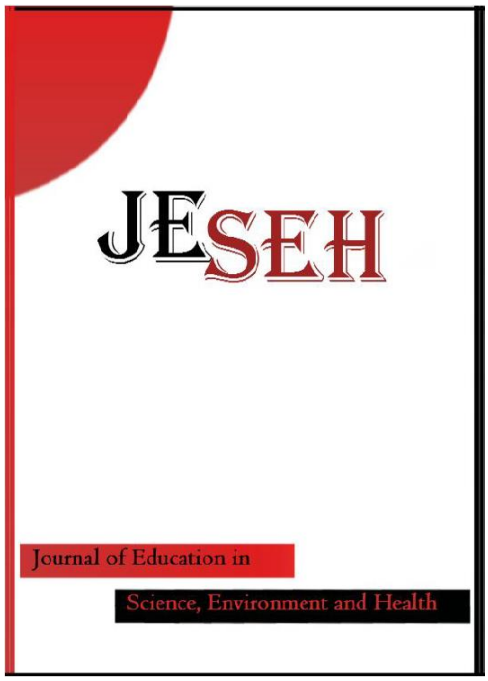

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Muhamad Imaduddin[1], Ihsan Ihsan[2], Muhammad Ali Shofyan[3], Muhammad Mujahidus Shofa[4], Muhammad Fatkhur Riza[5], Ro'i Khatul Jannah[6], Novi Lailatul Fitriani[7], Rizky Ulya Dewi[8]

Institut Agama Islam Negeri Kudus

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Abstract

Further development of a pedagogic framework to teach design thinking processes needs to be designed and implemented to strengthen pre-service science teachers' entrepreneurial self-efficacy (PSTs' ESE). This research aims to analyze the stages of the design thinking process in the eco-printing STEAM-projects, as well as to review the differences in PSTs' ESE after participating in this program. The participants are 22 PSTs consisting of 18 PSTs in the 3rd year of the program and other students in the 2nd year of the training program. Qualitative data were collected by observing, documenting the process of activities, interviews, and reflection questionnaires from the implementation of the program. Quantitative data were obtained from the entrepreneurial self-efficacy questionnaire. Interventions for PSTs include three main phases of the design thinking stage consisting (1) Understand; (2) Explore; and (3) Materialize. The existing stages not only teach the product design process, but also the design of the teamwork pattern that is formed. The ESE covers aspects, namely (1) searching, (2) planning, (3) marshaling, (4) implementing-people, and (5) implementing-financial. The change in category only occurs in the "planning" aspect. While the significance of the changes can be seen in two aspects, namely the "searching" and "planning" aspects. The PSTs have a positive response to what they do. PSTs also provide an overview of responses to entrepreneurial attitudes that have been learned during the process of strengthening programs dominated by "Collaboration" and "Time discipline" responses.

Introduction

As professional educators, teachers have the main task of educating, teaching, guiding, directing, training, assessing, and evaluating students. Teachers in formal education, primary and secondary education, play an important role in the success of the educational process. The exemplary attitude of a teacher is very important so that it can be used as a reference for students to behave and act in everyday life, especially in the learning process at school. One of the "exemplary" attitudes and behaviors can be found in the entrepreneurial character which includes discipline, energetic, creative, innovative, and productive characters (Rohmah, 2017). Teachers who have an entrepreneurial spirit will dare to take risks, are highly motivated, creative, innovative, productive in presenting classroom teaching or in managing their own lives. Teachers who have entrepreneurial characters can imitate and be imitated as well as have high productivity. The entrepreneurial spirit can be owned by anyone with a variety of professions. An entrepreneur is a person who can see and assess business opportunities, gather the necessary resources to take advantage of them, and take appropriate action to ensure success (Suherman, 2008). Thus, it is crucial to prepare pre-service teachers with "exemplary" characters because they will bring the characters into their profession as professional teachers. In addition, pre-service teachers need to be prepared to be work-ready after completing the teacher training program, whether they will work in the field of formal or non-formal education, or start their own business. The personal characteristics of entrepreneurs are considered to play an important role in environmental adaptation and personal achievement (Byrne & Shepherd, 2015) of future teacher candidates.

Entrepreneurship education has a relationship with design thinking in enriching the implementation of current entrepreneurship education (Huber et al., 2016). Design thinking is an interesting perspective for learners to learn about customer development, problem-solving, product solutions, creativity, divergent and convergent thinking, iteration, failure, resilience, and teamwork. Through processes in design thinking, pre-service teachers can develop their creative beliefs and transform entrepreneurial self-efficacy (ESE). One of the central roles in the regulatory process between motivation and the achievement of work performance is one's self-efficacy

(Fallast & Vorbach, 2019). Self-efficacy can predict the extent of entrepreneurial achievement, and entrepreneurial intention (Li, 2017). ESE is a construct that measures a person's belief in their skills to be able to successfully start entrepreneurship. ESE is particularly useful because it combines personality as well as environmental factors, and is considered a strong predictor of entrepreneurial intention and ultimately entrepreneurial action (Mcgee et al., 2009). On the other hand, design thinking-based teaching seeks comprehensive design-thinking skills. In this case, design thinking education is indispensable basic research to understand and enhance human creativity and innovation in various fields (Georgiev, 2012). Design thinking is a natural connector that blends art into the STEM (science, technology, engineering, and mathematics) field of work. Through design thinking, there is a great opportunity to incorporate engineering design principles across curriculums (The Institute for Arts Integration and STEAM, 2021) that could potentially be packaged into entrepreneurship education. Entrepreneurship education has a trend showing the increasing demand from universities and higher education institutions (Fallast & Vorbach, 2019).

Design thinking can be described as a paradigm, not as an example of a method or methodology. An understanding of the design thinking paradigm begins with an analysis of the designer's thought process. This process has long been the focus of research efforts to analyze design activities (Cross, 1982; Lawson, 2004). This paradigm directs design thinkers to avoid absolute answers and to deductive logic to obtain alternative answers that are not perfect (Collins, 2013). This process allows learners to deeply analyze and internalize various concepts and ideas. Design thinkers emphasize the communication and collaboration skills of learners which are at the core of constructivism. This is in line with STEAM learning which starts with defining real problems in everyday life (Boakes, 2020) and provides solutions by focusing on problem-solving skills (Herro et al., 2017) and team collaboration (Kijima et al., 2021). This paradigm extends further and includes how knowledge of such approaches, adopted by designers, can be imparted, taught, and applied in addressing (or providing answers) to further problems. The existing curriculum is sometimes not sufficient for the needs of the labor market. Existing education is often away from real situation conditions and problem-solving (Kersanszki & Nadai, 2020).

A pedagogical framework for teaching design thinking needs to be developed. Teaching approaches address some of the aspects of design thinking or design thinking teaching models (Oxman, 2004). Currently, project-based learning (PBL), explored by Dym et al. (2005), is the most frequently practiced for teaching design thinking. STEAM learning with projects makes it possible to teach these design thinking skills well. One form of project that can be implemented for pre-service science teachers is an eco-printing project. Eco-printing is a natural dyeing technique that transfers color and produces natural shapes from plants, such as leaves and flowers, fruits, vegetables, and organic waste materials (Pancapalaga et al., 2021). This dyeing process involves chemical bonds between natural dyes and fibers in the fabric (Kasipah et al., 2015). This project involves components that exist in integrative learning that combine science, technology, engineering, arts, and mathematics. Previous research has shown that there is a positive impact on learning, namely students' ability in presenting their creative ideas based on the development of eco-printing materials so that good works of art can be created (Syaifudin, 2018). Learning with eco-printing techniques can be an example of multi-disciplinary learning that combines learning about art and the environment (Kharishma & Septiana, 2019). Other research has also shown that eco-printing projects also have the potential for students' business ideas to be developed further (Husna & Nahari, 2021). This project has the potential to strengthen entrepreneurial self-efficacy with the knowledge of science concepts possessed by learners, Pre-service science teachers (PSTs). Through this research, further development of a pedagogic framework to teach design thinking processes needs to be designed and implemented to strengthen PSTs' ESE. This research aims to analyze the stages of the design thinking process in eco-printing STEAM projects, as well as to review the differences in PSTs' ESE after participating in this program. For PSTs, this will be the foundation to be able to teach design thinking in their future classrooms.

Method

Research Design

This research is a classroom action research that aims to strengthen PSTs' ESE so that the orientation of future educators instills an entrepreneurial spirit that is visionary, creative, and innovative concerning the substantive context of science. Action research is an appropriate means of improving quality on a classroom scale (Cohen et al., 2007). This study leads to an understanding of the ongoing phenomenon, so this is descriptive research (Sagor, 2005). The action research cycle begins with the stage of clarifying the vision that aims to build assessment criteria (in this case ESE). In the next stage, the theory is articulated related to the STEAM design

thinking process and eco-printing projects. The stages are continued by implementing actions, as well as reflecting and planning improvements in the next cycle if further actions are taken. The details of this cycle are depicted in Figure 1.

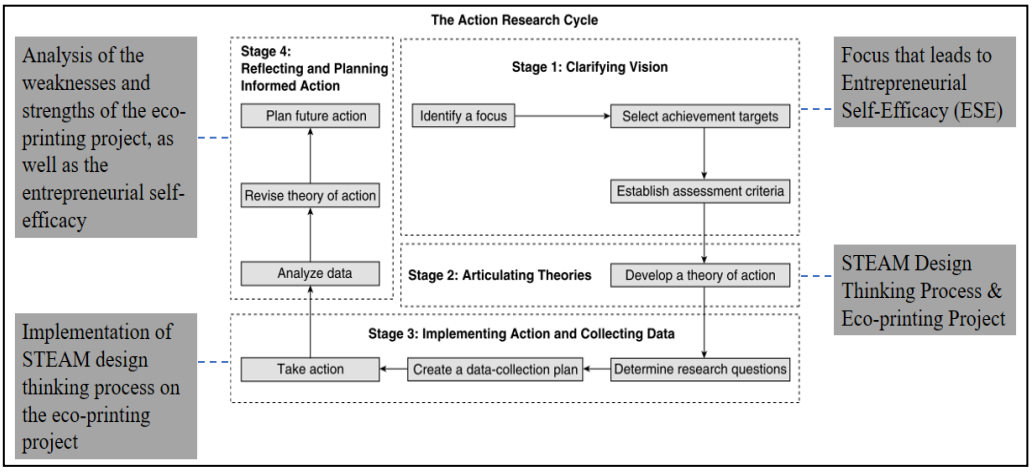

Figure 1. The modified action research cycle of Sagor (2005)

Data Collection & Analysis

The data in this study include qualitative data and quantitative data. Qualitative data includes various process findings at the stage of strengthening entrepreneurship as well as PSTs responses. Quantitative data includes entrepreneurial self-efficacy (ESE) scores. Qualitative data were collected by observing, documenting the process of activities, interviews, and reflection questionnaires from the implementation of the program consisting of (1) Yes/No questions and (2) open-ended questions. The validity of the qualitative data used a credibility test through member checking, which is the process of checking the data obtained by the researcher to the data provider. The purpose of which is that the information used in writing the report will be appropriate to what was intended by the data source or informant. The reliability of the qualitative data, which in this case is termed dependability, was obtained by an independent audit using a reflective journal (Cohen et al., 2007). Qualitative data were analyzed with narrative descriptions, furthermore, the results of reflection in the form of Yes/No questions were presented with a recapitulation table. The PSTs' reflections were analyzed using QDA Miner software to obtain word clouds and bar charts.

Quantitative data were obtained from the entrepreneurial self-efficacy questionnaire which consisted of 19 items for efficacy. Item validity using Pearson Correlation which is the lowest result at r= 0.486 and the highest at r=0.870. The reliability of the instrument was tested using Cronbach's Alpha (0.962). The validity and reliability of each indicator item are shown in Table 1. The existing indicators refer to Mcgee, Peterson, Mueller, & Sequeira (2009). The ESE data were categorized as 1,00 ≤ Mean < 2,33= Low (L) ; 2,33 ≤ Mean < 3,66 = Medium (M); 3,66 ≤ Mean ≤ 5,00 = High (H). The ESE data were analyzed by testing the significance of the differences before and after the program using the Wilcoxon test. This test is a non-parametric test that is used to measure the difference between 2 groups of paired data on an ordinal scale but the data are not normally distributed.

Table 1. Validity and reliability of each indicator of the entrepreneurial self-efficacy questionnaire

No	Indicator	Number of Items	Validity (Pearson Correlation)	Reliability (Cronbach's Alpha)
1	Searching	3	0.486; 0.718; 0.897	0.820
2	Planning	4	0.724; 0.836; 0.768; 0.731	0.872
3	Marshaling	3	0.687; 0.673; 0.800	0.762
4	Implementing-people	6	0.804; 0.816; 0.822; 0.792; 0.870; 0.620	0.913
5	Implementing-financial	3	0.576; 0.763; 0.732	0.845
	Total	19		

Profile of Pre-service Science Teachers

The total number of PST participants who participated in this research was 22 PSTs consisting of 18 PSTs in the 3rd year of the program and other students in the 2nd year of the training program. The selection of participants is based on the willingness of prospective teachers to fill out a volunteer form, which requires PSTs to be students who have taken courses in Organic Chemistry and Inorganic Chemistry in which the context of chemistry in coloring has been discussed. PSTs have received Organic Chemistry lectures which discuss secondary metabolites that affect color in plants, as well as Inorganic Chemistry lectures which discuss complex reactions on metal elements in the binding of textile dyes. Participants were selected based on the results of the development of the course project on the eco-printing that had been made and the willingness of PSTs to follow the series of processes. Details of the characteristics of PSTs participants can be seen in Table 2.

Table 2. Description of participants in research

No	Characteristics	N	No	Characteristics	N
A	Gender			b. Mother's Education	
	1) Male	5		1) <Elementary School	1
	1) Female	17		2) Elementary School	9
B	Family Background			3) Junior High School	7
	a. Father's occupation			4) Senior High School	4
	1) Teacher	4		5) Bachelor's Degree and above	1
	2) Government Employees	1	C	Obtaining Allowance from Parents	
	3) Farmer	5		1) Yes	20
	4) Traders	1		2) No	2
	5) Labor	5	D	Business Ownership/Part-Time Work	
	6) Tailor	1		1) Yes	8
	7) Entrepreneurship	3		2) No	14
	8) Not Working	2	E	Type of Business / Work Part-Time	
	b. Mother's occupation			1) Mentor at the Tutoring Institute	4
	1) Housewife	10		2) Selling Food	1
	2) Teacher	1		3) Online Shop	3
	3) Farmers	1	F	Income from Part-Time Work / Business	
	4) Traders	2		1) < IDR 1,000,000 (USD 69.03)	7
	5) Labor	3		2) IDR 1,0000,000 – IDR 2,000,000 (USD 69.03 – USD 138.05)	1
	6) Entrepreneurship	5	G	Participation in entrepreneurial development activities	
	c. Father's Education			1) Yes	19
	1) <Elementary School	1		2) No	3
	2) Elementary School	5			
	3) Junior High School	6			
	4) Senior High School	6			
	5) Bachelor's Degree and above	4			

The Intervention

Interventions for PSTs include three main phases of the design thinking stage (Gibbons, 2016) which consist of (1) Understand; (2) Explore; and (3) Materialize. In the first phase, PSTs are directed to analyze the understandings of product design users and determine problems based on research and field findings. In the explore stage, PSTs have the opportunity to create various product development ideas and design prototypes. In the final stage, PSTs test the product to users, evaluate the feedback provided by users and improve the quality of the final product.

Results and Discussion

The Stages of Design Thinking Process on the Eco-Printing STEAM-Project

Design thinking is a perspective that is accompanied by a process. This perspective involves a direct, user-focused approach to solving various problem findings that lead to product innovation that is differentiated and competitively superior (Gibbons, 2016). The framework of design thinking includes a series of stages 1) understand, 2) explore, and 3) materialize. These three stages include six phases, in which the understanding phase includes empathizing and defining phases, the second phase includes ideating and prototyping, and the last phase consists of test and implementation phases.

Stage of Understanding in Design Thinking Process

In the first stage, PSTs try to develop knowledge about what users do, say, think, and feel. This is the empathize phase of the design thinking framework series. PSTs researched to develop their knowledge related to textile dyeing techniques with eco-printing technology. Eco-printing is an environmentally friendly coloring technique through dyes made using a selection of natural materials, such as fruit, flowers, and plants that can be used for clothing, linens, curtains, and even paper (Brojt, 2021). This is done by mixing it into a paste or boiling it into a liquid or using the pounding technique. The use of natural dyes mostly involves the presence of metal ions (mordant) which can form chemical bonds between textile fiber polymer chains and adsorbed dyes (Dean, 2010; Montazer et al., 2004) to increase the colorfastness of the dyed fibers (Prabhu & Teli, 2011). This is as shown in Figure 2. by illustrating one of the natural dyes, namely alizarin. Natural dyes include reactive dyes because natural dyes are dyes that can color cellulose fibers. Textile fibers have a negative charge while dyes in general also have a negative charge. This is what causes the diffusion of dyes in textile fibers to be hampered. Therefore the reactive groups of dyes which can be in the form of triazine, pyrimidine, konoaxali, vinylsulfon, or acrylamide are easily released. After releasing the reactive group, the reactive dye will be positively charged which can react by addition or substitution with the negative group of the cellulose fiber (Kasipah et al., 2015).

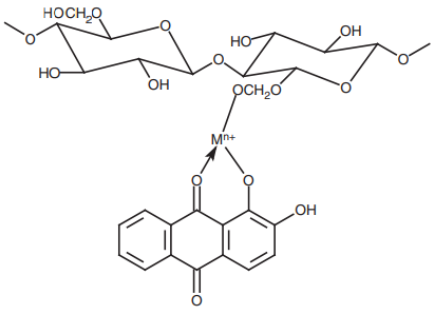

Figure 2. Chemical bonding between natural dyes (illustrated is alizarin) and cellulose through the presence of mordant (Mn+) (Ding & Freeman, 2017)

In empathize phase, PSTs in groups tried to understand eco-printing techniques by testing various natural materials to produce color variants, as well as testing the composition of the mordant materials. The simple mordants they used were alum, limestone, and chalk (Figure 3.). In the end, the choice of the most appropriate mordant material for their project was alum, and vinegar was used to clean the impurities on the leaves used for coloring and motifs, as well as to sharpen the colors obtained from natural materials.

Figure 3. PSTs try to consider various materials that are mixed in natural dyes and fabrics to obtain an accurate composition and eco-printing technique.

Understanding the concept and practice of making eco-printing, the PSTs group also tried to review the market potential and condition of product competitors around them (Figure 4.). Comparative study activities and small group discussions were carried out with eco-print entrepreneurs as resource persons and also teachers at one of the vocational high schools in Kudus Regency. The results of the product diversity information obtained from

this resource show the potential for further development of eco-print products that can be created by PSTs. This stage is the defining phase, in which the PSTs have been able to determine user needs and begin to highlight opportunities for product innovation. During the "empathy" and "defining" phases, students can engage directly with their peers to understand community needs related to the design of the product to be created (Dotson et al., 2020).

Figure 4. Comparative study of eco-print products and small group discussions

Stage of Exploring in Design Thinking Process

The second stage is the exploration process which begins with the ideate phase. This stage emphasizes the process of brainstorming various creative ideas to meet user needs identified in the define phase. Each PSTs are given total freedom to express their ideas for the process of implementing the eco-print product commercialization project. PSTs determine the division of teams and work consisting of 1) development team including a) Leader group, b) Media Team, c) Technical Team, d) Promotion Team, and 2) Production team. This process conditions that teaching is a collaborative work that ultimately distributes a variety of skills. This is contrary to the concept that prospective teachers must have the same knowledge (Paulino Preciado Babb et al., 2016). Through this design thinking process, each PST has great potential to contribute to the eco-printing of the STEAM project. PSTs coordinate teams to exchange ideas and combine ideas. In this phase, the results of collaborative ideas are obtained with several important points for the next stage which includes product development variants, product branding, and technical implementation of production. The details are shown in Table 3.

Table 3. Various ideas emerged and were compromised at the ideate stage.

No	Items	PSTs' Ideas
1	Product variant	Tote bag
2	Product branding	The product brand is "Tabassam" with the tagline "*Menyapa Alam dengan Seyuman*" (Greet nature with a smile). The logo brand is as shown in the picture. 
3	Production technique	1) Pre-production schedule and location 2) Recipes on the composition of materials, techniques, and types of fabrics for trial activities. The method or technique used is the pounding technique without steaming, and the mordanting process is carried out at the beginning before the design is printed and after the design is formed. The materials are calico fabric and canvas which are used for the production of tote bags.

After creating ideas, PSTs execute existing ideas through eco-print-based product production activities. PSTs try to create various motifs with predetermined techniques and print them on materials that have also been selected in the previous stage. Some of the motif design results in this phase are shown in Figure 5. This stage is the prototype phase. The results of this prototype will be tested at the next stage to obtain the final results that will

be implemented. The ideate and prototype phases are multiple alternative phases in short iterations (Carlgren, 2016). The group then presented the design matrix, explained resource constraints, and received feedback from peers (Dotson et al., 2020).

Stage of Materializing in the Design Thinking Process

At this stage, the development product has been obtained. Before arriving at the stage of implementing the product, testing is carried out first. The test was carried out by reviewing the responses of several respondents qualitatively on the designs that had been made, as well as testing prices and marketing processes. The results of design changes at the prototype stage are shown in Figure 5.

Figure 5. Design of motifs and products in the prototype phase, as well as their change in the test phase.

Trials were also carried out on the suitability of prices with consumer interest in marketing activities. Trials on promotion and marketing were carried out through social media accounts via Facebook and Instagram. The official Instagram account for the promotion is the IG account: @tabassam.eco. However, the social media accounts of each PSTs and the student community also support the promotion of the Tabassam eco-printing product as shown in Figure 6.

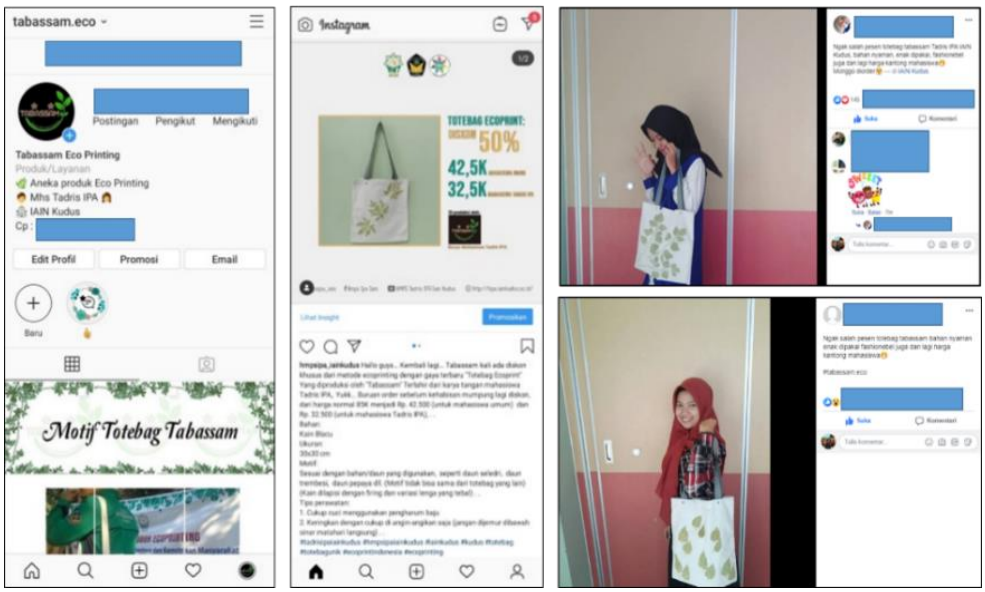

Figure 6. Several promotional techniques are carried out by the developer PSTs group through official product accounts (Instagram), student community accounts (Instagram), and PSTs personal accounts (Facebook).

The trial results of offering prices to the market and promotions through social media indicate a positive response from the public to PSTs products. For 1.5 months, 122 tote bag orders were obtained. At this stage, the organizational work design pattern is implemented. Due to limited human resources and time, the PSTs team limited the number of orders even though they had tried to also carry out partnership activities with the community. Production is carried out in 10 stages of production as shown in Figure 7. The weakness of the PSTs group in organizing a large number of orders at this stage has not been overcome. The design of the production organization will be further improved at the stages in the design thinking process cycle in the next period.

Figure 7. The production process to fulfill Tabassam product orders.

The PSTs group also introduced this tote bag through exhibitions and workshops. PSTs also think about packaging so that the resulting product is suitable as a souvenir and looks practical when it is in the hands of consumers. Products that are ready to sell and arrive at the hands of consumers as shown in Figure 8.

Figure 8. The final design of Tabassam products that are ready to be accepted by consumers.

The three stages in the design thinking process cycle in the PSTs' ESE strengthening process have been carried out by considering the time aspect of PSTs. This is because PSTs must also consider that they are students who should complete their studies. Teamwork and good time management are key in this process. The existing stages not only teach the product design process, but also the design of the teamwork pattern that is formed. Lecturers act as guides to stimulate conversation and research by PSTs. PSTs are allowed to evolve through the design and redesign phases of the design process, this is where creativity and problem solving begin to grow (Mayes et al., 2018). 21st-century learning can be driven by the process of design thinking through its application in complex interdisciplinary projects in a holistic constructivist manner (Scheer & Plattner, 2011). One of the forms of this project is the production and marketing of eco-print products. As a holistic concept, design thinking enables participants to work successfully collaboratively in a multidisciplinary field of study to solve difficult real-life problems (Rauth et al., 2010).

The Entrepreneurial Self-Efficacy of Pre-Service Science Teachers

One of the things that PSTs must have to start entrepreneurship is entrepreneurial self-efficacy (ESE) which is an important starting point for the intention to open a new business (Barbosa et al., 2007). ESE is an important factor in encouraging one's entrepreneurial intentions (Krueger, 2003). Entrepreneurial self-efficacy describes the self-confidence that leads to the behavior of someone who successfully runs the entrepreneurial process (Hisrich et al., 2017). In a recent study, it was found that self-efficacy in entrepreneurship in individuals can be increased through training and education. PSTs' ESE was reviewed from five indicators and analyzed their condition before and after the completion of the design thinking stage in the strengthening program through the eco-printing project. The details of the changes are shown in Figure 9.

Figure 9 shows the most visible change conditions in the "searching" aspect. In each indicator, there is an increased condition as referred to in recent research that self-efficacy in entrepreneurship in individuals can be increased through training and education (Hisrich et al., 2017; Wijangga & Sanjaya, 2018). Santrock (2011) also stated the importance of students having work readiness before entering a career. Therefore, the introduction to the world of entrepreneurship with the formation of comprehensive competencies is considered important for students (Wijaya, 2007). Entrepreneurship education for students, especially in Indonesia, can be one of the factors driving the emergence of entrepreneurial intentions. A good education will increase entrepreneurial self-efficacy so that it raises entrepreneurial intentions. Entrepreneurial self-efficacy is a construct that shows that behavior, cognition, and the environment are interconnected (Wijangga & Sanjaya, 2018). ESE is the degree to

which a person believes or believes that he or she can successfully start and run a new business (Bandura, 1997). In this study, the detailed conditions of changes in each indicator and their level of significance are shown in Table 4.

Figure 9. PSTs' ESE changing conditions on each indicator

Tabel 4. Categorization of conditions and significance of PSTs' changes

No	Aspect	Mean response per item		Rank			Sig	Significance of the difference (<.005)
		Pre-program	Post-Program	[-]	[+]	Ties		
1	Searching	3.74 (H)	4.08 (H)	3	14	5	0.003	Significant
2	Planning	3.57 (M)	3.81 (H)	2	11	9	0.006	Significant
3	Marshaling	3.67 (H)	3.77 (H)	7	12	3	0.423	Not significant
4	Implementing-people	3.70 (H)	3.74 (H)	9	10	3	0.731	Not significant
5	Implementing-financial	3.77 (H)	3.83 (H)	9	9	4	0.597	Not significant
Entrepreneurial Self-Efficacy		3.69 (H)	3.85 (H)	9	13	0	0.338	Not significant

(H) = High category; (M) = Medium category

Table 4 shows that category change only occurs in the “planning” aspect, namely from the medium category (M) to the high category (H). While the significance of the changes can be seen in two aspects, namely the "searching" and "planning" aspects. The “searching” aspect is an aspect that involves unique ideas and their development by PSTs. This aspect refers to creative talent and the ability to innovate. Entrepreneurs differ from managers in terms of their ability to understand and take advantage of opportunities that exist before they are recognized by many people (Hisrich et al., 2017). This shows that the eco-printing project provides an overview of unique ideas and business opportunity ideas that are meaningful to PSTs. This aspect is contained in a series of activities in the "Understanding" and "Exploring" stages. The search for the right formula for production activities, design, promotion techniques, and marketing is something that is mostly done by PSTs.

In the planning aspect, PSTs through the team initiate activities which consist of activities in which entrepreneurs turn ideas into viable business plans. At this stage, the PSTs are not actually writing a formal business plan. However, the PSTs group tried to evaluate the possibilities needed to initiate ideas related to an eco-printing idea project. PSTs carry out planning activities at the “Exploring” and “Materializing” stages. The plan answers questions such as: Who are the target customers? Where is the production location? What are the product specifications? How and by whom will the product be produced? What is the initial cost? What is the cost of recurring operations in doing production? Will the business be profitable? (Mcgee et al., 2009). The aspect of self-efficacy in planning shows a change in the level category from medium (M) to high (H), and is significantly different.

In the marshaling aspect, there were no significant changes in categories and differences. This aspect involves assembling the existing resources in the PSTs group. To realize the previously planned business, entrepreneurs collect various necessary resources such as capital, labor, customers, and suppliers for business sustainability (Mueller & Goic, 2003). In this activity, the production process is carried out in one cycle of the design thinking process and is only used to fulfill the order target for one month. This aspect has not seen any significant changes considering the product development process has not been done much in the design thinking cycle period. This marshaling phase includes assembling natural and human resources to make the existing business

concept a reality (Mcgee et al., 2009). The phase carried out in this research is only at the initiation stage and has not been processed in a continuous cycle. During this initial process, the skills of this aspect have not yet developed in PSTs.

Table 5. PSTs' responds to the ESE strengthening program through an eco-printing project

No	Statements	Number of Answers		
		Yes	No	Maybe
1	[-] When it comes to bringing materials for eco-print production activities such as leaves, cloth, and so on, I feel bit awkward or embarrassed.	1	20	1
2	[-] I feel it is inappropriate if I have to be involved in the eco-print production process because it is a job that involves hand labor (coolie work).	0	21	1
3	[+] I don't hesitate to show my eco-print to my family or friends.	17	5	0
4	[-] I feel awkward using my own eco-print products.	0	22	0
5	[+] I enjoy promoting my eco-print products both directly and through social media.	19	0	3
6	[+] I feel I can inspire others through my eco-prints	17	1	4
7	[+] I want other people to be interested and buy my eco-print	21	0	1
8	[+] I hope to profit from my eco-print products	17	1	4
9	[+] I am proud to introduce and sell eco-print products to the wider community.	22	0	0
10	[+] I want to have many partners in producing and marketing eco-prints.	22	0	0
11	[+] This eco-printing project taught me how to behave, act well, and be ethical	20	0	2
12	[+] In the eco-printing project, I learned some knowledge related to science material	20	1	1
13	[+] Through the eco-printing project, I am motivated to hone my skills and skills in entrepreneurship (not only eco-print production).	18	0	4

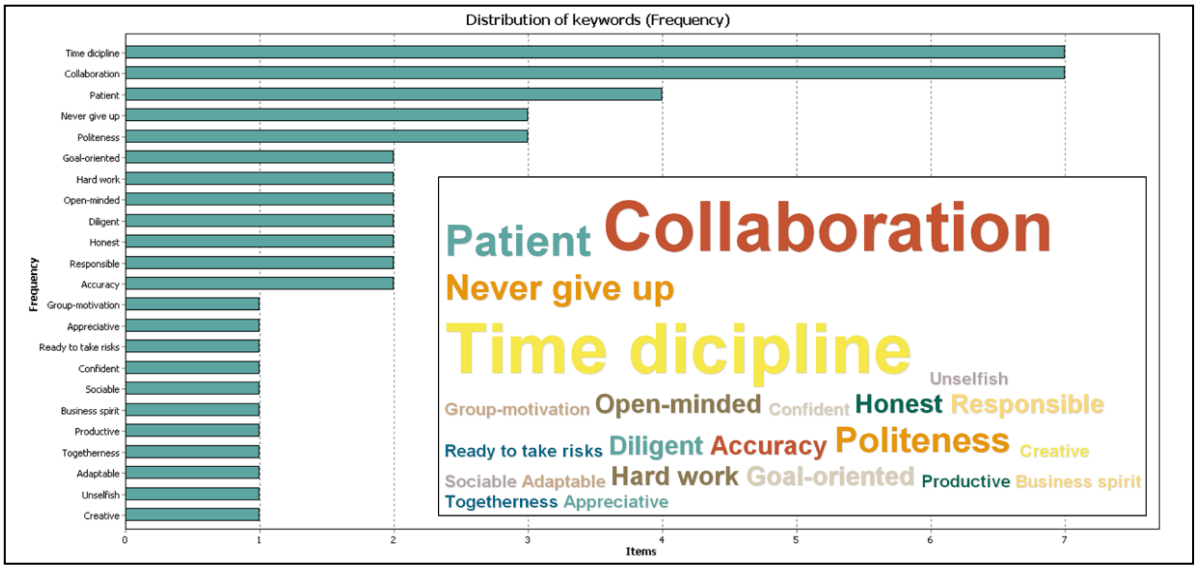

Figure 10**.** PSTs' responses to what was learned in the process of the eco-printing project

Another aspect that is part of the ESE is the implementation aspect which also in this study did not change in the category of efficacy level, and there was also no significant change. This aspect shows the entrepreneur's belief in being responsible for developing the business and sustaining the business through its growth period. This aspect includes the human and financial components. As entrepreneurs, PSTs must have confidence in strategic planning and managing various business relationships with suppliers, customers, employees, and capital providers. In addition, PSTs are the main risk bearers in eco-printing projects where this risk is always in the financial interest as long as the business grows and achieves its long-term success (Mueller & Goic, 2003). The short program duration for the materializing stage has not been able to show significant changes in the implementation aspects of PSTs' ESE. Thus, the overall change in ESE has not shown a significant difference, although it can be seen that before the implementation of the strengthening program, the average PSTs' ESE was

already at a high level. Only in the aspect of searching and planning, the condition of strengthening the efficacy of PSTs in starting entrepreneurship through eco-printing projects can be shown significantly.

The strong condition of ESE is also shown by the pattern of responses to statements related to the eco-printing project as shown in Table 5. In general, the answers show that the PSTs have a positive response to what they do. PSTs also provide an overview of responses to entrepreneurial attitudes that have been learned during the process of strengthening programs (Figure 10.) which are dominated by “Collaboration” and “Time discipline” responses.

Conclusion

The strengthening program for PSTs' ESE is carried out through mentoring which is constructed through a STEAM approach with a design thinking paradigm. The design thinking paradigm includes the stages to produce products through eco-printing technology which include 1) understanding, 2) exploring, and 3) materializing. The design thinking with the STEAM paradigm can teach PSTs to work together successfully by solving the problems and challenges of eco-printing products, namely the design of development products and the acquisition of profits on product sales. PSTs have succeeded in proving the implementation of the stages to the implementation phase and showing that tote bag products can be sold and profitable. However, not all aspects of PSTs' ESE changed significantly during the process.

Self-efficacy in the aspects of "searching" and "planning" has changed significantly during this action research. From the start of the program, PSTs' ESE has been at a high level. The changes in ESE in all aspects did not show a significant difference. The PSTs’ responses showed positive conditions on what has been done during the eco-printing project process. The response during the process showed the expression of words that are dominated by "Collaboration" and "Time discipline".

Recommendations

This research has limitations, namely, it is only carried out at one stage of the design thinking cycle and on a limited variety of eco-print products. In the future, components on duration, product variety coverage, and expansion of PSTs work patterns by involving partnerships with surrounding communities need to be followed up. Thus, the focus of the design of PSTs is not only on the product, but also on the managerial work of the team in the production process, management, and product promotion.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

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Author(s) Information

Muhamad Imaduddin
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia
Email : imad@iainkudus.ac.id

Ihsan Ihsan
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia

Muhammad Ali Shofyan
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia

Muhammad Mujahidus Shofa
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia

Muhammad Fatkhur Riza
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia

Ro'i Khatul Jannah
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia

Novi Lailatul Fitriani
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51,Kudus, Indonesia

Rizky Ulya Dewi
Institut Agama Islam Negeri Kudus
Jl. Conge-Ngembalrejo PO BOX 51, Kudus, Indonesia