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Developing Students' Entrepreneurial Characters through Downstreaming Research on Natural Product Learning with Ethnoscience Integrated Stem

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Developing Students' Entrepreneurial Characters through Downstreaming Research on Natural Product Learning with Ethnoscience Integrated Stem

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Abstract.: This study intended to develop the entrepreneurial characters of UNNES Chemistry students through the implementation of Natural Product learning integrated with Ethnoscience and STEM (Ethno-STEM). This research is a descriptive-qualitative study subjected to Chemistry education students who joined the Natural Products and Chemical Entrepreneurship course. The research subjects were introduced to the project-based learning integrated with Ethno-STEM concerning concepts related to terpenes, steroids, flavonoids, and alkaloids; also, the introduction of natural chemical isolation and distillation processes both in the community and laboratory. The students were assigned a project of chemical batik production, i.e., batik with chemical structure patterns followed by evaluation and assessment. There were six best batik designs proposed to one of the traditional batik centres named "Zie" to be printed by using batik printing machine. These designs are said to be worthy of production; in other words, they are valued economically. The research results indicated that the Natural Product learning integrated with Ethno-STEM was able to well develop the students' mastery concept of chemistry, creative and innovative thinking, perseverance, and conservation of national culture.

Keywords: Downstreaming of research, ethnoscience, STEM, entrepreneurship

1. Introduction

Higher education is obliged to hold Tri Dharma Perguruan Tinggi activities, namely research and community service activities in addition to implementing education [**1**]. In line with these obligations, the Higher Education Law [**2**] Article 45 emphasizes that research in higher education is directed at developing science and technology, as well as improving people's welfare and national competitiveness [2]. The nation's competitiveness is meant by the nation's competitiveness in facing globalization in all fields. Therefore higher education is needed that is able to develop science and technology and produce intellectuals, scientists, and/or professionals who are cultured and creative, tolerant, democratic, strong character, and dare to defend the truth for the benefit of the nation. Regarding these demands, the Semarang State University (UNNES) has focused on the downstreaming of research, namely learning research, knowledge research, institutions, and downstreaming research [3]. Thus in the future at UNNES, research is not limited to the output of scientific publications, product prototypes, but how research has a business impact and economic value. At the time UNNES had emphasized the downstreaming of research to develop students and alumni with entrepreneurial competencies.

Entrepreneurship competencies are built from tri dharma activities and performance in the fields of Education, Research and Community Service [4]. Therefore the development of entrepreneurial character cannot only be with a class of entrepreneurship education in the class, without the implementation of various innovative research models for the development of entrepreneurial character for students [5]. Besides that the downstreaming of this research is the output of the project that has been implemented by the Ministry of Technology Research and Higher Education [6]. The problems in various tertiary institutions are still found by lecturers in tri dharma tertiary education activities not in accordance with the demands of the current global era, and applying the results of their research in research and downstream research, as a result of knowledge transfer unable to improve the quality of education. Even though quality lectures if the study material is taught research-based on the scientific field and in accordance with the latest developments. At present, the implementation of research is no longer process-based, but is output-based, such as a prototype of an economically valuable innovation product that is prioritized and develops entrepreneurship. As for service to the community, the output is the downstreaming of research to improve people's lives. This paradigm continues to be developed and as a first step for the campus world to become an entrepreneur university

Downstream research is also expected to be able to improve science and technology capabilities and innovation to produce added value innovation products from a research. This research downstreaming program is to answer the problems of science and technology development and higher education. Downstreaming this research is also in line with one of the Ministry of Research, Technology and Higher Education's strategic plans for 2015-2019 which stated that in order to fulfill community expectations that universities could act as agents of social and economic development, research needs to be downstreamed. At the level of implementation of downstream research, collaboration between academic, business, and government is needed. The campus where the results of research and the community are stored is the market for applying research. Therefore a business intermediary is needed whether it is an industry or a company to connect the research output to the needs of the community. The government has the power to implement research policies and have work areas in the community. Closely related academic, business, and government gave birth to science tech park. Adhering to the entropy theory which states that naturally everything will be degraded, for example young people will be old and lost, so every business needs innovation. A business that has a brand needs to register its product in the form of intellectual property rights (IPR) so that the same product does not emerge and shut down the business that was initiated from the beginning. Innovative products require research from a tertiary institution, so that with the downstreaming of the research an industrial product or business of economic value is produced, and will support the close ties of academic, business, and government [7].

Referring to the above problems, research has now been developed using the Science Technology Engineering and Mathematics (STEM) approach to develop thinking skills abd 21 [8] [9] [10]. Thus, with this STEM education every research conducted by lecturers must encourage the activities of the academy to become more qualified [11]. For example, in the context of the chemistry lectures of natural materials, a lecturer in the chemistry of natural materials, not only knows well what is called secondary metabolites, classification, biosynthesis, and various structures of compounds contained. Chemistry lecturers of natural materials are required to be innovative in isolating and extracting the main compounds in a plant by replacing certain solvents and giving scientifically why to isolate and extract secondary metabolites in essential oils with these solvents, and their impact on yield and economic value. Thus the lecturers of natural materials chemistry must master comprehensively related to knowledge (S), Technology (T), Engineering (E), and Matehematics (M) related to the study material of secondary metabolites, for example in Essential Oils. In this case what is essential oil (S), how to isolate and extract essential oils (T), the ability to think innovatively and creatively to produce quality processes and results from essential oils (E), and mathematically capable of calculating yield, profit loss on a business basis, or think mathematically and act as an economist (M). Thus science is needed as a foundation for technology, while mathematics is a support for science competencies. Therefore, science cannot automatically present technology, it is necessary to have an in-depth study so that science does not stay in books in the library, it is necessary to conduct research to explore innovative potential that can increase economic value and human life according to the principle of research downstream.

In this research will be applied the integrated STEM approach of Ethnosains on the learning of Natural Product chemistry to develop the character of student entrepreneurship, and the downstreaming of this research in batik products with chemical structure motifs. This research refers to the vision and mission of Semarang State University (UNNES) as a university with conservation and international reputation, and as an independent university and entrepreneur in 2034 [3]. The UNNES Vision and Strategy Plan needs hard and real work for the academics at UNNES. This is because there are real problems now that many UNNES alumni have not been able to work according to the competencies of their graduates. At this time, there are fewer opportunities to become public and private employees, meaning that many graduates have been produced as teachers or scientists but the opening of civil servants as teachers and bureaucracy is not available and if there is very limited. One solution to overcome the problem of college graduates is to equip graduates with entrepreneurial character. Thus the character of entrepreneurship needs to be provided to every UNNES student

The importance of entrepreneurial character, because in the current global era entrepreneurial character is very important in the 21st century for every young generation. Therefore, in this research, research will be conducted to design and implement a project learning model integrated with the ethno-STEM to develop the entrepreneurial character of students. The results of this research will be the downstreaming of research through the manufacture of batik cloth products with the main motif of the secondary chemical structure of mentabolites, and this research is a continuation of scientific development grant research in 2018 [12]. The research findings are expected to be a pattern of UNNES policy. In this research, STEM was integrated with Ethnosains (Ethno-STEM), which meant a course learning that combines STEM with the context of local culture containing the concept of science (Ethnoscience). The Ethno-STEM approach has not been widely developed and is expected to be a trend for learning models in Indonesia.

2. Methods

This research consists of two stages, namely developing a learning model of Natural Chemistry with the integrated STEM Etnosains approach so as to produce a product of chemical structure batik design products; while the second stage is the downstreaming process of design prototypes of chemical structure batik motifs to be printed in batik cloth in collaboration with Zie Batik in Malon Gunungpati Semarang. This research uses a qualitative descriptive approach regarding the reconstruction of scientific science based on community science with the context of ethnosains and the STEM approach. The technique of collecting data is through observation of active participation, interviews with resource persons, documentation studies of essential oils and chemical structure motif batik. The object of the interview was about people's knowledge regarding refining essential oils and batik, distillation techniques and batik, creative ideas to produce essential oils and the best batik motifs, and calculation of yields and profit and loss for local essential oils and batik. The collected data is verified, validated by experts and reconstructed into scientific knowledge.

The next research is the design of the project learning model designed by integrating the STEM and Etnosains approach, followed by the effectiveness test to develop the entrepreneurial character of students. The research subjects were students at FMIPA UNNES who took courses in natural materials chemistry and entrepreneurship. Assessment of batik motif design products with observation sheets and entrepreneurial character aspects using observation sheets and questionnaires, and the results are analyzed by the N-gain equation as follows:

$$N - gain = \frac{S_{posttest} - S_{pretest}}{S_{max} - S_{pretest}}$$

In this research, the high and low N-gain prices can be classified as follows, if the N-gain price ≥ 0.7 is obtained, including the high criteria, N-gain with 0.7> g 3 0.3 medium criteria, and N-gain < 0.3 is a low criterion. In this research, the best batik motif design products were carried out downstream by the collaboration of Zie Batik to produce them in the form of batik fabrics that were worthy of economic value, and were taken care of by HAKI to obtain simple patents.

3. Researh Results and Discussion

3.1 Reconstruction of Scientific Knowledge of Essential Oils and Batik in the context of STEM and Ethnoscience

In this research the research location took place in two places, namely in Boyolali and Gunungpati Semarang. The location of Boyolali for essential oils and Semarang for Zie Natural Batik, Observations and interviews were conducted on the respondents in Boyolali District, namely Mr. Sadjimin (52 years) and Mr. Eko (37 years). The interview results, they said that the experience had been 10 years, and the local essential oil business had been going on for around 23 years. The informant said that the knowledge and skills of extracting essential oils were obtained from generation to generation by ancestors, and instincts. While the resource person for Batik Craftsman, Ms. Zie (46 years old) and her husband stated that batik business had been long, only for Semarang only 10 years. Batik skills are actually more instinctive and fun; actually the one who really plays a role is her husband. Batik knowledge is derived from the family, as well as the results of fostering the Ministry of Small and Medium Enterprises (MSMEs). The results of interviews regarding economic aspects are known that the selling price of essential oils is not stable, while the price of batik tends to be stable. In this research, besides focusing on the reconstruction of scientific science based on community science, also developed the Natural product learning model from the topic of essential oils through Ethnoscience integrated approach to Science Technology Engineering and Mathematics (STEM).

The STEM approach is a learning model that integrates science, technology, engineering, and mathematics to foster the STEM workforce, as well as develop citizens to become literate in STEM, and enhance global competitiveness in science and technology and entrepreneurship innovation [13]. In this research the information from the interview results is analyzed and reconstructed into scientific knowledge and validated by various scientific literature, both textbooks, scientific articles, or information from experts. The results of the reconstruction of scientific knowledge related to essential oils, the scientific concepts in essential oil distillation are essential oils producing materials, distillation concepts, secondary methanolite components in essential oils, evaporation events, condensation, specific gravity concepts, and mixed concepts [14], [15]. In this research scientific explanations from various experts and sources of information will generate scientific knowledge that is conceptually correct and used as lecture material for natural materials chemistry. In this research found the entrepreneurial character of essential oil owners and workers and Zie Batik Natural is hardworking, disciplined, creative, responsible and innovative [16] [17]. In this research also carried out observations and interviews with the owners of Zie Batik, namely Ms. Zie regarding the stages of coloring Batik Fabrics, and the batik coloring process as follows, namely:

1. Process of Mordanting: The process of giving metal elements so that the dyestuff is firmly bound to the fabric fibers. The material used is a mixture of alum, soda ash and water. In this mordanting process the concepts of natural dyes, molecular atoms, mixtures are contained
2. Extraction Process: The process of isolation of a secondary metabolite from a plant, in this case is a natural dye for batik. According to the resource person, this extraction process depends on the material to be extracted, it can be leaves, roots, fruit, stems, or cambium. The order of extraction of leaves / bark / seeds / fruit / fruit peel can be done by boiling with a general procedure as follows: I kg leaves / small cut bark / seeds / fruit skin, dissolved in water 5-10 liters of water, heated in water boil, let stand in a boiling state for 1 hour counted from the water begins to boil, then let stand for ± 1 hour in the solution, after being left alone then filtered, natural dyes ready to be used.

3. The process of dyeing / coloring cloth: Giving color to the fabric by dipping the cloth in the liquid color, steps as follows: (1) Fabrics that have been in mordan wet with TRO solution (Wetting agent), (2) preparing water solutions for natural dyes in a dip of ± 2-5 liters for dyeing 2-3 meters of cloth, (3) dyeing the cloth in a solution of natural dyes until even, (4) then drain / dry until the cloth is damp-dry, (5) do a minimal dyeing again 3 times the dyeing and 3 times the drying / until the desired level of color aging is obtained, and (6) After that do the fixation process (locking natural dyes)
4. Fixation Process: The purpose of the fixation process is to lock the natural dyestuffs of the mordan group and function to strengthen the color and give the effect of color (color direction) that varies according to the substance of the fixation used. Recipes commonly used according to Zie [17] are: (1) as much as 70 grams of alum / aluminum KAI $(SO4)_2$ dissolved in 1 liter of water then stirred, and left to stand for 24 hours, (2) as much as 50 grams of lime / calcium CaCO3 dissolved in 1 liter of water then stirred, and left to stand for 24 hours, (3) as much as 30 grams of Tunjung / iron $FeSO_4$ dissolved in 1 liter of water then stirred, and stayed for 24 hours, (4) Cloth that has dried after the coloring process later fixation process is done by soaking or dipping it so that it is flat on the desired fixation substance, (5) Alum will have a young effect on yellowish color, lime will give a dark / old effect on bluish colors.

In the process of batik contained the concept of scientific concepts related to science [S], namely the concept of compounds and molecules of dyes, natural dyes, preservatives, and chemical reactions in batik, concepts related to technology [T] batik namely extraction process, fixation, heating , and procedural knowledge of batik. In the process of batik also related to creative ideas [E] in order to obtain colors, motives, the quality of batik that is very, good, and mathematical knowledge [M] related to business profit and loss of batik, very concerned about the mathematical loss and profit.

3.2 Results of Development Natural Product Learning Based Project Integrated Ethnoscience and STEM Projects

In this research, before the design of a project based on integrated ethnosains and STEM learning models was carried out an analysis of several articles related to STEM. Project-based learning (PjBL), natural material chemical syllabus, and essential oil study materials. Furthermore, the device design and conceptual learning model are carried out, so that a valid and feasible learning model is obtained. At the implementation stage, namely the empirical stage for the learning model of natural material chemistry based on the integrated Ethno-STEM project, then at this stage also to develop the entrepreneurial character of the Student. As for this research the learning model was designed in the form of class lectures and the assignment of project assignments for the design of batik motifs of the structure of secondary metabolites. The learning process took place eight times, namely twice to understand the nature of STEM and Ethnosains, and entrepreneurial character, two meetings to understand the scope of secondary metabolites, as well as various examples of secondary metabolites. In the next two meetings to understand the various formulas of the chemical structure of attractive secondary metabolites as initiations of the bati motif. In the last two meetings the assignment was to design a motif on the canvas. In Table 1, the stages of the project-based natural material chemistry learning model are integrated Ethnoscience and STEM.

Table 1. The Syntax of Project-Based Natural Product Learning Models in Ethnosciene Integrated STEM

Fase	Project Learning Syntax	STEM Integrated Ethnoscience Project Learning Activities
1	Orientation to the problem	Explain the purpose and achievement of learning, motivate students to be active in learning, introduce the concept of secondary metabolites, especially essential oils.

		Introducing technology and engineering of refining essential oils, accompanied by question and answer, how to calculate the yield of essential oils
2	Determination of essential questions	The lecturer provided a stimulus through video or picture shows related to essential oil distillation technology and presented a form of real problems related to essential oils and batik.
3	Organizing students to study	The lecturer facilitates students to find information on essential oil distillation and batik traditionally associated with ethnoscience and STEM
4.	Arrange Schedule	The lecturer guides students in compiling a schedule so that the project designs and produces essential oils and chemical batik can be solved using effective time
5	Designing Project Planning	The lecturer encourages students to collaboratively design projects for making chemical batik in canvas fabric, planning creatively, innovatively, and logically.
6	Guiding the implementation of project tasks	The lecturer guiding students to carry out the design of batik production projects, chemical formula motifs on the canvas.
7	Monitor and Progress projects	Lecturers and students conduct evaluations and monitoring of project progress made.

At the end of the learning process the mastery test was carried out, and the results of the mastery test showed that students obtained 98% good and very good categories, and students were able to reconstruct scientific knowledge related to essential oils in the Ethno-STEM context, for example, familiar with the term distillation , and break oil from mixture. While in entrepreneurship lectures, students are given material Chemo-Entrepreneurship approaches and assignments of design projects and the practice of making batik with chemical structure motifs on canvas. The resulting project results are evaluated by the research team and between groups. In this research before making batik, students are given experience in how to make batik or paint with instructor Ibu Zie and help with videos on techniques and how to make batik on canvas. At the next stage the lecturer gave several motifs of "batik chemistry" to provide real experiences to students. In the next stage a group was formed to make batik on canvas in an effort to develop creativity as an entrepreneurial character. In Figure 1, the results of the batik creativity of the students are presented with the chemical structure motifs depicted on the canvas.

Figure 1. Batik Motifs of Students' Natural Product Structure

In this research, eight batik products were produced from eight groups, and four of the student's works were listed in Figure 2 above. The results of expert evaluations of the batik designs are as follows: (1) Batik type: Lurik Batik and Malay model, (2) Motif Batik: Contrasting colored, (3) The batik motif depicts the eugynol chemical compound compound from clove oil , curcuminoid, phenilpropanoid, polyaromatic, flavonoids, alkaloids, and flowers or clove leaves, (4) This was batik painting colored using natural color and color obtained from curcumin extract, (5) The batik fabric costs Rp. 250,000 - 300,000 / meter, (6) Entrepreneurial character developed by creativity, innovation, responsibility, and diligence.

In this research to develop students' entrepreneurial character, students of observation armpit are required to observe the characteristics of the owners, workers, and batik designs produced, as well as the results of interviews regarding entrepreneurial character of essential oil business owners and Batik. According to students the character of entrepreneurship from essential oil owners and workers and batik is as follows, namely (1) unyielding and heavy workers, marked by resource persons always trying to produce essential oils and batik despite constrained infrastructure, funds, basic materials, and unstable prices. (2) the character of discipline, marked by them every month having a minimum production target to fulfill customer demand, discipline of disipilin essential oil workers when to add water, fuel, and separate products, (3) creative and innovative characters, which are marked by how they to always be creative and creative to increase the yield and utilization of essential oil waste, while batik owners are characterized as creative and innovative in producing batik products and the quality of their batik. In this research presented the results of the batik product project evaluation in Table 2.

Table 2. The Scoring Results of the Students' Entrepreneurial Characters in Designing Chemical Batik

Group	**The average score of Indicators**									
	Motif		Attractiveness		Creativity		Color		Originality	
	Pre test	Pos tes	Pre test	Pos test	Pre test	Pos test	Pre test	Pos tes	Pre test	Pos test
1	80	87	81	86	81	88	80	88	80	88
2	79	87	78	85	78	87	82	88	79	88
3	78	86	80	86	80	86	81	86	79	87
4	80	87	79	86	79	87	80	86	80	87
Averag	79.3	87.8	79.5	86.8	79.5	87	81.3	87	79.5	87.5
N-gain average	0.68 [High]		0,56 [intermediate]		0.58 [intermediate]		0.44 [intermediate]		0,64 [High]	

In Table 2, the results of the average score of the N-gain score show that entrepreneurial character scores are in the high category for motives and authenticity, while for indicators of attraction, creativity and color contrast are moderate. In the research carried out entrepreneurial character values, namely in terms of creativity in designing "chemical motives" on the canvas and the results, in the data the value for pretest was obtained during design design and post-test scores after the project was completed, and the results of this research were in accordance with Nancy's work procedures (18) . The results of "chemical batik" creativity were assessed by inter-groups, lecturers, experts and posted on Social Media. The results of netizens' assessment of the batik works were positive responses with the number of likes 42 and 8 comments in a span of 24 hours, and agreed to be

IPR patents and forms of student entrepreneurship. The findings of this research indicate that the Ethno-STEM integration project based learning model is able to make a positive contribution to creativity.

3.3 Downstream Design of Research on the Development of Natural Material Learning with the STEM Integrated Ethnoscience Approach

The current research decentralization policy is expected to be able to create excellence in university research (PT) not only in terms of conducting basic or applied research but also development research that leads to the downstreaming of research results (2). In this research to achieve the downstreaming of research into the development of natural material learning with Ethnoscience's integrated STEM approach, basic research, research and development has been carried out, scientific field development research grants, and the final product of the research are teaching materials and learning tools, learning models, textbooks ber ISBN, publication of articles, and finally a batik design with the dominant motif of the chemical structure of secondary metabolites. At the downstream stage of this research, the prototype of chemical motif batik is produced in the form of batik cloth with the motif of the chemical structure of secondary metabolites and patented in the form of Intellectual Property Rights (IPR) with a certificate of cipto rights registration. In this research to produce batik cloth with the dominant motif of the structure of secondary metabolites in collaboration with Batik Zie as a private party. The following table 3 presents the downstream process of the research that the researchers have done before.

Table 3. Preliminary Research of Downstream Supporters of Developed Research

No	Previous research experience	Research findings
1	Development of the Chemical Learning Model of Natural Material Organics with the Integrated Ethnoscience STEM Approach	Textbook for Natural Product Learning Model with STEM approach integrated Ethnoscience, batik motif design with the structure of secondary metabolites.
2	Science Learning Models for Developing Teaching Materials characterized by Conservation (Hibah Pasca, 2016)	Teaching materials and learning models with the Ethnoscience approach, conservation character cultivation, and scientific publications
4	Science Learning Model Based on Ethnoscience to Develop Conservation Character Values and Science Literacy (Hibah, 2014 dan 2015)	Learning model of Ethnoscience approach, Understanding of scientific literacy, conservation character, and scientific publications
5	Reconstructing Scientific Knowledge Based on Culture and Local Wisdom in Karimunjawa To Develop .(Hibah Pasca, 2013)	Findings Teaching materials and scie[illegible]e-based learning devices. Ethnoascience, planting, character of conservation, and scientific publications

Basically, the outline is for the downstream process of research on the results of research developing learning models for Organic Chemistry of Natural Materials with the STEM Integrated Ethnoscience Approach as follows.

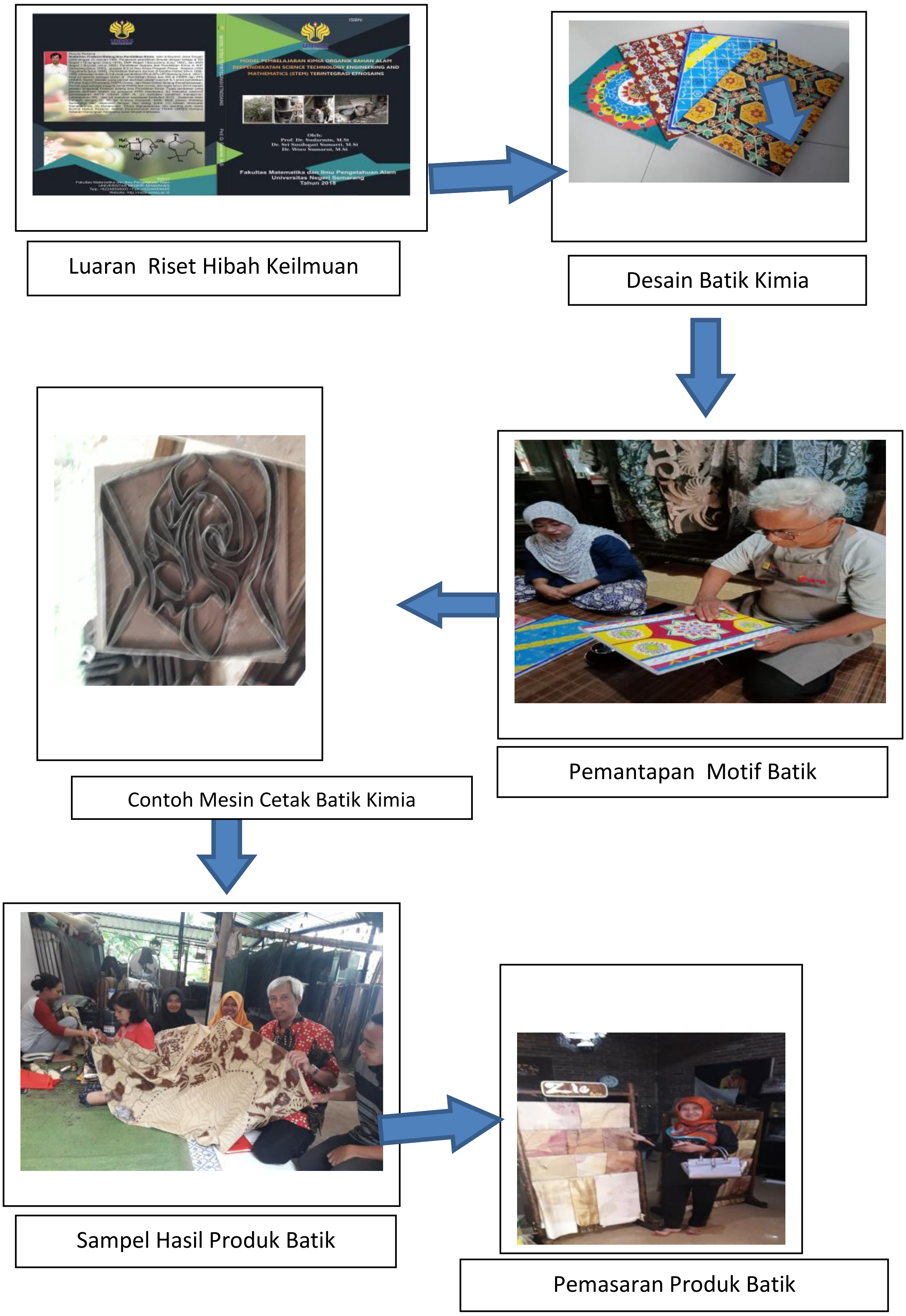

Figure 2. Research Downstreaming Steps to Produce Batik Fabrics (Personal Documents, 2019)

In figure 2, a series of activities to produce Batik products are seen as the end result of the downstream research activities, in addition to the motifs and designs of chemical batik which in this case as many as six designs are registered with the Indonesian HAKI center to obtain simple patents from this research.

4. Conclussion

The results of the analysis from the research data from the resource persons and discussion can be concluded that (1) The sources of the owners of essential oil refining and batik have understood correctly according to scientific knowledge, (2) the results of research and discussion, it can be concluded that (2) The learning model of essential oils with STEM approach was found, and (3) the results of the implementation of the essential oil learning model of the STEM approach were integrated ethnics acquired. of Zie batik, so that six printing machines of Chemical batik motifs were set up with various chemical structures and were feasible for the motives and production of chemical batik fabrics of economic value. The results of the study also found that the learning model of natural culture and creativeness can be creatively, innovatively, diligently and characteristically towards national culture.

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