The Work Posture Assessment Towards Musculoskeletal Disorders in Coloring Activities of Indonesian Hand Drawn Batik

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Abstract. This study aims to determine how big the level of musculoskeletal complaints is, the fatigue and increase productivity of batik maker after body posture changes in coloring (dyeing) hand drawn batik cloth uses a machine in standing body posture. This study used Nordic Body Map musculoskeletal measurements and subjective fatigue, the research method used the experimental design of the same subject, namely the design that is variable observation carried out several times, the control subject also applied as the experimental subject. The results of processing data on 20 batik makers were concluded that the percentage of pain in the coloring activity (manual dyeing) by squatting and stooping body posture with a mean was about 65.18 ± 6.45%. The percentage of pain in the machine dyeing activity for standing posture was 50.73 ± 71.73%. The average difference between the level of musculoskeletal complaints on batik staining with squatting/stooping body posture compared to the staining of the standing body posture was 16.80 or a decrease of 19.34%. The results of subjective fatigue questionnaire obtained a decrease in fatigue of manual dyeing activity with dipping machines, namely an activity attenuation decrease from 90% to 62%, attenuation of motivation from 88% to 58%, physical attenuation from 78% to 64%. The average difference between the degree of fatigue in batik staining and stooping body posture compared to the staining of the body posture is 25,25 or there is a decrease in fatigue of 26.69%. The work posture improvement of standing position on batik dyeing machine that is designed using 3 roll (cylinders) which has a driving power of 0.190 HP, with the working concept of a sheet of fabric wrapped around a cylinder with a 72.5 rpm rotation, frame material made of elbow iron painted and cylinders made of data a the PVC pipe to avoid corrosion could actually increase work productivity by 0,0190 or 29.19%.
1. Introduction

Batik is a painting on cloth which is a hereditary inheritance from Southeast Asia, especially in the region of Java Indonesia. The cloth is painted with a heated candle, then undergoes a coloring process or dyeing and washing the wax [21]. Batik technique is a way of holding a candle to be scratched in the form of a point or line and can be a motif of artistic value and beautiful [11].

Batik process starts from the process of making patterns, painting, coloring (removing wax by heating), washing and drying. Among the most difficult batik processes are coloring or dyeing process, which is to arrange the color composition to produce the desired blend of motifs. Coloring of fabrics that have been painted with hot wax must be evenly distributed so that the wax attached to the fabric does not break. Uneven coloring makes the painting become pale and faded [18].

The process of coloring batik in Kalinyamat Wetan Kota Tegal Indonesia is generally done by dipping (manual) with stooping and squatting work postures. The results of the initial study of 10 batik makers after doing batik coloring manually caused musculoskeletal complaints in back, lower neck, right shoulder, waist, left elbow, right elbow, right thigh, right ankle pain. Getting pain on the back of Occupational low back disorders (LBD) (lower back pain, lower back muscular tissue, lumbar disc disorder) is a socio-economic burden in many Industrial countries and often associated with physical factor which is related to works, such as directing energy, highly repetitive movements and continuous static posture, such as squatting and standing posture. LBD is caused by non ergonomic work postures such as stooping and standing [15]. This disorder occurs because of fatigue which leads to changes in the trajectory of the spinal movements which can increase the risk of injury.

Abnormality of Musculoskeletal often happens and has a major impact in health and quality as well as workers’ health. Safe lifting techniques become a concern due to high risk of injury and low back pain (LBP) because of frequent lifting activity in the industry. The recommended compression strength limits for material handling often occur such as lifting, squatting and stooping. [1]. Analysis of squat and stoop dynamic liftings: muscle forcesand internal spinal loads. Biomechanical literature does not allow for squatting techniques as a means of preventing lower back pain [5]. Musculoskeletal complaints of batik coloring activities as shown in Figure 1 influence the level of batik makers and reduction of productivity. One of the efforts to reduce complaints is by creating a coloring machine for dyeing batik cloth.

![Figure 1. The Animation of Hand Drawn Batik Staining Process with Manual Dyeing of (a) Squatting and (b) Stooping Body Posture](image)
Musculoskeletal disorders and the risk of injury can be reduced by using an ergonomic work system design [6]. Workers' tools help to reduce physical loading on the spine by reducing or eliminating some load during stooping or squatting posture. There are many types of mechanical work and worker assistance which have a potential to control the stooping posture as in agricultural production work so that it is needed the design / specification feature which can determine better height / size / installation location [14]. In designing the dye machine, height of the machine is adjusted to the height of the batik maker posture so that the machine can be adjusted up and down to adjust the length of the fabric.

The main factor of batik makers who get musculoskeletal is from work postures that stooping and squatting by using buckets and wooden frame during the coloring process. Squatting and stooping posture causes discomfort. The working conditions force workers to always be in an unnatural posture and work position. An unnatural, long-lasting / static attitude can cause injury [20]. The results of the analysis of hand drawn batik dye machine are designed using 3 roll (cylinders) that have a driving power of 0.190 HP, with the concept of sheet fabric work wrapped around the cylinder with a 72.5rpm rotation. The frame material is made of painted elbow iron and cylinders of PVC pipe to avoid corrosion. The assessment of the workers' posture in the coloring process (manual dyeing) is obtained by REBA scores of 5 to 8 at moderate to high musculoskeletal levels (need to be repaired immediately). After applying the design results of coloring machines in the batik coloring process by workers, REBA scores obtained namely 2-4 at safe musculoskeletal levels to low (long-term repairs needed). It shows that there is a change in body posture after applying a staining machine, which is from a squatting and stooping body posture that is not natural to become a more natural standing body posture. The development of batik coloring tools/machines is advised by conducting socialization to workers to apply the dyeing method using dye machines so as to increase the productivity of batik artisans and reduce the risk of injury [12]. Paying attention to the body position in batik staining by squatting and stooping, the complaints of the musculoskeletal system will often be found by batik makers. Therefore this research was carried out to uncover musculoskeletal complaints and fatigue systems faced by batik makers after designing batik dye machines, wherein the machine operator worked with standing posture.

![Figure 2. The animation of the Hand drawn Batik Coloring Process with the dyeing of standing body posture](image)

**Problem Formulation:** How big is the level of difference in musculoskeletal complaints, fatigue and increase in the productivity of batik maker after a change in standing posture on coloring (dyeing) of batik cloth using a machine?
2. Methodology

The subjects of this study were 20 female batik makers. The qualitative analysis of the subjects was done by calculating the mean and standard intersections for each criterion, namely age, height, weight, and work experience. The object of the research is work attitude or body posture for batik coloring activities with manual dipping positions, namely body posture squatting or stooping, and the dipping position of the machine with standing posture. The research was located in Fitri Ayu batik group in Kalinyamat Wetan village, South Tegal sub-district, Tegal city, Indonesia.

Methods and data analysis: The measurement of Musculoskeletal complaints is done with NIOSH Nordic Body Map Subjective Filling, the measurement of fatigue with 30 Item Self Rating Questionnaire Industrial Fatigue Research Committee is from Japan Association Of Industrial Health. The data analysis is divided into three parts, namely descriptive analysis, normality test, and different test.

a. Quantitative analysis calculates the mean and standard intersections for each criterion, namely age, height and weight.

b. Test for normality: using the Kolmogorov-Smirnov Test (with a significance level of α = 0.05)

c. Different test: using different test two groups in pairs with a significance level (α = 0.05). If the data is normally distributed, then paired t test is used. If the data is not normally distributed, the Wilcoxon test is then used.

Nordic Body Map Questioner is a map of the body that analyzes the body parts of the muscles or joints that undergo complaints. Parts of the body from numbers 0 to 27 or from neck to feet.[19]. A biomechanical tool for assessing MSS subjectively is the Nordic body map questionnaire, developed by the Institute of Occupational Health. This tool has been widely used throughout the world. The Nordic body maps are equipped with body maps with a number of each part of the body. The person assessed must fill out the questionnaire by giving a sign of the level of discomfort in the intended body part.

Musculoskeletal disorders (MSD) that was experienced by workers caused by uncomfortable working conditions while practicing the operation of machinery and equipment. The findings are supported by several ergonomically designed workstation studies that can reduce MSD and increase productivity. Musculoskeletal disorders are obtained from repetitive work including injury or disruption of muscles, bones, tendons, tendon sheaths, ligaments, bursa, blood vessels, joints, intervertebral discs, etc. Other terms which are used to describe MSD including Repetitive Strain Injury, Musculoskeletal Injury, Cumulative Trauma Disorder, Occupational Overuse Syndrome, or Strain or Sprains [4]. to reduce the risk of working related to musculoskeletal disorders (WMSD) Finally, the prevalence of pain symptoms in various parts of the body has been found relating to age, work experience, work shift, and body mass index [6].

According to [10] fatigue is caused by a non-ergonomic work environment, batik makers who complain of fatigue while doing work activities. Housewives, have jobs other than as batik craftsmen who are able to maintain a family economy of more than 50% of their daily economic needs. To work more efficiently, Batik craftsmen are needed to ergonomically design batik workspaces.

In the study [8] showed that the health of spinning operators was greatly affected due to the body posture and imperfect workload. These postures require them to work in a non-neutral position which increases overall discomfort and pain in the lower back, neck and shoulders, non-ergonomic work postures and modification. New breakthroughs for health promotion in the workplace are still needed to increase K3 which are implemented in UKM Batik and innovative approaches are needed to get the attention of UKM workers [22] According to [13] in batik process is carried out manually for approximately 7 hours every day (08.00 - 15.00 WIB) so that it has the potential to cause various kinds of complaints experienced by workers, including fatigue and risk of injury. The study was conducted to evaluate the risk of muscle injury using the Posture Activity Tools Handling (PATH) method and the Ovako Working Posture Analysis System (OWAS).

In developing the industry, especially batik industry, which is a hereditary inheritance, the home industry must pay attention to healthy environmental conditions, such as the tools and machines used by the place to work. When batik makers feel pain in certain parts of the body, they cannot complete the
work optimally so that they cannot fulfill the order as targeted. According to [17] that certain body aches cause work discomfort resulting in impaired health factors and lower productivity. The important aspect of work productivity and quality measurement is time. In human interaction, the cycle timer requires the work time of the worker and the operating time of the machine. The working time of the worker is influenced by the interaction of the mass work posture and the workplace dimension. This interaction produces comfortable work so that it will increase work productivity and quality of workers. [3] according to (Hutagalung) that work productivity is measured from the ratio of output where the amount of time produced divided by input, namely the average workload (the average work pulse) during working hours.

3. Result and Discussion
   a. Subject Characteristics
   The subjects of the study were batik makers who were coloring fabric with a total of 20 women. The subject description is shown in Table 1. It states that the age of the subjects was obtained with a mean of 46.65 years ± 9.82 years with a range of 34-67 years. Subject height obtained with a mean 1.52m ± 0.06m with a range of 1.40-1.60 meters. Subject weight gained mean of 51.65 kg ± 4.42 kg with a range of 45-58 kilograms. Subject work experience obtained with a mean 22.58 th ± 1.87th with a range of 18-24 years.

   Table 1. Subject Description
   | Aspects                  | Women       |
   |-------------------------|-------------|
   |                         | Average     | Standard Deviation | Range         |
   | Age (years)             | 46,65       | 9,82               | 34,00-67,00   |
   | Height (m)              | 1,52        | 0,06               | 140,00-160,00 |
   | Weight (kg)             | 51,65       | 4,42               | 45,00-58,00   |
   | The duration of work (years) | 22,38   | 1,87               | 18,00-24,00   |

   b. Body Posture of Batik Coloration Activity
   1) The manual dyeing body posture is the body posture on batik coloration activities which uses a bucket (tub) with a body posture is squatting or stooping, both hands are entering the bucket (tub) by dipping a cloth that will be given dye so that the body position adjusts the material and tools on top of wooden frame then the body posture of the batik makers stoop to adjust to the material / tool being done. The position of the knees (feet) of the batik maker is bent. The body position of manual dyeing and dyeing of the machine can be seen in Figures 3 and 4.
2) The body posture of machine dyeing is the attitude or standing body posture with both hands holding the cloth forward and upward with hand angle of 45 degree, the material that is done is placed in front of the body, or placed on the machine then the body posture is adjusted to the material / tool what is done. The knee (foot) position of the batik maker is straight.

c. Musculoskeletal systems of batik coloration in manual dyeing and machine dyeing

The questionnaire results of the level of musculoskeletal complaints decrease can be seen in Figure 5 below. The reduction in subjective complaints is feeling pain in upper neck from 55% to 50%, lower neck from 60% to 45%, left shoulder from 85% to 50%, right shoulder from 60% to 50%, left upper arm from 70% to 45%, back from 65% to 45%, right upper arm from 65% to 60%, waist from 65% to 50%, buttocks from 70% to 60%, buttocks from 65% to 50%, left elbow from 55% to 40%, right elbow from 70% to 45%, left forearm from 65% to 50%, right forearm from 65% to 60%, left wrist from 55% to 50%, right wrist from 70% to 65%, left hand from 65% to 45%, right hand from 70% to 45%, left thigh from 60% to 45%, left thigh from 60% to 55%, right thigh from 70% to 55%, left knee from 65% to 30%, right knee from 70% to 55%, left calf from 60% to 50%, right calf from 75% to 45%, left ankle from 65% to 20%, ankle from 60% to 45%, left foot from 65% to 60%, right foot from 65% to 60%.
d. Fatigue in manual and machine dyeing batik coloration

The fatigue measurement results using 30 questions questionnaires of activities attenuation, motivation, and physical can be seen in Figure 4 below. Most of the samples experienced a decrease in fatigue, namely a decrease in activity attenuation from 90% to 62%, weakening motivation from 88% to 58%, physical attenuation from 78% to 64%.

![Figure 4: Percentage Graph of Decrease level in Musculoskeletal Complaints for manual and machines dyeing](image)

**Figure 5.** Percentage Graph of Decrease level in Musculoskeletal Complaints for manual and machines dyeing

e. Productivity of manual dyeing and machine dyeing batik coloration

Batik makers’ productivity is the ratio between the number of products divided by the number of pulses. The productivity which is produced by 20 batik makers in dyeing machine has a mean of $0.07 \pm 0.02$. The average yield of pulse rate is 77 per minute, thus the batik coloring activity with squatting and
stooping position has a light workload. The productivity which is produced from 20 batik makers in
stooping and squatting postures on fabric staining using manual dye has a mean of 0.08 ± 0.01. The
average yield of pulse rate was 75.03 per minute, thus batik activity with manual dyeing position has a
light workload.

Table 2. The average difference of Control Groups and Experimental Groups

| Aspect                                | Control group | Experimental group | Difference | %     | Remark |
|---------------------------------------|---------------|--------------------|------------|-------|--------|
| musculoskeletal                       | 86,850        | 69,600             | -17,25     | -19,86| Decrease |
| Exhaustion                            | 94,600        | 69,350             | -19,00     | -21,63| Decrease |
| Productivity                          | 0,0650        | 0,0840             | 0,0190     | 29,19 | Increase |

f. Data Analysis
1) Normality Tests on Musculoskeletal Complaints, Fatigue, and Productivity

The Normality test is to test questionnaire data on the level of musculoskeletal complaints in the control
group before activity, the level of musculoskeletal complaints in the experimental group before activity,
the level of musculoskeletal complaints in the control group after activity, the level of musculoskeletal
complaints of the experimental group after activity, fatigue of the control group before activity,
exhaustion of the experimental group before activities, fatigue control group after activity, exhaustion
of the experimental group after activity, productivity of the control group before activity, productivity
of the experimental group after activity, productivity of the control group after activity, productivity
of the experimental group after activities. This normality test aims to find out whether the sample comes
from a population with a normal distribution of distribution. The normality test using Kolmogorov-
Smirnov is shown in Table 3.

Table 3. The average Standard Deviation and Normality Test. Source. Author.

| Aspect                                | Average | Standard Deviation | p   |
|---------------------------------------|---------|--------------------|-----|
| Musculoskeletal aspects of manual dip | 86,850  | 10,2406            | 0, 056 |
| Fatigue aspect of manual dip          | 96,600  | 3, 1522            | 0, 112 |
| Productivity aspect manual dip        | 0, 0650 | 0, 0202            | 0, 128 |
| Musculoskeletal aspects of machine dip| 69,600  | 5, 4134            | 0, 071 |
| Fatigue aspect of manual dip          | 69,350  | 11, 0895           | 0, 117 |
| Productivity aspect manual dip        | 0, 0840 | 0, 0127            | 0, 127 |

p = probability value
Based on the calculations, it is obtained that the p value for all aspects is greater than 0.05 (p> 0.05) thus
all data are normally distributed.

1) T Test of Musculoskeletal Complaints, Fatigue, and Productivity
The overall normality test results of the data are normally distributed, so the analysis used is the compare
mean test by using paired sample T-Test. The results of the t test for the subject are shown in Table 4.
Table 4. Mean, Mean Difference, and T Test Between Control Groups and Experimental Groups

| Variable | Group     | Mean     | Standard Deviation | Mean Difference | t count | P   |
|----------|-----------|----------|--------------------|-----------------|---------|-----|
| Musculoskeletal | Control    | 86.8500  | 10.2406            | -17.25          | 7.48    | 0.000|
|           | Experiment | 69.6000  | 5.4134             |                 |         |     |
| Exhaustion | Control    | 94.6000  | 3.1523             | -19.00          | -9.363  | 0.000|
|           | Experiment | 69.3500  | 11.0895            |                 |         |     |
| Productivity | Control   | 0.0650   | 0.0202             | 0.0190          | -3.300  | 0.004|
|           | experiment | 0.0840   | 0.0127             |                 |         |     |

Table 4 It states that the level of musculoskeletal complaints, fatigue and productivity in the sample obtained the probability value of 0.000; 0.000; and 0.004 (p <0.05). Thus it can be concluded that there is a significant reduction between all variables in the control group and the experimental group. The average difference in the level of musculoskeletal complaints between the control group and the experimental group was 17.25 or a decrease in musculoskeletal complaints by 19.86%. The difference in average fatigue between the control group and the experimental group was 19.00 or there was a decrease in fatigue by 21.63%. The average difference in the level of productivity between the control group and the experimental group is 0.0190 or an increase in productivity is 29.19%.

Figure 7. Graph of Musculoskeletal Complaints between Control Groups and Experimental Groups
The improvement of work attitude or staining of the body posture from the squatting position (stooping) into a standing position as a whole can reduce musculoskeletal complaints, fatigue and increase productivity of the batik maker. This matter is caused by the squatting work position which is depending on the ankle support which must support weight, [2]. Working posture by squatting has a higher blood pressure burden than standing posture, namely decreased blood pressure after standing from squatting [9].

According to [16] works with squatting and stooping techniques using maximum acceptable weight (MAW), perceptions of exertion (RPE), discomfort and preference. Mean (SD) MAW for squatting is...
lower than stooping (7.0 (2.2) kg vs. 8.5 (2.4) kg) and RPE for squatting is greater than for stooping (15.2 (1.5) kg vs 13.3 (1.5) kg). More subjects reported discomfort after squatting and preference for stooping. The result shown the limited support for the use of stooping techniques rather than squatting.

The application of ergonomics into the work system has been proven to be able to increase productivity, health, safety and comfort of work by the use of methods such as tools or practical and inexpensive tools for a long time which can achieve the desired results in reducing musculoskeletal disorders on a small scale and poor industries in developing countries [7].

4. Conclusion
The results of data processing and analysis can be concluded that the changes in squatting/stooping body posture to standing on coloring / dyeing of hand drawn batik cloth using machines makes the level of musculoskeletal complaints, fatigue decrease and productivity increases significantly. The Different mean of musculoskeletal complaints before and after the experiment is equal to 25.50 or there is a decreased level of musculoskeletal complaints by 26.26%. While the mean difference in fatigue complaints before and after the experiment was 25.25 or a decrease in complaints of 26.69%. The average difference in productivity achievement before and after the experiment was 0, 0 190 or there is an increase in productivity was 29.19%. It is necessary to be investigated further about the factors that cause differences in musculoskeletal system complaints, work fatigue and increase of the productivity of batik makers especially for batik coloring.

References
[1] A. A. S. (2007). Analysis of squat and stoop dynamic liftings: muscle forces and internal spinal loads, 687–699. https://doi.org/10.1007/s00586-006-0240-7
[2] Asuyama, T. A. K., & Akamoto, M. A. S. (2009). Ankle Joint Dorsiflexion Measurement Using, 195–199.
[3] Hartomo, H., Hassan, A., & Haron, C. H. C. (2005). Validation of Ergonomics Model for Estimating Work Productivity and Quality in Manual Handling Activities. Jurnal Teknoin, 10(2).
[4] Hazards, M. D. (2008). Musculoskeletal Disorders.
[5] Hoozemans, M. J. M., & Toussaint, H. M. (1999). Stoop or squat: a review of biomechanical studies on lifting technique, 14.
[6] Islam, U., Islam, U., & Surakarta, B. (2017). THE USE OF MACRO-ERGONOMIC WORK SYSTEM DESIGNS TO REDUCE MUSCULOSKELETAL DISORDERS AND INJURY RISK IN TRAINING H. Purnomo 1 *, E. Giyono 1 & A.E. Apsari 2 ARTICLE INFO, 28(May), 47–56.
[7] Jahangiri, M., Ali, S., Najarkola, M., Gholami, T., Jahangiri, A., Hesam, G., & Jalali, M. (2015). Ergonomics Intervention to Reduce Work-Related Musculoskeletal Disorders in a Lead Mine, 4(4), 5–7. https://doi.org/10.17795/jhealthscope-29507
[8] Kolgiri, S. (2018). Work Related Musculoskeletal Disorders among Power-Loom Industry Women Workers from Solapur City, Maharashtra, India, (March).
[9] Krediet, C. T. P., Go-schön, I. K., Kim, Y., Linzer, M., Lieszout, J. J. Van, Wieling, W., … Lieszout, J. J. Van. (2010). Management of initial orthostatic hypotension: lower body muscle tensing attenuates the transient arterial blood pressure decrease upon standing from squatting To cite this version: HAL Id: hal-00479369.
[10] Maarif, U., & Latif, H. (2017). Redesign of Work Environment with Ergonomics Intervention to Reduce Fatigue, 12(7), 1237–1243.
[11] Maulik, S. R., Bhowmik, L., & Agarwal, K. (2014). Batik on handloom cotton fabric with natural dye, 13(October), 788–794.
[12] Siswiyanti, Studi, P., Industri, T., Pancasakti, U., Teknik, S., Universitas, M., & Tegal, P. (2018). Jurnal Optimasi Sistem Industri Penerapan Ergonomi pada Perancangan Mesin Pewarna Batik untuk Memperbaiki Postur Kerja, 1, 75–85. https://doi.org/10.25077/josi.v17.n1.p75-85.2018
[13] Pratiwi, I., & Kartikasari. I. (2018). Evaluation of Work Posture for Non Repetitive Job in
Kampoeng Batik Laweyan Using PATH and OWAS Method, 20051. https://doi.org/10.1063/1.5042907

[14] Proceedings, C. (2004). Squatting Postures.

[15] Spyropoulos, E., Kyvelidou, A., Stergiou, N., & Athanassiou, G. (2016). Quantifying Muscle Fatigue of the Low Back during Repetitive Load Lifting Using Lyapunov Analysis, 6(6). https://doi.org/10.4172/2165-7556.1000180

[16] Straker, L., & Duncan, P. (2000). Psychophysical and psychological comparison of squat and stoop lifting by young females, 27–32.

[17] Susihono, W., & Istianah, I. (2018). Assessment of Musculoskeletal Disorders and Fatigue of Workers in Creative Industry of Carving Wood in PK Novi Cilegon, Banten, 2018, 361–371. https://doi.org/10.18502/kls.v4i5.2567

[18] Tembalang, C. (2015). Measuring Efficiency of Using Resource in the Production Process of Making Stamped-Batik: A DEA Approach Aries Susanty Sri Hartini Diana Puspitasari, 6(5), 318–327. https://doi.org/10.5901/mjss.2015.v6n5s2p318

[19] Wahyudi, M. A., Dania, W. A. P., & Silalahi, R. L. R. (2015). Work Posture Analysis of Manual Material Handling Using OWAS Method, 3, 195–199. https://doi.org/10.1016/j.aaspro.2015.01.038

[20] Widyanti, A. (2018). Ergonomic Checkpoint in Agriculture, Postural Analysis, and Prevalence of Work Musculoskeletal Symptoms among Indonesian Farmers: Road to Safety and Health in Agriculture, 20(1). https://doi.org/10.9744/jti.20.1.1-10.

[21] Wyvill, B. (1999). Rendering Cracks in Batik.

[22] Yunita, F. H., Kurniawidjaja, L. M., & Susilowati, I. H. (2018). Workplace Health Promotion Related to Occupational Safety Climate: A Case Study by the Government on Batik SMEs in Pekalongan Regency, Central Java, Indonesia, 2018, 260–267. https://doi.org/10.18502/kls.v4i5.2558.