encourage learners to understand more about the entrepreneurship such as analyzing the strength, the weakness, the opportunity, and the threat (SWOT) in creating the products with Semarang signature and using waste as the primary materials. According to Sudarmin et al. (2016) & Sumartini et al (2018), the skills for analyzing the strength, the weakness, the opportunity, and the threat in creating a learning product are correlated to the intention to be entrepreneur in the future.

CONCLUSION

The development of the integrated biology-entrepreneurship learning design based on STEAM with a material about the environmental change had met the validity and effectiveness criteria to improve the critical thinking skills and the entrepreneurial interest of the learners.

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