Improving the Entrepreneurship Competence of Pre-Service Elementary Teachers on Professional Education Program through the Skills of Disruptive Innovators

Yıkıcı Yenilikçilik Becerileri Aracılığıyla Mesleki Eğitim Programlarında İlköğretim Öğretmenlerinin Girişimcilik Yetkinliğini Artırma

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Abstract. The main objective of this research was to describe the effectiveness of Science learning based on the Skills of Disruptive Innovators (SDI) to improve the entrepreneurship skills of Pre-Service Elementary Teachers (PETs) on Professional Education Program (PEP). Entrepreneurship competence is essential for PETs because it includes the skills that must be possessed in the 21st century, preparing them on PEP in the ASEAN Economic Community (AEC) to become job creators. The design of this research was an experiment involving one-group pretest-posttest design. The data were analysed using N-Gain score. This research involved 40 PETs on PEP at Universitas Sebelas Maret. The results of the research showed that (1) the entrepreneurship competence of PETS on PEP can be improved through the SDI implementation in Science learning; (2) the component of entrepreneurship competence with the highest N-Gain was making observations and inferences by 0.74; the N-Gains of association through analysing and designing an experiment were in moderate criterion (0.52 and 0.43); the N-Gains of networking with oral presentations and questioning were in the lowest criterion (0.29 and 0.27).

Keywords: Science learning, 21st century skills, disruptive Innovators

Öz. Bu araştırmanın amacı, hizmet öncesi öğretmenlerinin fen öğreniminin etkinliğini Yıkıcı Yenilikçiler Becerilerine (SDI) dayalı Mesleki Eğitim Programı yoluyla girişimcilik becerilerini geliştirerek belirlemektir. Girişimcilik yeterliliği PET'ler için önemlidir, çünkü 21. yüzyılda sahip olması gereken becerileri içerir ve bunları iş yaratıcıları olmak için Asya Ekonomi Topluluğu'nda mesleki eğitime hazırlar. Bu araştırmanın tasarımı, tek gruplu ön test-son test tasarımını içeren bir deneydir. Veriler N-Kazanım skoru kullanılarak analiz edilmiştir. Bu araştırma Universitas Sebelas Maret'teki mesleki eğitim alan 40 hizmetöncesi öğretmeni içermektedir. Araştırmanın sonuçları (1) adaylar mesleki eğitim girişimcilik yeterliliğinin, Fen öğrenimindeki yıkıcı yenilik becerileri uygulaması ile geliştirilebileceğini; (2) N-Kazanım ile girişimcilik yeterliliğinin en yüksek bileşeni, 0.74 ile gözlemler ve çıkarımlar yapmaktır. Bir deneyi analiz ederek ve tasarlayarak N-kazanımı birleşme ölçütleri orta ölçüttedir (0.52 ve 0.43); Sözel sunumlarla ağ oluşturma ve sorgulama konusundaki N-Kazanımlar en düşük kriter (0.29 ve 0.27) olarak belirlenmiştir.

Anahtar sözcükler: Fen öğrenimi, 21. yüzyıl becerileri, yıkıcı yenilikçiler

INTRODUCTION

Competence is a set of knowledge, skills, and behaviours that teachers need to possess, live, and master in performing their professional duties (Memduhoğlu, 2017; Skills & Education, 2018; Don, 2018; Can, 2015; Arkan & Bağcı, 2011; Ünsal, 2013). The meaning of teachers' competencies is the wholeness of knowledge, skills, and attitudes in the form of knowledgeable and competent actions in carrying out the tasks as the agents of learning (Skills & Education, 2018; Uerz, Volman, & Kral, 2018; Zlatić, Bjekić, Marinković, & Bojović, 2014).

Based on the Government Regulation No. 19 2017, professional teachers have four competencies; they are pedagogic, personality, social, and professional competencies. In addition, every teacher who is assigned as the head of an education unit is required to perform managerial tasks, entrepreneurship skills, and supervisions to teachers and educational personnels. Based on this regulation, entrepreneurship competence is needed and needs to be empowered to the pre-service teachers, especially elementary school teachers with the aim of more optimal entrepreneurship competence development in elementary schools (Aslan, 2010; Sutiadiningsih, Sonhadji, Sutadji, & Nurlaela, 2016; Paiva & Tadeu, 2015).

Entrepreneurship can be developed through the learning process in accordance with Law No. 20 2003 on Indonesia's National Education System which states that one of the goals of education is to form independent human beings. Universities is an educational institution through which the learning process is expected to achieve the goal of education. The policy of the Ministry of Research, Technology and Higher Education on the curriculum in the digital age, 21st century skills, and industrial revolution 4.0 has been directed at the obligation of entrepreneurship in universities.

Entrepreneurs are actors while entrepreneurship is a process, and enterprise is the impact of activities (Ismail, Zain, & Zulihar, 2015; Jati & Priyambodo, 2015). There is a difference between inventors and entrepreneurs. An inventor creates a new thing while an entrepreneur assembles and integrates the resources to add the value of the inventor (Saputra, 2015); Bakar, Islam, & Lee, 2015). Entrepreneurship has two skills; a) creating new and different things which have the elements of creativity and innovation, and b) organizing, taking risks, yield-orientation, opportunities, personal satisfaction, and freedom with risk-taking. The natures of entrepreneurship are creativity, innovation, and risk-taking (Fernández-Salinero & de la Riva, 2014; Saputra, 2015).

Improving entrepreneurship competence is done by integrating the skills of entrepreneurs in the course. One of the courses that can be integrated with entrepreneurship aspect is Science (Scipreneur) (Kyndt & Baert, 2015; Education & Technologies, 2013). The integration of entrepreneurship competence in the Science course is based on the similarity between scientific attitudes in Science and the aspects of entrepreneurship such as problem-solving, creativity, critical-thinking, innovation, persistence, risk-taking, and open-mindedness (Heilbrunn & Hefer, 2008; Polat, 2018; Ismail et al., 2015). The implementation of Science learning integrated with entrepreneurship requires a learning model that has the characteristics that can facilitate entrepreneurship and scientific attitudes (Rehmat & Bailey, 2014; Kartashova, Shirko, Khomenko, & Naumova, 2015; Olofson, Swallow, & Neumann, 2016). Skills of Disruptive Innovators (SDI) based learning through the empowerment of associating, observing, questioning, experimenting, and networking skills can facilitate to improve the entrepreneurship competence of elementary school teachers (Dyer, Gregerse, & Christensen, 2011; Thompson & Miller, 2017; Esturgó-Deu & Sala-Roca, 2010).

The first skill of SDI is associating. In this activity, the skills empowered are critical-thinking, creativity, and open-mindedness of Pre-Service Elementary Teachers (PETs) by searching for research articles and studies related the problem given by their lecturer (Sumen & Calisici, 2016; Svensberg, Brandlistuen, Björnsdottir, & Sporrong, 2018). The problem given is in

the form of producing new products that will be made by PETs in accordance with the learning material of food technology. Articles and information collected by the students are used as reference materials to create new food products. The second activity is observing. The activity at this stage is observing the product plan to be made (Kalthoff, 2016; Castro-Alonso, Ayres, & Paas, 2014). The observation is made through internet and visiting traditional and modern markets to find out whether the product to be made is available or not in the market, so students can determine the modification or development that can be done on their product plans. The second stage is empowering the skills of persistence, problem-solving, and critical and creative thinking. The third stage is questioning. Students ask each other and provide suggestions among groups to make better products (Merisier, Larue, & Boyer, 2018; Yeşil & Korkmaz, 2010; Merisier et al., 2018). The third stage empowers critical thinking and open-mindedness. The fourth stage is experimenting. In this activity, each group makes a product about food technology previously designed to which feedbacks and suggestions are given by other groups (Timostsuk, 2015; Mynbayeva, Vishnevskaya, & Sadvakassova, 2016). In the fourth stage, the students' creativity, risk-taking, and innovation are improved. The last stage is communicating. At this stage, students do marketing activities of the products they made by communicating how to create, the materials, and the excellence of the products (Svensberg et al., 2018; Grenci, 2010; Zlatić et al., 2014). In this fifth stage, the students' persistence, risk-taking, and innovation are enhanced. The five SDIs are expected to enhance the entrepreneurship competence: (a) creativity, (b) innovation, (c) critical-thinking (d) open-mindedness (e) persistence, (f) problem-solving (g) risk-taking. Table 1 shows the relationship between entrepreneurship competence and SDI components.

Table 1. *The Roles of SDI components*

SDI	Entrepreneurship
1. Associating	(a)(c)(d)
2. Questioning	(e)(f)
3. Observing	(c)(d)
4. Experimenting	(a)(b)(g)
5. Networking	(b)(e)(g)

METHOD

The method utilized in this research was a quantitative research. The research design was one group pretest-posttest. In this research, PETs on PEP were given a pre-test in the form of performance assessment using an observation sheet in accordance with the aspects of entrepreneurship competence on food technology material. Having implemented the learning using SDI, and the final performance assessment test was conducted. The research design is shown in Figure 1 as follows:
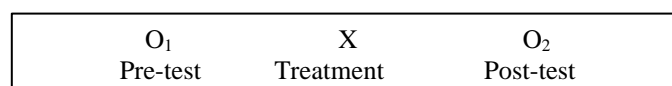
O_1	X	O_2
Pre-test	Treatment	Post-test

FIGURE 1. *One-group pretest-posttest research design*

The data obtained in this study were quantitative data of pre-test and post-test results in the form of students' performance assessment scores. The population of this research was all PETs who followed the PEP of elementary school teacher education program at Universitas Sebelas Maret, consisting of four classes. The data collection process was carried out after the researcher first asked permission from the PEP supervisor. The average number of students in each class was 30. The sample used was PEP participants of the second semester which

amounted to 40 people. The data processing in this research began with calculating the scores of pre-test and post-test. Subsequently, the effect of implementing SDI on PETs following PEP was determined by using normalized gain analysis. The improvement before and after SDI implementation was calculated by computing the normalized gain equation <g> as follows.

$$\langle g \rangle = \frac{\text{Post-test score} - \text{Pre-test score}}{\text{Ideal score} - \text{Pre-test score}}$$

Normalized gain criteria proposed by Hake (Hake, 1999) can be seen in Table 2.

Table 2. *Normalized-gain criteria*

<g>	Criteria
≥ 0.7	High
0.3 < (<g>) < 0.7	Moderate
(<g>) < 0.3	Low

The data from the performance assessment were collected, encoded, and tabulated to make the analysis. In Table 3, we can see the detailed description of the performance assessment to measure entrepreneurship competence with the assessment rubric shown in Table 4. The number performance-assessment items was 50 with point assessment and earned assessment (self or lecture).

Table 3. *The Description of performance assessment instrument*

Skills of Disruptive Innovators Integrated with Entrepreneurship Competence					
Association through data analysis	Asking **questions**	Making **observations** and inferences	Designing an **experiment**	**Networking** with oral presentations	**Total Items**
3	10	9	17	11	**50**

Table 4. *Performance-assessment rubric and its scales*

Decision Rubric						
Unusually Excellent	Evenly Excellent	Mostly Excellent	Neutral	Evenly Poor	Mostly Poor	Very Poor or not done
7	6	5	4	3	2	1

RESULTS and DISCUSSION

Science learning integrated with entrepreneurship using SDI is able to empower the five components of competence; they are (a) Association through data analysis (b) Asking questions, (c) Making observations and inferences (d) Designing an Experiment (e) Networking with oral presentations (Hibbard, 1995). The results of the normalized gain analysis of each component are presented in Table 5.

Table 5. *The normalized gain recapitulation in each component of entrepreneurship competence*

	Components	Average scores		<g>	Criteria
		Pre-test	Post-test		
1	Association through data analysis	3.8	4.7	0.52	Moderate
2	Asking questions	3.8	4.4	**0.27**	Low
2	Making observations and inferences	3.3	5.3	**0.74**	High
4	Designing an Experiment	3.7	4.7	0.43	Moderate
5	Networking with oral presentations	3.2	4	0.29	Low

The improvement of entrepreneurship competence varied on each component. The component that had a high N-Gain (<g>) criterion was making observation and inferences (0.74). The components of association through data analysis (0.52) and designing an experiment were in moderate criterion (0.43). Of the five components of entrepreneurship competence, the components that had the lowest N-Gains (<g>) were asking questions (0.27) and networking with oral presentations (0.29). Based on the random interviews with five PETs and the observations made during the learning process, PETs can do a good observation because observation activities can be done by utilizing the human senses such as sight, smell, touch, taste, and hearing so N-Gain becomes higher (Hibbard, 1995; Kalthoff, 2016; Taut & Rakoczy, 2016). The components of asking questions and networking with oral presentations were included in the low criterion because PETs had difficulty in generating questions. There are several causes of PETs having difficulty in making questions, one which is the questions made are not in accordance with the learning materials so that if they do not understand the learning materials then there is difficulty in making questions (Zolfaghari, Fathi, & Hashemi, 2011; Magas, Gruppen, Barrett, Dedhia, & Sandhu, 2017). The competence of networking with oral presentation was also in the low criterion because networking conducted through the activities of communicating the experimental results orally has not been mastered well by PETs (de Kruijf & Stobbelaar, 2015; Carvalho & Goodyear, 2018). Communicating the experimental results through oral presentations requires courage (confidence), material mastery, implementation, and the experimental results. If PETs have not mastered the capabilities that support networking with oral presentations, it causes N-Gain to be low. The average N-Gain of each component of the entrepreneurship competence is presented in Figure 2.
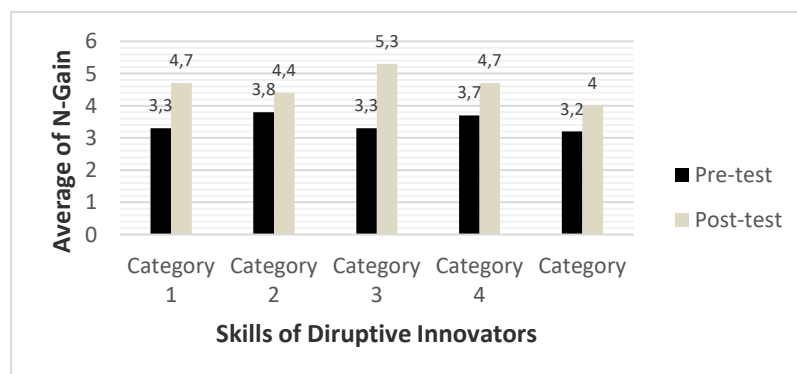

FIGURE 2. *The development of each creativity indicator*
(Category 1. Association through data analysis, 2. Asking questions, 3. Making observations and inferences, 4. Designing an Experiment, 5. Networking with oral presentation)

Based on Figure 2, it can be seen that the lowest pretest score was in the category of networking with oral presentations. This was because PETs dominantly used PowerPoint slides

in making presentations on PEP. Besides, the technique in making the presentation did not consider the material content, volume, articulation, and body-language. The questioning category had the highest pre-test score because PETs have started to show insight on PEP by compiling good and coherent questions and entered into the high-order thinking questions. (Carvalho & Goodyear, 2018; de Kruijf & Stobbelaar, 2015; Peters, Pressey, & Johnston, 2016; Magas et al., 2017)

The category that had the highest post-test score after being given treatment using discovery skills learning was making observations and inferences with N-Gain of 0.74 which falls into the high criterion. In this category, it has begun to show the detailed observation sheets accompanied by clear pictures to complete the data in accordance with the content of the material being studied. The category of networking with oral presentation had a low post-test score even though it has been given treatment using discovery skills learning with N-Gain of 0.29 included in the low criterion. There were several elements in the category of networking with oral presentations that were still low, including the ability to create media for PETs' presentations (picture, diagrams, photographs, videos, and flow-charts) on PEP using only one teaching-aid only. The use of multimedia (merging two or more media) in the presentation can help transfer the information better. In addition, the other element that was still low in the third category was body-language such as eye contact, posture, and body movements. Many PETs who made presentations were in sitting position and did not make eye-contact with the participants so that they were less enthusiastic in receiving the information. Based on the results of research, the appropriate use of body-language such as eye contact and body movements plus positive humour doing the presentations can increase the enthusiasm of the participants in listening the presentations so that information can be delivered to the participants well (Hibbard, 1995;Kalthoff, 2016).

Despite the given treatment using discovery skills learning, the low criterion of networking with oral presentations allows this skill to be modified or developed in terms of learning activities that pay more attention to the elements of networking with oral presentation skills (Dyer, Gregerse, & Christensen, 2011). In addition to the modification of networking with oral presentations, another way to improve the ability of PETs is to add other skills or divide this category into two specific skills: networking with written presentations (posters, diagrams, graphs) and with oral presentations (de Kruijf & Stobbelaar, 2015; Natale & Lubniewski, 2017).

CONCLUSION

Based on the results of the research, it can be concluded that (1) the entrepreneurship competence of PETs on PEP can be improved through the implementation of SDI on Science learning, (2) the highest N-Gain of the entrepreneurship components is making observations and inferences of 0.74; the component of entrepreneurship competence with moderate N-Gain criterion was is found in the association through data analysis (0.52) and designing an experiment (0.43); the component with the lowest criterion is in networking with oral presentations (0.29) and asking questions (0.27).

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