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THE INFLUENCE OF SCIENCE, ENVIRONMENT, TECHNOLOGY, AND SOCIETY IN CREATIVE INDUSTRIES ON SCIENTIFIC BASED BUSINESS DESIGNING SKILLS OF PRE-SERVICE SCIENCE TEACHERS

Parmin*, Erna Noor Savitri

Program Studi Pendidikan IPA FMIPA, Universitas Negeri Semarang, Semarang, Indonesia

*Corresponding Author: parmin@mail.unnes.ac.id

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Abstrak. Permasalahan pada penelitian ini adalah kurangnya ketrampilan kewirausahaan pada calon guru IPA. Penelitian ini dimaksudkan untuk mengukur pengaruh dari pendekatan pembelajaran SETS berdasarkan sudut pandang industri kreatif terhadap keterampilan kewirausahaan calon guru IPA. Sampel dalam penelitian ini adalah 82 mahasiswa Jurusan IPA Terpadu sebagai target penelitian yang mengikuti kursus Kewirausahaan. Kemampuan berwirausaha dibutuhkan para calon guru IPA agar nantinya setelah lulus, selain menjadi pendidik juga dapat mengembangkan usaha sendiri, baik itu berupa produk maupun jasa yang berbasis sains. Data primer diambil dengan teknik observasi dan diuji dengan menggunakan uji regresi yang menghasilkan skor yang signifikan yaitu 0,048 <0,05. Hal ini berarti bahwa penerapan pendekatan SETS dalam pembelajaran memiliki pengaruh signifikan pada keterampilan kewirausahaan calon guru IPA. Pendekatan ini dapat menjadi salah satu solusi alternative untuk menghasilkan lulusan yang terampil secara ilmiah. Calon guru IPA yang memiliki pandangan kewirausahaan terintegrasi telah terbukti mampu merancang penerapan sains untuk menghasilkan barang-barang yang mengantisipasi efek negative pada lingkungan.
Kata Kunci: SETS, industry kreatif, kewirusahaan, guru pra-jabatan

Abstract. The problem of this study was the lack ofpre-service science teachers' entrepreneurial skills This study intended to measure the impacts of SETS learning approach based on creative industry point of view towards pre-service science teachers' entrepreneurial skills. There were 82 students as the research target who joined an Entrepreneurship course. The primary data were examined using a regression test which resulted in a significance score of 0,048 < 0,05. This means that applying the SETS approach in learning had a remarkable influence on the pre-service science teachers' entrepreneurial skills. The approach was expected to be one of the alternative solutions to produce scientifically-skilled graduates. Pre-service science teachers who own an integrated entrepreneurial sight have been proven to be able to design the science application to produce goods by anticipating negative environmental effects.
Keywords: SETS, creative industry, enterpreunerial, pre-service teachers

INTRODUCTION

Modest technology dominates creative industries as it is employed to produce certain limited products. Moreover, creative industries are managed using limited knowledge and technology, yet the workers have the ability to operate it (Wu & Anderson, 2015; Seager & Hinrichs, 2017). The most-run creative industry in Indonesia

is food processing. However, the use of technology in food production is limited to operating existing tools and creative industry developers do not engineer the used technology. With this in mind, this study pointed the creative industry as a learning object for the students who learned entrepreneurship to inspire that creative industry managers to remain to be able to run businesses within the limited knowledge and technology.

According to Aziz & Rowland (2018) revealed that entrepreneurial skills should be trained programmatically through an in-depth analysis of the application of knowledge and needs. Moreover, Brown & Kant (2009) stated that the failure of entrepreneurship education is due to a gap between the provided knowledge and the lack of real experience. An entrepreneurship course should orient to project-based and direct experience which requires the active participation of students. Ribeiro, et al. (2018) reinforced by Kaijun & Ichwatus (2015) explained that behavioral differences in creating business opportunities between Indonesians and Chinese made up a big discrepancy of entrepreneurship development between the two countries. Hence, students are expected to develop their entrepreneurial sense by analyzing communities' entrepreneurial activities.

A study on pre-service science teachers' entrepreneurial interest was performed to obtain the types of entrepreneurship run during their college period showed that 14,6% of 298 students had their own business. The form of business undertaken by the students was food and beverages, clothing, credit, tutoring, plant cultivation, online shops, production of organic fertilizers, data processing, and computer rentals. Among those types are linked with science such as food and beverages, tutoring, plant cultivation, and production of organic fertilizer yet most of the business fields are no tin line with the scientific field.

The above results were useful for a reference of entrepreneurship course given to students. Gandhi & Raina (2018) and Ibrahim, et al. (2017) elucidated that entrepreneurial sense emerges in accordance with a person's attitude and talent. Entrepreneurship is not limited to a certain discipline yet knowledge of the related sciences is an important part. Take an example of pre-service science teachers. They surely have adequate knowledge of natural sciences; therefore, they should run a business related to their educational background. Businesses run during a learning process are possibly developed further based on the entrepreneurs' knowledge (Yin & Liang, 2018; Apostolopoulos, et al., 2018; Kakouris & Georgiadis, 2016). However, lots of business are discontinued after the entrepreneurs' graduation, and the latest research revealed that one of the main reasons underlying this fact is the lack of young Indonesian entrepreneurs' knowledge (Hadi & Atun, 2015; Hasmidyani, 2017). Hence, this urges universities to facilitate students in applying scientific knowledge to their business, for instance, through the use of appropriate learning approach.

One of the approaches that suits the expected entrepreneurship course is Science, Environment, Technology, and Society (SETS)SETS is an approach that integrates the four constituents completely, provides solutions as well as impacts of science and technology development (de Bettencourt, 2000; Pedretti, 2003; Zoller, 2011; Zoller, 2013; Maknun, et al., 2018). The implementation of SETS has proven to give a new perspective about the application of science in the form of technology, people's needs, and people's responsibilities for environmental preservation either physical or social (Esmiyati, 2013; Hasanah & Mahdian, 2016; Komariah, et al., 2015). Natural sciences, as a scientific center of study, are implemented through technology which orients to problem-solving. Its main indicator includes producing goods, knowledge about the

performed activities, and product benefits for the society. In other words, SETS could conceptually be utilized as an approach to entrepreneurship learning.

Entrepreneurship is one of the courses offered to the pre-service science teachers of Universitas Negeri Semarang. The students are hoped to optimize their entrepreneurial interest and potentials. They are asked to analyze the type of entrepreneurship developed in the surrounded society from the scientific point of view; for example, the use of modest technology or so-called as 'creative industry' (Rukmi, et al., 2012; Kamil, 2015). Creative industry has been an important part of business development as it is established autonomously by people. Moreover, creativity and innovation coming from the society is an assurance of the demand appropriateness and long-life business. However, non-professional people is the major creative industry developments which utilized indigenous knowledge instead of scientific knowledge (Luciana & Aldi, 2018; Gunawan, et al., 2017).

With this in mind, it's clearly essential to analyze the pre-service science teachers' entrepreneurial skills in terms of its impacts on science learning implementation. The researchers therefore frankly stated the purpose of this research was to measure the influence of SETS learning approach on the pre-service science teachers' entrepreneurial skills. Creative industries were the object of this study and limited to the modest industry in which the SETS aspects could be easily observed.

METHOD

The research targets were 82 pre-service science teachers of Universitas Negeri Semarang who joined the entrepreneurship course. A descriptive method by Sugiyono (2016) was employed and the primary data were analyzed using a regression test. There were two variables; entrepreneurship course with SETS approach as the independent variable and entrepreneurial skills as the dependent variable.

There were five research stages: 1) determining creative industries as the students' information sources; 2) identifying the SETS aspects in the creative industry activities; 3) designing an entrepreneurship learning by integrating the SETS aspects employed in the creative industries; 4) implementing the entrepreneurship learning by including the analysis results of the observation; and 5) the students design scientific-based business. Five indicators in designing business were the type of business, the employed scientific knowledge, product design, innovation, and market analysis. The business design was assessed as a consideration in determining the level of entrepreneurship

The design of entrepreneurship learning integrated with SETS approach had the following stages as presented in Table 1.

Table 1. The stages of entrepreneurship course

SETS Aspects	Creative Industry	Learning Activities
Science	Scientific knowledge found in the production process	Examining scientific knowledge applied in the industrial activities
Environment	Environmental impacts of the industrial activities	Analyzing the follow-up done by the industry managers on the waste produced

Technology	Technology applied	Revealing the used modest technology
Society	Benefits for the surrounded community	Analyzing the benefits obtained by the people from the industrial products

The research data included a list of creative industry names, description of the SETS elements found in industrial activities, students' understanding of entrepreneurship in accordance with the SETS, scientific-based entrepreneurship design, and attitudes as the students' interest. The data were analyzed using a correlation model to see the relationship between the two variables to examine the impact of the SETS-based entrepreneurship course on pre-service science teachers' business designing skills. A regression technique referring to Algifari (2015) was employed in this study to test the research hypothesis stating that there was an influence of SETS-based entrepreneurship course on designing scientific-based business.

RESULTS AND DISCUSSION

The SETS aspects found in creative industries are presented in the following Table 2.

Table 2. The SETS aspects found in creative industries

Creative Industries	SETS Aspects			
	Science	**Environment**	**Technology**	**Society**
Peanut Bakpau	Food fermentation	Peanut skin waste as a briquette ingredient	Production of peanut bakpau	Fulfilling food needs from easily available ingredients
Mineral Water	Mixed separation	Watering plant using filtering waste	Water filtration and purification	Meeting the needs of clean drinking water
Oyster Mushroom Milk Pie	Nutrition and food	Oyster mushroom waste as a medium for worm cultivation.	Production of oyster mushroom milk pie	Fulfilling food needs of higher economic value
Traditional Herb	Herb cultivation	The remaining herb processing as a woof mixture	Production of traditional herb	Safe health supplement

The community's creative industries picked in this study were only those relating to the application of science concepts. There were four creative industries that the students observed and analyzed from the SETS aspects. All the SETS elements were found in those four creative industries. As seen from the aspect of the environment, the creative industry managers have proven to treat the waste well by re-using it to make briquettes, water plants, cultivate worms, and woof. Therefore, the information obtained during the observation was appropriately referred to as a learning source. Nevertheless, the SETS approach was newly applied in the entrepreneurship course so that assessment of the students' understanding about the SETS concept was required.The students' understanding levels about the SETS concepts are presented in the below Figure 1.

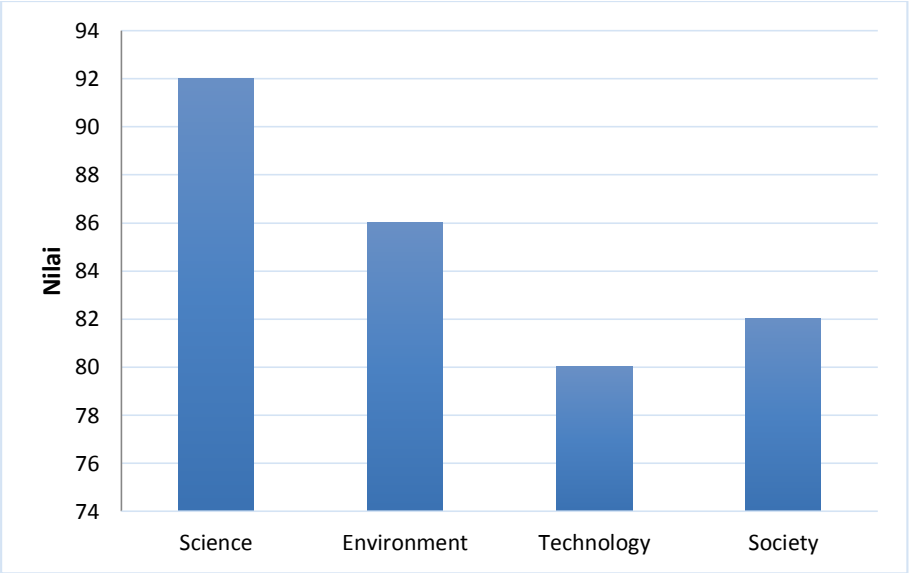

Figure 1. The students' understanding levels about the sets concepts

Based on Figure 1, the students have had a high level of understanding about the elements of SETS applied in entrepreneurship. A good understanding of the four elements was an important basis in designing scientific-oriented business. The success of entrepreneurial learning was determined by the skills of students in compiling a scientific-oriented business. The scores of the business design that have been compiled are shown in Figure 2.

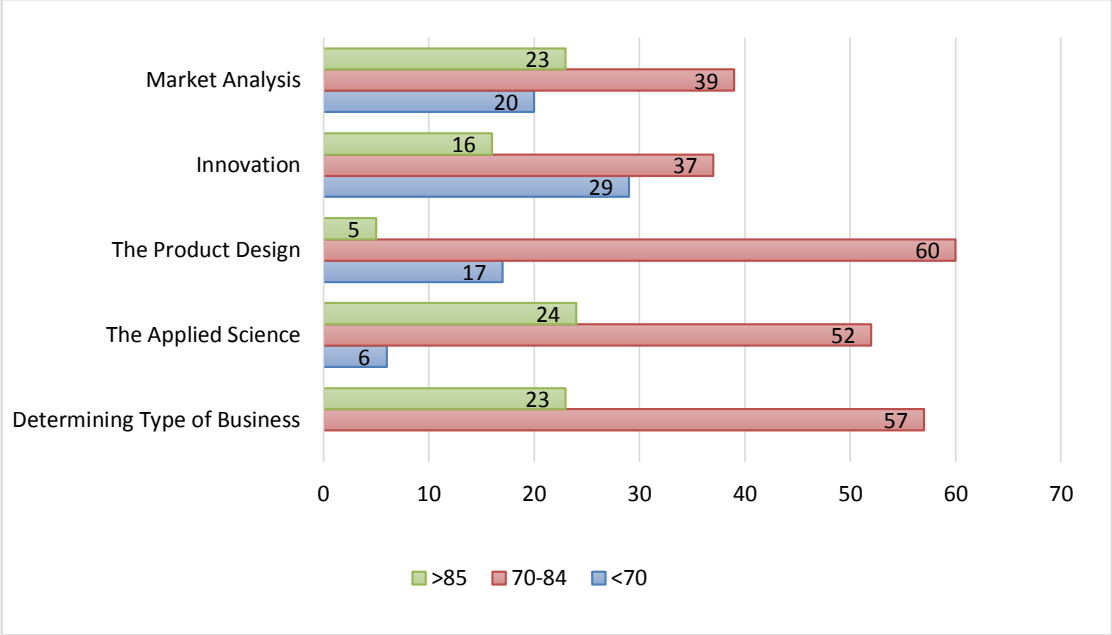

Figure 2. The pre-service science teachers' business designing skills

According to Figure 2, the business design has been oriented to the field of science as 78 students have recognized the applied science. This finding was important as the achievement of learning as well as being a movement to develop scientific-based business and not solely because of talent and entrepreneurship opportunities. Setting up a new scientific-oriented business may shift the society's stigma that many businesses are not in line with natural sciences, or, teachers should only teach instead of starting up business. Further, the influence of entrepreneurship course on the entrepreneurial skills was analyzed quantitatively using a regression test.

The regression test resulted in a significance score of 0,048 < 0,05. This indicated that the independent variable impacted significantly to the dependent variable. In other words, the SETS-based entrepreneurship course influences significantly on the pre-service science teachers' entrepreneurial skills. This significant influence has made the hypothesis assuming that there was an effect of the SETS-based entrepreneurship course on business designing skills was accepted.

Entrepreneurship education is a discipline that needs to be taught because it learns values, abilities, and behavior in facing life's challenges (Nursito &Nugroho, 2013). Entrepreneurial readiness is absolutely necessary for someone who will start a business. Readiness is synonymous with ability (competency). Measurement of competence always involves 3 aspects, namely affective (attitude), cognitive (knowledge), and psychomotor (skills). So competence can be used as an indicator of one's ability and or readiness to start a business (Sulistyowati, et al., 2016).

After implementing the SETS-based entrepreneurship course, each pre-service science teacher responded through questionnaires, and the questionnaire results are shown in Table 3.

Table 3. The responses of pre-service science teachers after joining the sets-based entrepreneurship course

No	Questions	Number of Repondents (%)		
		Very Agree	**Agree**	**Disagree**
1	Entrepreneurship course is important for future science teachers.	82 (100)	-	-
2	Businesses should be based on scientific knowledge.	64 (78)	13 (16)	5 (6)
3	The SETS approach is relevantly applied in an entrepreneurship course.	71 (87)	11 (13)	-
4	I have comprehended the SETS elements and their implementation in creative industries	74 (90)	8 (10)	-
5	Studying creative industry activities strengthens entrepreneurial interest according to scientific fields.	63 (77)	11 (13)	8 (10)

The pre-service science teachers strongly agreed with the importance of entrepreneurial learning. This answer describes their interest and encouragement to study seriously. 78% of the students strongly agreed that business should be based on science. Awareness of the importance of mastering science in entrepreneurship strengthens the form of scientific application in society. The average value for the understanding of SETS was 85, and 90% of the students have understood SETS in the application in the industrial world.

Science concepts found in the creative industries were food fermentation, compound isolation, nutrition and food, and herb cultivation. These findings have illuminated several types of science concepts applied in the creative industry. However, the entrepreneurs are local residents who lack scientific knowledge yet they are able to produce goods as a result of years of practice, which was contradictory with the goal of entrepreneurship course that is to generate skilled future entrepreneurs having proper scientific knowledge. This finding is in line with Parsons & Carlone (2013), Probosari, et al. (2018), and Isozaki (2018) who stated that the ability to apply science concepts might be earned from not only formal learning but also field experience. Moreover, some of the indigenous knowledge has been passed through the generations. However, Nguyen (2018) explained that short-lasting business might be due to the entrepreneurs' lack of scientific knowledge. Therefore, the existence of the entrepreneurship course has given new hope to bear young entrepreneurs having strong scientific knowledge.

Entrepreneurship for students, needs to be managed so that it can be a means of implementing science and technology that is studied in college with the real world. Students need to understand how science and technology that have been learned can provide practical benefits for the community. The creation of new products and the

improvement of market products with the touch of science and technology will provide different selling points and value for those products (Mardiyaningsih, et al., 2015).

There has been proven that the SETS aspects existed in the activities of the creative industry. The science concepts applied were simple yet applicable. Strengthening the applied science in entrepreneurship course has proven to be very relevant with entrepreneurship practice in the society. There is no need to study inappropriate science concepts yet it should even emphasize the fulfillment of life needs in the industrial era. Applicable sciences tailored to the needs would provide a high level of trust in the learning process (ALTAN & Ercan, 2016); Rosenbaum, et al., 2007; Hinrichs, et al., 2017; Azhari, et al., 2018). The findings of this study revealed that the entrepreneurs of creative industry do not have the knowledge about waste processing yet have treated the waster as other products beneficial to the environment. Without having sufficient knowledge about waste treatment, they have taken an important role in preserving the environment around the industrial sites. Only if they acquire sufficient knowledge about the technology of waste processing, it has the potential to be wider utilized.

The prior study emphasized less favorable entrepreneurship course on the number of students running a business, only 14,6% among all. In this study, the students were given the experience to learn from home industries by analyzing the application of SETS in the business activities carried out. 78% of the students stated that entrepreneurial skills need to be supported by a sufficient scientific background. Science awareness as a basis for entrepreneurship reveals the old belief that entrepreneurship is not sufficiently based on one's interests and talents only. Referring to the results of this study, learning about science application is needed by means of being involved and taking part directly from the activities being studied. It has been found that SETS was integrated with entrepreneurial activities so that it is appropriate as an approach to entrepreneurship learning. The SETS applied in entrepreneurship learning provided orientation to prepare the design of entrepreneurial product development.

The scientific-based business designs were made by the students as the outcome of the entrepreneurship course. These scientific-based designs were included as a new entrepreneurship learning compared to other previous similar research which resulted in a business design based on market needs. Courage in facilitating students to design scientific-based business was expected to provide new strategies in preparing graduates who are able to apply science in society. However, the weakness in this study was that there was no measurement made for the business design made by students to the real implementation. This means that the data regarding the suitability of the design with the follow-up were not measured so that the realization of the design might not be the same.

The students' business design was arranged to start from determining the form of business. The business fields chosen by prospective science teachers included food, herbal medicines, teaching aids, learning videos, and fertilizers. All the selected business fields are related to science. Furthermore, the students have been able to determine the science concepts used in the design. Awareness of the use of scientific concepts has provided a new solution to competitive entrepreneurial strategies as well as scientific insights. Product designs developed by the students were completed with an explanation of the SETS elements used in the production process. Innovation in the design was one of the assessment aspects. Yang & Andersson (2018) stated that business innovations are determined after analyzing the differences in products with other existing products. The assessment of business design revealed that the prospective science teachers already had skills in designing scientific-based business.

SETS has become an integrated part of the creative industry activities, seen from the findings of this study. Science as knowledge has been applied by the community through simple technology. The community, as the entrepreneurs, might be the information source for entrepreneurship course. The results of this study contributed to preparing the education of prospective science teachers who have a spirit of independence through entrepreneurship. As other expert said that entrepreneurial skills are results from long training as it requires initial abilities such as innovation (Hoogendoorn, et al., 2019; Neessen, et al., 2019). Entrepreneurship competency is realized in this research through learning and training the students in designing business forms that suit their scientific background.

CONCLUSIONS

The SETS elements were found in activities of creative industries so that it has a strong empirical foundation when applied as an approach to entrepreneurship course. The SETS approach is a solution to efforts to generate college graduates having scientific-based entrepreneurial skills. The SETS-based entrepreneurship course has proven to help the students acquire knowledge in designing business. They were found to know how to apply scientific knowledge to produce goods by anticipating negative environmental impacts.

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