

APPLICATION OF JBATIK TECHNOLOGY IN THE DEVELOPMENT OF MOTIF DESIGN FOR TRADITIONAL BATIK CRAFTSMEN

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Abstract: This participatory action study is aimed at identifying the adaptation level of traditional batik craftsmen in developing batik motif designs using jBatik software technology. The research participants consist of 10 traditional batik craftsmen, three from the innovators group and seven from the adopters group located in Kerek District, Tuban Regency, East Java Province, Indonesia. The application of jBatik technology will be carried out using the Diffusion of Innovation theory which divides the process stages into 5, namely the knowledge stage, persuasion stage, decision stage, implementation stage, and confirmation stage. The results of the theory application resulted in 4 things. First the knowledge about various social system variables and the characteristics of the innovation recipients. Second, the design of the communication model to include knowledge about the innovation of batik motif design as a result of the J-Batik software. Third, the results of the simulation of the application of batik motif designs produced by the jBatik software with craftsmen. Fourth, validation of the simulation results of the application of batik motif design innovations by craftsmen by people who had the ability to measure the level of absorption of innovation, so that the level of adaptation of traditional craftsmen to the technological challenges of the j-batik device could be identified. This study contributes to determining the level of knowledge and basic skills possessed by traditional batik craftsmen to serve as a starting point in deciding innovation strategies to be solutions that can be implemented by them.

Keywords: development, motif, batik, jBatik, craftsmen.

1 INTRODUCTION

The culture of Indonesian people is rich in diversity. One of them is batik. For Indonesian people, batik is not only an ordinary sheet of cloth that has material elements but also contains non-material values. Precisely on October 2, 2009, Indonesian batik received international recognition from the United Nations Educational, Scientific and Cultural Organization (UNESCO) as Masterpieces of the Oral and Intangible Heritage of Humanity [1,2].

Through the process of inheritance carried out continuously to subsequent generations, batik has been able to continue to exist until present time. Although in the process of the inheritance there were also changes in aesthetics, values, and functions because batik is used by the community as one of the solutions to life in order to improve the quality of life without leaving all the characteristics and traditions that it carries [3,4].

In order to survive, basically, any product needs to innovate its design, which actually plays an important role in determining product success by focusing on mastering tools and technology, taking advantage of market opportunities, and also understanding user needs [5,6]. Batik design

innovation itself has been carried out by adapting to digital transformation through the use of design software for the development of motif designs [7], product development in accordance with community trends and needs [8], as well as in ways that still maintain traditional ways such as developing variations of natural dyes for textiles using various types of natural materials that have never been explored before [9].

All of these batik innovations are actually the development of batik which was previously a traditional product used for daily needs, and has now become one of the important commodities in the national economy. Batik also contributes to foreign exchange for the country [10]. Based on data released on the official website of the Ministry of Trade of the Republic of Indonesia in 2020, it was known that batik industry had made a significant contribution due to the export performance of batik and batik products in 2019 worth USD 54.36 million.

Meanwhile, in the period of January to July 2020, it was USD 21.54 million. Batik production in Indonesia is dominated by micro, small and medium enterprises, with 88 % of the employees or craftsmen who are local people and home-based

craftsmen (Ministry of Trade of the Republic of Indonesia, 2020). One example is the batik industry located in Kerek District, Tuban Regency, East Java Province, Indonesia.

The batik industry in Kerek is one of the representations of other batik industries in Indonesia which is still done at home with traditional processes and relies on local craftsmen. For the people of Kerek, batik has become part of a tradition that is firmly embedded in the pattern of daily life, and has developed into one of the livelihoods of most of the community. Until now, the number of batik industries on the S.M.E. scale in Kerek is around 924 units. Even compared to the handicraft industry and agriculture, batik contributed more as much as 65% [11].

One of the challenges faced by traditional industries, one of which is batik, a representative of other products, in general, is the lack of ability to adapt to change, especially in creating innovations in the appearance of batik. This is due to the mentality of the craftsmen and workers who are still conservative, rigid and difficult to work with various forms of novelty and changes in the environment [12,13]. Especially in Kerek, actually there are no rules in the form of norms and customs that strictly limit the craftsmen to explore batik in order to create novelty. This is more due to the influence of an internal rejection attitude from the craftsmen because they feel safe in their comfort zone, so they decide not to change [11].

While batik craftsmen in Kerek still have problems with mentality, in Indonesia, various trends and technologies are available and can be used to increase the effectiveness and productivity of batik. One of them is the j-Batik software technology which has been developed since 2007 with the aim of assisting batik industry in Indonesia to create variations of traditional motifs development easily and quickly by utilizing shape processing inspired by the shape of the traditional batik motif module [14].

Additionally, as an effort to maintain the existence of batik in this era in which technological intervention is a challenge that must be faced, it is not enough to use conservative methods by keeping batik in its original form. Batik also needs to open itself to the possibility of change and innovation to fit the current conditions. In fact, innovation is considered not only to keep the tradition fresh, alive, and not just static; but also to strengthen the identity so that it can be well maintained [11].

Therefore, the challenge faced by traditional batik craftsmen in Indonesia, especially those selected in this study with batik craftsmen in Kerek as representatives, is how to be able to build the mentality of craftsmen so that they can be open to design innovation in order to present a form of novelty of batik itself.

2 REVIEW OF RELATED LITERATURE

Traditions and Modernity

The term 'tradition' refers to an established knowledge, method, practice, belief, custom, habit, legend, or story that is conveyed and passed on from one generation to another and is deliberately preserved in the present [15]. Additionally, the word tradition is also used to express the state of being 'old' and expired. This is related to the past, pre-industrial, local wisdom, vernacular, and opposite to modernity. Likewise, the term 'traditional object' can mean an object representing all uses of ancient materials, tools, techniques, forms and functions, with a specific place and time [16,17]. The meaning of modernity is something related to the historical period to the present. The word modern refers to the present, contemporary or the last time, something new, as well as trying to create something fresh and not traditional. Furthermore, the definition of modernity also relates to ideas and related to the latest concepts and thoughts [18].

Tradition in its current condition has experienced a narrowing of meaning. There are still some misunderstandings in seeing it. Tradition is considered to be something that is permanent and eternal and its identity is inherited without being able to change, so we cannot change identity and only need to pass it on to future generations. Related to this, identity in tradition should become an opportunity to be analyzed by involving all communities to build new meanings together, so that identity can be negotiated, so that it becomes pluralistic and democratic [19]. Additionally, everything related to tradition is considered good, must be preserved and maintained, so that sustainable local development must respect beliefs, ritual practices, and habits that cannot be changed. Regarding to this matter, possibilities should be opened so that alternative ideas for each individual or group can also appear and develop [20].

Innovations of Traditional Objects

Innovation on a traditional object is basically a process of solving community problems through optimizing the processing of forms, techniques, content, functions and contexts of a traditional object, taking into account the needs, safety, security, health, comfort, and beauty for people [21]. This innovation of traditional objects ends in the form of objects that contain new values taking the main potential source of the tradition itself then combined with modern knowledge and the latest technology [17].

In a traditional object, there are at least four types of methods in the form of mutations to create innovation and novelty [22]. First, primary mutations, i.e traditional objects created by accident. They are caused by a leap in the human imagination. Second, free mutation, that is after the traditional object formed by accident, then changes are made to improve its function. Third, substitution i.e changing or exchanging the material with the

same concept. Fourth, cross mutation i.e adapting thoughts or ideas from one traditional object to another. In the beginning, most of the development of a traditional object was obtained through primary mutation and free mutation methods. However, since the amount of knowledge increased and very basic findings became increasingly difficult to obtain, growth and product development began to be dominantly obtained from a cross mutation method.

This innovation with the cross mutation method seems to be enriched by other thoughts, that is in principle every innovation made by taking inspiration from a traditional object needs to first identify 4 main things [23,24], as follows:

1. What is retained? What elements in the tradition must remain and must not be changed. These elements represent the strongest traditional identity, so radical changes to these elements can risk the loss of the entire traditional identity.
2. What was replaced/changed? Which elements in the tradition that can be replaced or changed.
3. What are the new things? What elements can be added to the tradition which previously non-existent, including substitution of materials, techniques, ornamentation, colors, textures, additional tools to help with practicality, to economics.
4. What is omitted? What elements in the tradition that need to be removed / omitted.

Theory of Innovation Diffusion

An understanding of the theory of innovation diffusion is needed for the application of innovation in the form of ideas and technology to a group of people in a social system, so that the possibility of innovation brought can be accepted by local traditions in certain ways [25].

The theory of innovation diffusion is a communication theory needed to explain how a new idea and technology can be disseminated to a social system of society by being communicated from time to time in a social system. There are at least 4 main elements as the prerequisites for this theory to be carried out successfully, namely: 1) Innovation, 2) Communication media and ways of communicating, 3) limited time, and 5) the social system of society [11][26]. The process of innovation diffusion occurs through five stages of decision making according to Figure 1.

The theory of innovation diffusion is useful as a guide in carrying out experimental steps to see the level of readiness to adopt an innovation [27]. The term "adoption" is used to describe the decision to accept the offered innovation fully and consider it the best course of action. Meanwhile, there is also the term "rejection" which is used to explain the decision not to adopt the offered innovation.

Rogers classified innovation recipients into 2 groups, namely innovators and adopters. Innovators are people who are willing to take risks, have the highest social status, have financial stability, are social and have influence as central figures in society.

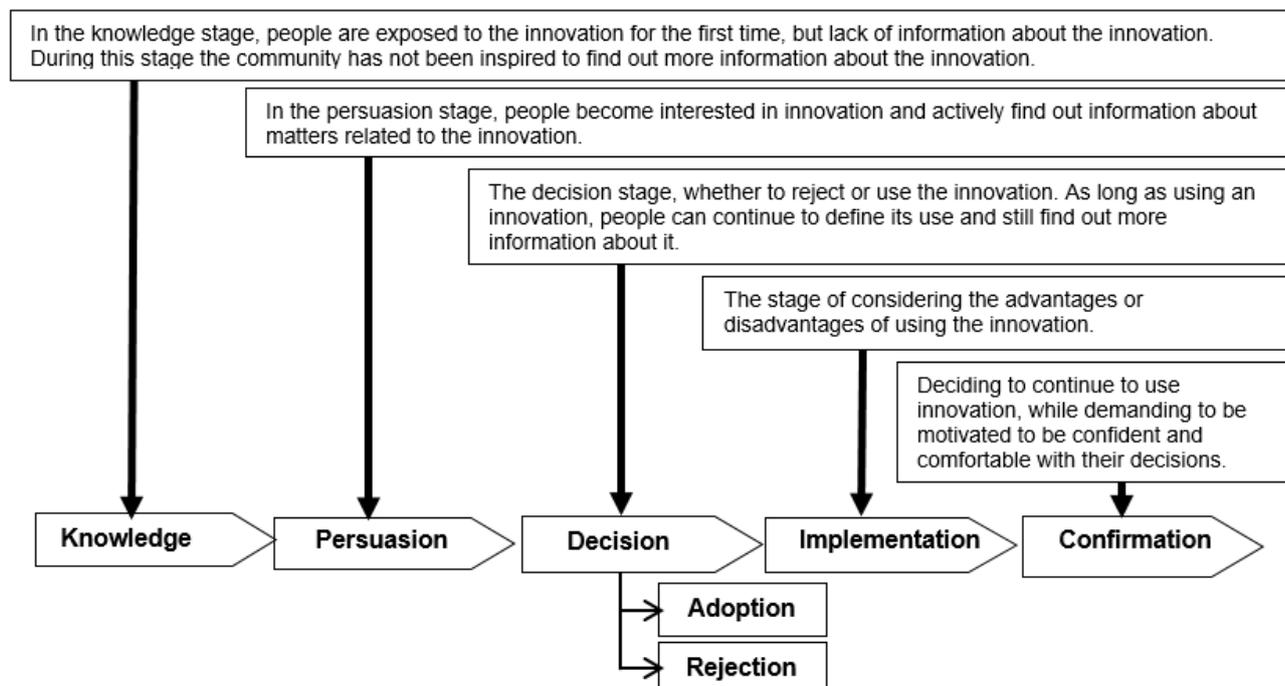


Figure 1 Innovation adaptation process based on innovation diffusion theory

While the adopters are people who receive the influence of the innovators. There are several levels of adopters, ranging from early adopters (i.e. the group of people who first receive influence from the innovators and tend to have no conflict in accepting it) to late adopters (which is the group of people who get the most influence after being influenced by seeing most people who have already done so) [25][26].

Kerek People Batik Tradition

Batik is a cloth made traditionally using ‘canting’ or copper stamp as a tool for drawing motifs on the cloth and ‘wax’ as a barrier material during the coloring process. This cloth in traditional contexts is used for traditional purposes and as decorative patterns [28]. A cloth can be called batik if it has at least three main elements, namely: (1) a barrier technique using hot wax as a color barrier, (2) a way of applying wax to the surface of the cloth using a canting and/or stamp and then coloring it by dyeing, and 3) a distinctive and varied pattern on the

philosophy of life of the Kerek people [29]. In traditional batik in Kerek these conditions are met.

In particular, what distinguishes Kerek batik from other traditional batiks in Indonesia is its visual appearance, namely motifs and colors that contain certain meanings. In general, the motifs of the Kerek people take inspiration from the forms of objects that are often found in the surrounding environment [30]. Meanwhile, the colors in traditional Kerek batik contain a philosophy of traditional community life [31,32] as explained in Table 1.

The uniqueness of the traditional batik style of the Kerek people is also found in the details called *coblosan* and *ren-ren* as shown in Figure 2. *Coblosan* is a detail on batik cloth in the form of small fine dots, the effect of which is obtained by piercing the cloth covered with wax with a pointed object resembling a needle. *Ren-ren* is a style of drawing motifs by Kerek people by adding repeated straight lines resembling fine combs placed on the edges of the outline of the main motif [33].

Table 1 The color of traditional batik cloth based on the philosophy of life of the Kerek people

No	Colors	Pictures	Visual and Aesthetical Meaning
1	Putihan		A white background with dark blue or black motifs is considered a symbol of purity and holiness. Therefore, <i>putihan</i> cloth is usually used to wrap newborn babies, because by the Kerek people this is represented as a symbol of birth
2	Bangrod		It is used by unmarried women and associated with menstrual blood. It symbolizes fertility and productivity. The word <i>bangrod</i> comes from <i>diabang</i> (colored red) and <i>dilorod</i> (boiled to remove the batik wax).
3	Pipitan		It has a <i>remekan</i> basis (effect like cracking) and is commonly used by married women as a symbol of coexistence with their husbands, children, and childbirth. The word <i>pipitan</i> means togetherness. In Java, this is interpreted as togetherness and husband and wife as well as children.
4	Biron		This cloth is used as <i>sesrahan</i> (gift) of the groom to the bride. This is symbolized as the stage before the woman is finally ready to join as part of the man's extended family.
5	Irengan		It has a dark black motif, a symbol of an end and is usually used to cover corpses because it is considered sacred as a repellent for the salvation of spirits.

Generally, the aesthetics of the traditional batik of the Kerek community represent characteristics that are sociologically influenced by ethnicity describing Javanese values and culture, while psychologically influenced by the environment which is a coastal and agrarian area [34]. The composition is very irregular and is often made on a coarser cotton fabric. Agrarian nature is a source of inspiration, and the variety of decoration symbolizes an unpretentious everyday life. The forms of decorative motifs are often distorted, and the harmony of the design is not taken into account [35].

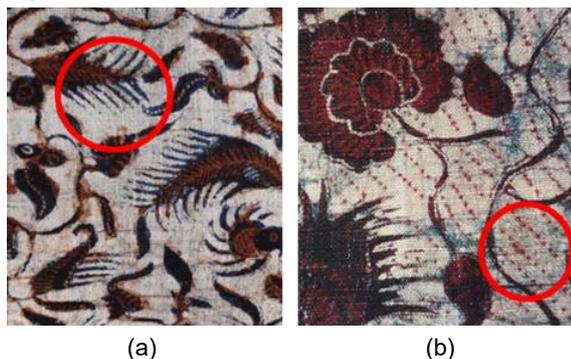


Figure 2 Ren-ren (a) and coblosan (b)

jBatik software

jBatik is a computer software created by the company P.T. Batik Fractal Indonesia, which aims to help craftsmen in Indonesia work efficiently to develop variations of new batik patterns with the help of technology quickly. This creation of jBatik is an effort that the company believes in preserving Batik in Indonesia by collaborating on technology. Information about the jBatik software can be found on the website <http://www.jbatik.com/>, and for batik products that have been produced, shown on <https://batikfractal.com/> website.

jBatik is a special software for creating various alternative new batik motifs by applying the fractal concept, that is the development of shapes based on objects in the form of geometric modules that have 'self similarity'. This means that every small part in the fractal geometry can be seen as part of a small-scale replication of the overall shape [14].

There are several forms of fractals, one of them is the Sierpinski triangle which was discovered by Waclaw Sierpinski by dividing an equilateral triangle which was partitioned into four equal parts. Then it is divided by other, smaller triangles. If the division is continued to infinity, it will get a triangular shape like the overall shape [36], as shown in Figure 3.

The motif design produced by the jBatik software has a shape with fractal properties, so it is called fractal batik. The application of the concept of fractal to batik is actually not something unintentional, but has gone through a series of research processes by calculating the fractal dimension until finally it can be proven that there

Table 2 Research participants from innovators category

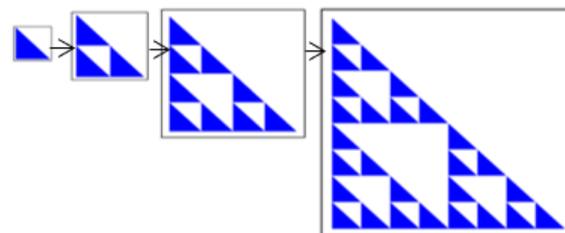


Figure 3 Sierpinski triangle fractal shape

are fractal elements in batik [14]. The existence of fractal properties in batik can be explained by understanding the nature of the fractal itself, namely self-similarity, which means that there is geometric detail on a smaller scale than the motif elements in batik. The concept can be explained simply as shown in Figure 4 illustrating fractal

properties in the examples of ceplokan batik motifs [11], namely: a) Flower Petals Module with Fractal Properties; b) Flower motifs with Fractal properties from the repetition of the shape of the flower petal module; and c) Composition of Ceplokan Motifs Partitioned from Flower Motifs.

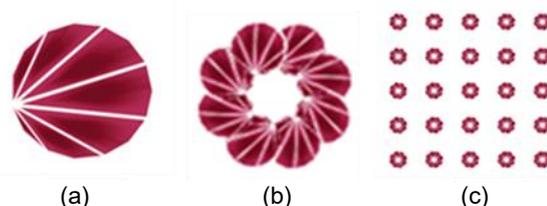


Figure 4 Fractal properties in Ceplokan batik motifs

The use of the jBatik software on fractal batik places it as something modern and oriented towards innovation and novelty. This becomes one of efforts to make the batik tradition able to co-exist with technology collaboratively [37].

Fractal batik still collocates the word batik in front of it to show that there are values which are the main principles of batik that are still maintained, that is the process of drawing motifs on cloth using hot wax barriers using tools in the form of canting tulis or canting stamps [11]. On the other hand, fractal batik tries to differentiate itself by involving the role of technology to help create motifs based on the principles of fractal mathematics. The use of this software technology replaces some of the process stages in batik making, especially at the stage of extracting motif ideas and pouring them in the form of drawings / sketches on paper [38].

3 RESEARCH METHODS

The research was conducted following the theory of innovations diffusion involving a group of traditional batik craftsmen in Kerek District, Tuban, East Java to apply jBatik technological innovations to the batik process to produce new batik motifs and the ability

Name	Age [yo]	Working period [year]	Notes
Rukayah	57	34	She was experienced and had opinion leadership among batik craftsmen in Kerek. She also played a role in popularizing Kerek batik until she was awarded <i>upakarti</i> by the president.
Uswatun Hasanah	51	31	A Batik entrepreneur who had employed dozens of batik craftsmen. She had received <i>upakarti</i> award from the president for her contribution to preserving traditional batik
Sri Lestari	45	26	Batik entrepreneur who had employed dozens of batik craftsmen. Open to various innovations and had won several provincial-level batik motif design competitions.

Table 3 Research participants from adopters category

Names	Age [yo]	Working period [year]	Age Group	Skill Quality
Ningsih	44	24	Middle Aged	Excellent
Sartika	30	12	Young	Excellent
Murti	42	20	Middle Aged	Good
Dewi Srianing	36	15	Middle Aged	Good
Purtini	44	26	Middle Aged	Good
Supiyah	43	21	Middle Aged	Fair
Krusingsih	26	7	Young	Fair

to adapt to innovation. The consideration in involving craftsmen in the design innovation process was to measure the objectivity of the craftsmen's level of readiness to accept innovations in the form of appropriate technology and at the same time so that innovation does not stop and can be continued in a sustainable way [39].

Craftsmen involved in the assignment of experiments were selected by considering several criteria, including: 1) innovators (explained in Table 2) and adopters; 2) the ability to absorb information, motivation, and skills; and 3) age level. This was done to find out whether there is an effect of the absorption rate of a design innovation on the craftsmen group based on these criteria [38].

The adopting craftsmen groups involved as research participants had different levels of absorption of information, motivation, and work skills and are divided into three groups based on the results of observations and identifications carried out directly to the craftsmen in Kerek [11], namely:

1. Excellent quality. Having skills and knowledge of making traditional batik very well from years of experience. Highly motivated (without limiting the reasons for their motivation), quick to receive information, and willing to accept challenges.
2. Good quality. Having the skills and knowledge of making traditional batik well from their years of experience. They did not close themselves to new ideas even though they had doubts about their success.
3. Sufficient Quality. They had the skills to make traditional batik but had not yet produced high quality batik. They did not close themselves to new ideas even though they were doubtful about their success.

At the age level, the grouping was divided into 3, namely: 1) the young group between 18 to 30 years old; 2) the middle-aged group between 35 to 45 years old, and 3) the group over 50 years old. The details of the craftsmen from the adopters category are as shown in Table 3.

Generally, all methods of applying jBatik technological innovations to craftsmen were carried out according to the principles of the theory of innovation diffusion in Figure 5.

Explanation of the numbers in Figure 5 is explained, as follows:

1. Data and information collection regarding social system variables as well as the cumulative personality characteristics of the community and traditional batik craftsmen in Kerek includes: the needs and priorities of the community, environmental conditions in Kerek, prevailing social values and norms, as well as language and ways of communication. The collection of data and information sources was needed by researchers to build a comprehensive understanding.
2. Communication done by researchers both verbally and non-verbally to batik craftsmen (innovators and adopters) in the form of persuasion to offer innovation.
3. Communication in the form of requests for decisions to adopt or reject the innovation
4. Continued communication after the decision to adopt the innovation, then the innovation is implemented.
5. The final decision for the community of traditional batik craftsmen in Kerek relates to its usefulness, whether to continue or discontinue.

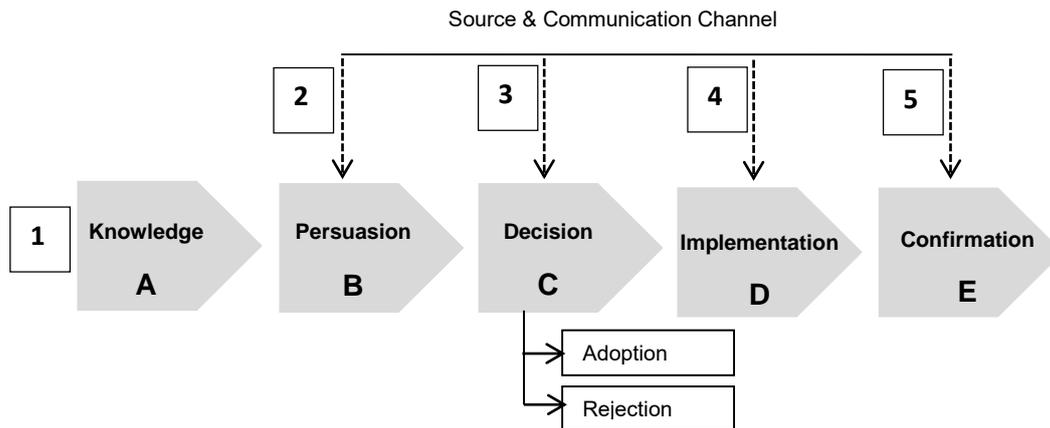


Figure 5 The method of implementing jBatik technological innovations based on the principles of innovation diffusion theory

3.1 Knowledge Stage

The knowledge stage in the application of traditional product innovation was carried out to explore data in order to find out various social system variables and also the characteristics of traditional batik craftsmen in Kerek as recipients of innovation. To be able to build that knowledge. This stage was carried out, as follows:

1. Literature studies from scientific journals, articles, main reference books belonging to Rens Heringa and Judi Knight Acjhadi, as well as visual materials in the form of cloth photos.
2. Observations to see various data and symptoms that occur at the location i.e the batik center area in Tuban, precisely in Kerek District which was spread over 4 hamlets, namely: Kedungrejo, Margorejo, Gaji, and Karanglo. Additionally, observations were made in the form of observing the patterns of interaction occurred among the craftsmen in the batik-making process.
3. Oral tradition to get testimony in the form of narratives of traditional actors who have information from the history of previous generations. This oral testimony was carried out through an in-depth interview process to obtain data and information that were difficult to find in written sources [40]. This process was carried out to several parties, including: 1) entrepreneur and batik craftsmen Uswatun Hasanah and Sri Lestari who were the 3rd generation of the traditional batik family in Kerek, 2) Rukayah community figure who was also one of the main resource persons in Heringa's research in 1994, 3) Santi Puji Rahayu as curator at Kambang Putih Museum in Tuban.

All data obtained were then analyzed to determine the appropriate treatment of innovation for Kerek batik so that the identity and values inherent as tradition are not completely eliminated, including:

- 1) what was maintained? 2) What was changed/changed? 3) what was added? 4) what was omitted?

In addition, the level of measurement of the readiness of the jBatik technology from the craftsmen involved is also carried out at this stage. This stage is done by giving treatment to several indicators in the use of the jBatik software, including:

1. Ability to operate the jBatik software, i.e., craftsmen have the ability to use the software and operate it to be able to create the development of batik motifs. The indicators are 1) Skills in operating the features of the jBatik software; 2) Knowledge of the features and functions of the jBatik software.
2. The ability to understand the concepts and workings of the jBatik software, even though the crafter is not able to operate the jBatik software himself, they know how a design is created using fractal concepts, from modules to the development stage into motifs and motif composition. The indicators are 1) Understanding how the motif design process occurs in the jBatik software; 2) Understanding how to develop motive ideas.
3. The ability to understand the design results from the jBatik software, namely the craftsmen are not able to operate the jBatik software and do not understand the stages of creating new motifs and motif compositions, but can understand and imagine the final design resulting from the development and then be implemented into batik techniques. The indicators are 1) Understanding how to read batik motif innovations in the form of pictures; 2) the ability to imagine the batik process that must be done to realize the batik motif innovation.

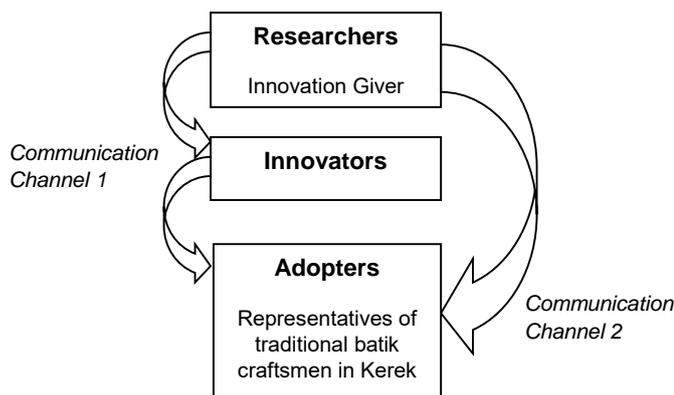


Figure 6 Communication strategy in persuasion stage

3.2 Persuasion and Decision Stage

The persuasion stage is the process of applying the right communication model to traditional batik craftsmen in order to accept innovation [41], which in the condition of the craftsmen in Kerek the innovation was the use of jBatik technology into the process of making batik habits. At this stage, the strategy was carried out according to the illustration in Figure 6 carried out in two directions, namely: 1) the researcher through the intermediary of the innovator as the first recipient of technological information and passed it on to the adopters; and 2) researchers directly to adopters.

Persuasion to craftsmen to accept innovation was done by adjusting the communication patterns that usually occur in the Kerek environment, namely: 1) delivered in a language they understand i.e Javanese; 2) choosing relaxed conditions so that communication is more directed like everyday conversation but has been inserted with an invitation to innovate; 3) persuasion to adopters is carried out by innovators so as not to create distance and craftsmen feel comfortable; and 4) carried out in the form of direct oral communication and minimize the possibility of distance to avoid distraction of messages and information.

The persuasion process was carried out by inviting innovators and adopters to communicate and being asked questions and offers in stages to know their level of motivation, including:

1. Optimistic. Be open to innovation and tend to desire the presence of novelty in the tradition of typical Kerek batik cloth. The question given: "Would you like?" and "Are you sure you can?" The answers and attitudes given were able to show a high desire and confidence to accept the offer.
2. Accepting but not motivated. Being open to innovation but not having the initiative to do so, because it is not born from their motivation. The questions at the motivation level are developed if one of the questions at the motivation level number 1 is not met. Additional persuasion needs to be given first to give confidence and then willing and ready: "We will do it together, later we will be guided

slowly until we can". If necessary, it can be explained in detail about the stages that will be carried out together. After that the question is asked again at the motivation level number 1, until they will finally give an answer and are willing and ready to accept.

3. Indifferent. Being indifferent and tending to choose the answer to reject, but change to accept the challenge of innovation if given a reward. The craftsmen's motivation to get involved was based on economic motivation. Questions at this level of motivation are developed if efforts at levels 1 and 2 are rejected. So, they would be given additional persuasion by rewards offer in the form of fees. The answer that is expected after being given this persuasion is willingness to accept.
4. Rejecting. Being closed to innovation offers and avoiding talking. All forms of efforts that have been given have not succeeded in influencing their willingness to accept.

3.3 Implementation Stage

The implementation stage was the application of the motif design produced by the jBatik software, then transformed into batik sheets by the craftsmen using batik tulis (handmade) technique. This handmade batik technique follows a process that has become a habit for traditional craftsmen in Kerek according to Figure 7. At this stage the craftsmen would be observed in terms of their ability to overcome design problems that they have never made before when implementing it using batik tulis technique.

In the implementation process, the requirements that limit the way of working are determined, including:

1. jBatik makes batik creations according to their characteristics but the inspiration for the motifs is taken from the traditional batik motifs in Kerek. It was decided to choose the Srigunting motif, which is one of the classic motifs and is mastered by most of the craftsmen.
2. The designs produced by jBatik are printed on 1:1 scale paper with the dimensions of the sayut cloth i.e 60 cm x 300 cm.

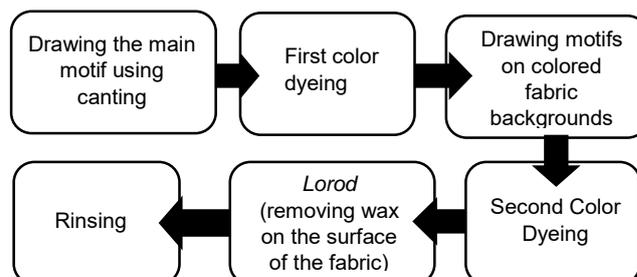


Figure 7 The process of making Batik Tulis (handmade batik) in Kerek

3. Craftsmen responded to designs on paper that have been produced by jBatik as a guide in describing motifs on fabrics through the batik making process. In this process, there was no intervention given to the craftsmen.

3.4 Confirmation Stage

The confirmation stage was carried out to obtain innovation recognition for the benefits of innovation, as well as to validate the simulation results of the implementation of batik motif development using the jBatik software by craftsmen. This assessment process was carried out using a semantic differential approach by determining the factors being assessed and the rating scale [42], as shown in Table 4, as follows:

The assessment on the indicators of the craftsmen's work attitude was carried out by researchers who know the entire series of experimental processes carried out. Meanwhile, the indicators of innovation in the design of batik motifs made by craftsmen, including:

1. Expert and researcher in the field of traditional textiles, Dr. Cut Kamaril Wardani Representative from Cita Tenun Indonesia.
2. Pikel Indonesia as the developer of the jBatik software, Muhamad Lukman.
3. Rukayah, senior traditional batik craftswoman in Kerek, as a representative of craftsmen who know about the development of batik in Kerek.

4 RESULT AND DISCUSSION

4.1 Knowledge about Factual Condition of Batik Tradition in Kerek

Knowledge about the factual conditions of batik tradition in Kerek was developed from observations, oral traditions as well information searching through literature sources that have been previously carried out. The results obtained were as follows:

1. The characteristics of the Kerek community was previously described as of rural communities such as having a strong relationship with nature so that many rules of life were born with the aim of protecting nature; livelihoods were generally farming, gardening, or making cloth; homogeneity in the form of similarities in social and psychological characteristics, language, beliefs, customs, and behavior was still very strong in society; and social differentiation showed the existence of social stratifications with different social status.

All of these characteristics now no longer represent the characteristics of the Kerek community, and are starting to be replaced with the characteristics of the suburban community. Nature in the framework of the concept of macrocosm and microcosm is no longer a priority for them, as evidenced by the growth of infrastructure and industrial development that sacrifices the preservation of nature. The people's mindset is more material-oriented than maintaining traditional values that have been considered ancient and unprofitable. This is most clearly seen from the work orientation of the Kerek people who decided to be factory workers. Additionally, a perspective had emerged on the acceptance of innovation in making batik cloth as a response to market trends and demands.

2. Spiritual practices in the form of rituals and traditional ceremonies were less frequently carried out by the Kerek community, due to the diminishing level of belief and appreciation of the community towards these matters. Previously the role of traditional cloth was considered important in ritual practices and traditional ceremonies. But now these practices are no longer implemented and are starting to lose their existence.

Table 4 Format for assessing the work attitude of craftsmen and visualizing innovations in batik motif designs

Factors	Rating Scale							Factors
1. Work attitude of craftsmen								
Confused	-3	-2	-1	0	1	2	3	Understanding instruction
Slow								Skillfull
Monotonous								Improvising
Very Slow								Fast
2. Innovation visualization of Batik motif design using jBatik by craftsmen								
Unclear shape	-3	-2	-1	0	1	2	3	Accurate shape
Ordinary								Aesthetics
Old/Ancient								New
Batik Kerek identity unrecognized								Batik Kerek Identity Recognized

Notes for Rating Scale : -3 (very bad); -2 (bad); -1 (not sufficient/minus); 0 (neutral); 1 (sufficient); 2(good); 3 (excellent)

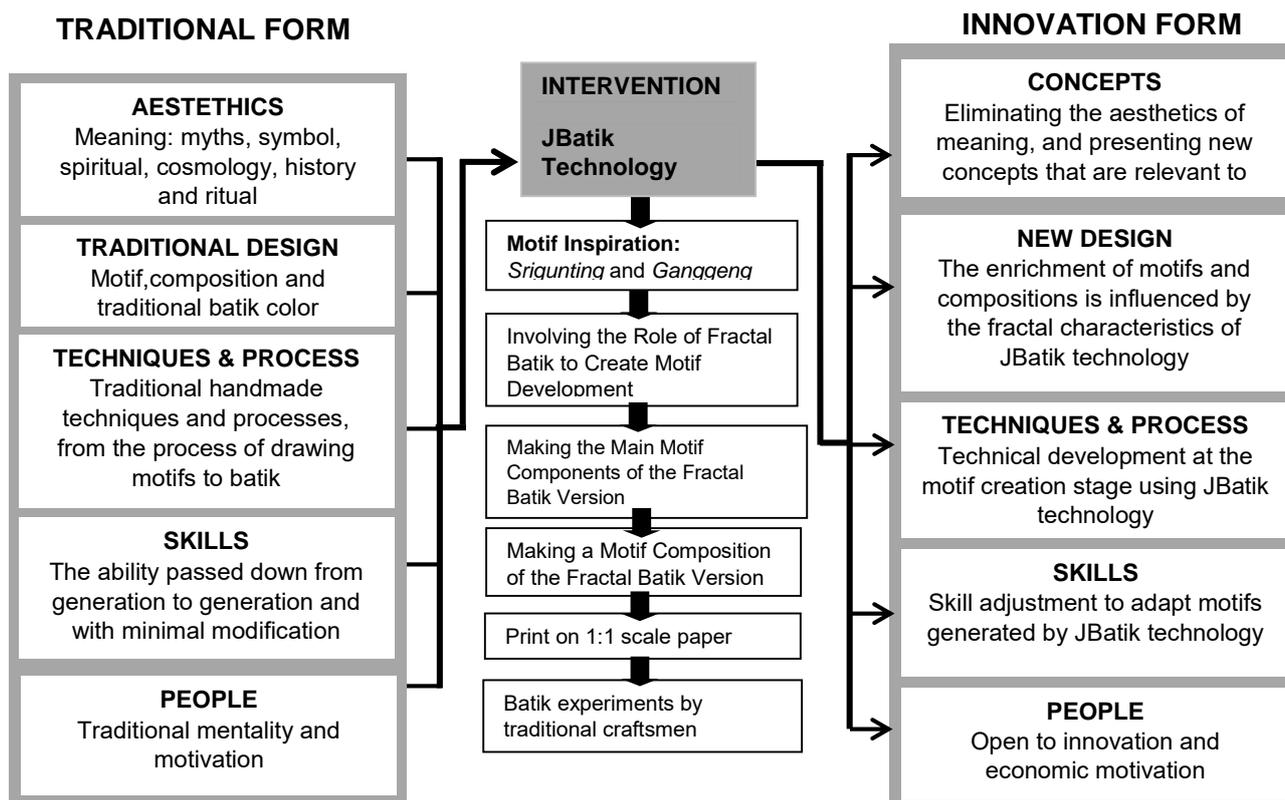


Figure 8 The expected form of innovation through the application of JBatik technology on Kerek batik

3. Environmental conditions in Kerek which are close to industrial areas also have an impact on growth in the infrastructure sector, thus opening up great opportunities to get to know technology and get information flow rapidly. The impact on this also has an impact on the mindset, motivation, and way of making decisions for the Kerek people who are slowly starting to leave things that are rural in nature and prefer the new things offered by the modernity concept.

Therefore, based on these facts, if you relate this to the act of preserving the existence and vitality of tradition, the most appropriate way is to carry out a transformation strategy, namely developing the tradition of making cloth through innovation by providing a touch of novelty both in terms of technique, function, and aesthetics without completely abandon its traditional values [11]. This needs to be given to the craftsmen so that they can adjust their abilities to create innovative batik.

4.2 Innovation Idea on Batik Kerek

Based on the factual conditions, the strategy implemented was transformation, as described in Figure 8.

Furthermore, transformation through innovation in developing batik motifs using jBatik software needs to measure the readiness of traditional batik

craftsmen in Kerek to technology. The following in Table 5 is the result of measuring the readiness of jBatik technology for traditional batik craftsmen in Kerek.

The analysis is the cause of the obstacles for traditional batik craftsmen in Kerek to have a level of readiness at stages 1 and 2, namely, there is a high gap between the basic knowledge and skills possessed by the craftsmen and jBatik itself at this time with the basic criteria that need to be possessed to understand and operate the jBatik software.

Basic criteria are needed for craftsmen to be able to operate the jBatik software; it includes: users have basic skills in understanding computer equipment. The basic requirements are the ability to turn on and off the device, use additional tools such as a mouse and keyboard, and operate the software. The jBatik software requires the user to understand the basics. In addition, early jBatik users are expected to be familiar with the software interface with various window functions and toolboxes. Understanding basic computer literacy is vital to understanding and even mastering how jBatik works. Some of these essential things are not owned by the traditional Kerek batik craftsmen, and none of the seven existing craftsmen know the basics. After mastering the understanding of basic computer literacy, it is also necessary to have basic knowledge of design elements and principles to

Tabel 5 Readiness of jBatik technology Traditional batik craftsmen in Kerek

No	Craftsman Name	Readiness of jBatik technology					
		1. Ability to Operate		2. Ability to understand concepts and how to work		3. Ability to understand design results	
		Ability to operate features on jBatik software	Knowledge of jBatik software features and functions	Understand the motif design process in jBatik software	Understand how ideas are developed	Ability to understand how to read motif innovations in the form of pictures	Ability to imagine the batik process that must be done
1	Ningsih	X	X	V	V	V	V
2	Sartika	X	X	V	V	V	V
3	Murti	X	X	X	X	V	V
4	Dewi Srianing	X	X	X	X	V	V
5	Purtini	X	X	X	X	V	V
6	Supiyah	X	X	X	X	V	V
7	Krusingsih	X	X	X	X	V	V

create various variations of new motifs that are diverse and contain ethical values.

The results of the measurement of readiness for jBatik technology are then used as a basis for consideration of the treatment of traditional batik artisans in Kerek, namely applying motif development innovation starting from the readiness level of stage 3, which has implemented the design of the jBatik software development results to the batik process.

4.3 Persuasion to Traditional Batik Craftsmen in Kerek

Innovation persuasion was carried out to innovators and adopters in order to accept the offer of innovation ideas given by researchers. After the persuasion process carried out according to the procedure, the innovators and adopters would show their attitude and then made decisions in the form of motivation. These decisions were further

grouped based on the level of motivation, as shown in Table 6.

4.4 Implementation Result of jBatik Technology

The implementation of jBatik technology resulted in design development, on the motif module which is processed with design principles, including: repeat, add, change scale, superimpose, and animated as shown in Table 7. The composition was made dynamic and fractal in order to be able to display something different from the composition of the motif which traditionally tend to be static.

The application of the motifs resulting from the development of the jBatik software is then carried out by the craftsmen by following the process of making batik as shown in Figure 9.

The relationship between the motivations shown by craftsmen from the adopter group to the innovation of batik motif designs produced by jBatik technology is shown in Table 8.

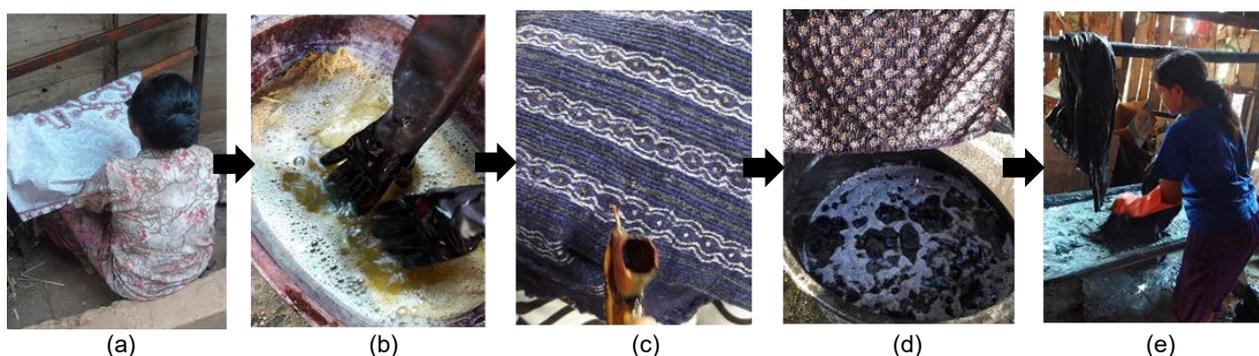


Figure 9 The process of implementing batik motifs resulting from the development of the jBatik software by craftsmen: (a) Drawing motifs with canting; (b) First color dyeing; (c) Draw a motif on a colored cloth background; (d) Second color dyeing; (e) Remove batik wax and rinse

Table 6 Motivation Level of Craftsmen

No	Name	Motivation Level	Notes
1. Innovator Category			
1	Rukayah	1	Had a desire to promote batik in Kerek and believed that outside assistance was needed. Therefore, ideas that come from outside would be fully supported
2	Uswatun Hasanah	2	Reason: Based on her experience of participating in the workshops of batik innovation held by the government. It often does not continue among craftsmen.
3	Sri Lestari	1	Had the desire to promote Kerek batik which was also one of his motivations for making batik so far.
2. Adopter Category			
1	Ningsih	2	Confident as an experienced batik craftswoman and had special skills. However, after seeing the new motif design, she expressed her disbelief.
2	Sartika	2	Confident as an experienced batik craftswoman and had special skills. However, after seeing the new motif design, she expressed her disbelief.
3	Murti	3	Not confident to be able to make it because she was comfortable with the existing pattern so far. The craftsmen have repeatedly said that they were more comfortable making batik as usual because it was easy to make.
4	Dewi Srianing	3	Before engaging in experimental assignments, she had shown high economic motivation. From the beginning, the craftsmen had asked whether they would be given a higher wage than ordinary batik making.
5	Purtini	4	Not willing because she had to go to the fields to harvest in her own field.
6	Supiyah	3	Refusing to get involved because of not confident enough to work it out, but eventually changed her mind after being offered a reward.
7	Krusiningsih	3	Refusing to get involved because of not confident enough to work it out, but eventually changed her mind after being offered a reward. There was even a bargain about the amount of rewards given.

Table 7 Application of Design Techniques in the Development of Typical Kerek Traditional Batik Motifs Using jBatik software

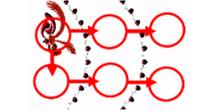
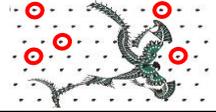
Original Form	Result	Techniques	Developed Motifs
		<i>Repeat</i>	
		<i>Superimpose & animated</i>	
		<i>Add</i>	

Table 8 Development Realization of motifs using jBatik software with hand-made batik techniques by craftsmen

No	Name	Design	Result	Findings
1	Dewi Srianing	Motif 1		There was a change in the batik making process. The craftswoman performed an additional process by firstly making a pattern using a pencil to help determine the shape of the curved line. To make the composition proportional like the example given, the craftswoman made it with the help of a ruler. The process of making batik is twice longer, because the craftswoman drew it carefully.
2	Ningsih	Motif 1		There was a change in the batik making process. The process of making batik is twice longer, as craftsmen often stopped to observe the details of the motifs on the paper and tried to carefully pursue the resemblance when drawing them with canting. There was an additional behavior, craftswoman use more than one canting. Canting with a small hole size was used to make the first outline before overwritten by the larger outline.
3	Krusningsih	Motif 1		There was no change in the batik making process from previous one. New motifs never been created before did not affect the way the craftswoman worked.
4	Supiyah	Motif 2		There was a change in the batik making process. The craftswoman performed an additional process by firstly making a pattern using a pencil to help determine the shape of the curved line so that it looks proportional. The process of making batik was twice longer, because the craftswoman drew it carefully.
5	Sartika	Motif 2		There was no change in the general batik making process from before, although in the process the craftswoman seemed to be more careful so that the completion time was longer than usual.
6	Murti	Motif 2		There was no change in the batik making process from before. New motifs never been created before did not affect the way the craftswoman worked.

Table 9 Validation of innovation indicators: Craftsmen work attitude

Indicators	Variables	Craftsmen	Individual Score	Average Score	Notes (the result of rounding the average value of 0.5 up/down)
Improvements in the work attitude of craftsmen in implementing the motifs of the results developed using the jBatik software	Understanding instruction	Dewi Srianing	2	1.6	Good
		Ningsih	2		
		Krusningsih	1		
		Supiyah	2		
		Sartika	1		
		Murti	2		
	Skills Improvement	Dewi Srianing	2	1.16	Sufficient
		Ningsih	2		
		Krusningsih	0		
		Supiyah	2		
		Sartika	0		
		Murti	1		
	Improvisation	Dewi Srianing	3	1.5	Good
		Ningsih	3		
		Krusningsih	0		
		Supiyah	3		
		Sartika	0		
		Murti	0		
	Fast	Dewi Srianing	-1	0	Neutral
		Ningsih	-1		
Krusningsih		2			
Supiyah		-1			
Sartika		-1			
Murti		2			

The results of the development of traditional batik motifs using jBatik software implemented by craftsmen were then analyzed by comparing the characteristics of traditional batik, as follows:

1. The overall motif line of the craftsmen had a character that is not much different from the traditional batik motif line i.e inconsistent and rough. This is because batik was still made using traditional woven fabrics which tend to have a rough and textured surface, making it difficult to make consistent, smooth, and neat line.
2. The shape and composition of the motif inspired by *srigunting* motif was made by applying the principles of fractal mathematics while still paying attention to the characteristics of the original motif so that its identity can still be recognized by changing the composition patterns of traditional motifs by using repeat, add, change scale, superimpose, and animated. This showed a completely different composition from traditional batik and its significance was easy to see.
3. In the developed batik, there were still *ren-ren* (except *Krusiningsih*) which show similarities to the characteristics of *ren-ren* in traditional batik motifs, although without the *coblosan* effect.
4. Color in traditional batik was one of the fundamental elements which, if removed, would result in the loss of the visual characteristics of the fabric. In the developed batik, it could be seen that the craftsmen were still influenced to maintain traditional colors.
5. *Remekan* was still dominant in some fabrics made based on the initiative of the craftsmen to maintain *remekan* like the traditional batik method.

4.5 Validation of JBatik Technology Motif Development Implementation

Validation was carried out firstly by providing an assessment using a semantic differential approach to measure the presence or absence of innovation content in batik fabrics made by craftsmen as an implementation of design development using jBatik software. The assessment process was carried out on 2 things that were used as indicators of innovation, namely: 1) Improvement in the work attitude of craftsmen in implementing the motifs developed using the jBatik software; and 2) Novelty in the visualization of batik motifs resulted from the implementation of motif development using jBatik software by craftsmen. The validation results are as shown in the following Table 9.

Based on the analysis of the validation results in Table 9, it can be explained that:

1. The variable 'understanding the instructions' was assessed based on the craftsmen's ability

to capture every work instruction given by the researcher and execute their understanding in the form of appropriate actions. The results showed the number 1.6 with a description of the score in the form of rounding was 'good'. There were 2 out of 6 craftsmen with a below average score.

2. The variable 'improvement of skills' was assessed based on the ability of the craftsmen to improve the basic skills they had previously by being able to do new jobs outside of their habits with the expected results. In this case, the improvement of skills was emphasized on the ability to understand the motifs on the paper before being transferred to the cloth. The results showed the number 1.16 with a description of the score in the form of rounding is 'enough'. There were 3 out of 6 craftsmen with a below average score.
3. The variable 'improvisation' was assessed based on the ability of the craftsmen to optimize their creativity to find various solutions from their limitations in order to be able to produce batik with the expected design. The results showed the number 1.5 with a description of the score in the form of rounding is 'good'. There were 3 out of 6 craftsmen with a score below average, and the rest got a 'excellent' rating.
4. The 'fast' variable was assessed based on the craftsmen's ability to complete their task in a quick time but did not leave the agreed work process. The results showed the number 0 with the description of the score in the form of rounding being 'neutral'. There were 4 out of 6 craftsmen with a minus score which indicated that the work process had taken much longer than the usual working process. As for the others, it had no impact at all. This variable is related to other variables, one of which was variables 1 and 3 where craftsmen improvised so that it increased working time, and some craftsmen needed time to understand the motifs on paper before starting to draw on cloth. In the case of craftsmen whose working time had no impact, even if you look at the previous variables, it showed that there was a relationship between the low level of understanding of instructions or improvisation.

Based on the analysis of the validation results in Table 8, it can be explained that:

1. The 'accurate shape' variable was assessed by the validator based on the clarity of the shape of the motif made by the craftsmen, including: the main motif form, the supporting motif form, and *isen-isen* (details of motif filler) by referring to the motifs generated by the jBatik software. The results showed that the average number of the three validators for all craftsmen was 1.4 with the description of the

score in the form of rounding the number is 'enough'. There were 3 out of 6 craftsmen with below average scores.

2. The 'aesthetics' variable was assessed by the validator based on the final appearance of the batik against its aesthetic content (such as meeting the criteria for elements and visual principles). The results showed the average number of the three validators for all craftsmen was 1.6 with a score statement in the form of rounding was 'good'. There were 3 out of 6 craftsmen with below average scores.
3. The 'new' variable was assessed by the validator based on the final appearance of batik which contained elements of novelty when compared to the appearance of traditional batik. The results showed that the average number of the three validators for all craftsmen was 1.3 with a score statement in the form of rounding was 'enough'. There were 2 out of 6 craftsmen having a below average score.
4. The variable 'identity of Kerek batik recognized' was assessed by the validator based on how much the impression of traditional Kerek batik could still be felt in developed batik. This could be manifested in the form of styles, details of motifs, and colors. The results showed that the average number of the three validators for all craftsmen is 2.3 with a score statement in the form of rounding is 'good'. The individual score of each craftsmen corresponded to the final average score. This showed that the mentality of the craftsmen was strongly influenced by the mental image of the traditional Kerek batik. Although it must also be considered that this could also be influenced by the decision to develop a motif by taking inspiration from traditional motifs.

5 CONCLUSION

Based on the results and discussions, conclusions can be drawn as follows:

1. This study provides an understanding that strengthens the researcher's assumption that the level of knowledge and basic skills possessed by traditional craftsmen in Kerek is below the standard level to meet the criteria that need to be possessed to be able to operate the jBatik software. So that for traditional batik craftsmen in Kerek, the application of motif innovation cannot be carried out at the level of technological readiness at the operating stage of the jBatik software. This provides support in taking a stance to determine an innovation strategy in order to pay attention to the level of

technological readiness of the craftsmen so that they do not offer innovation ideas that go beyond their basic knowledge and skills.

2. The process of implementing new motifs inspired by traditional Kerek decorations using jBatik software for traditional craftsmen could be carried out by going through all stages of the process in innovation diffusion theory. After conducting an assessment of the innovation indicators in the form of the work attitude of the craftsmen as well as the visual appearance of batik with new motifs; then it was known that none of these innovations was on a rating scale below zero. This indicated that the innovation could be accepted by the craftsmen and was successful. In fact, one interesting thing found from the characteristics of traditional craftsmen in Kerek was that in making batik with new motifs, they consciously added *ren-ren*. Therefore, it could be concluded that besides being able to adapt and show creativity in facing the challenges of change, the traditional batik craftsmen in Kerek also had a strong mentality in living every process when drawing batik so far. Additionally, this also proved that the visual of traditional Kerek batik had a strong mental image to keep exuding its own identity.
3. The innovation implementation process needs to refer to the characteristics of the group; as in the innovation diffusion theory, it is important to determine groups of innovators and adopters to improve communication channels so that they can be well received. In addition, in the adopter group, it was also known that age qualification and length of experience as a batik maker were not significant factors. Based on this data, it was known that the length of experience is not always a determinant of the skills quality possessed by the craftswoman. The things that significantly affected the innovation so that it can be done well are the quality of the skills and motivation of the craftsmen. Even though in terms of motivation, it is proven that there was one craftswoman whose motivation was based on economic motivation, but the performance and results of his batik were considered very good. Therefore, motivation was not an absolute thing for some craftsmen, even though it was the majority and dominant.
4. Research has been able to contribute and add value in the form of a precise mapping of the level of technological readiness and the level of basic knowledge and skills possessed by traditional craftsmen. That way, it is beneficial for researchers and designers if they will carry out further developments on the design of the typical Kerek motif so that it can be carried out gradually starting from the position that is the condition of the craftsman at this time. Any innovative ideas and solutions provided will be right on target and can be appropriately implemented in further experience.

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