Exploration of Science Concept in *Semanggi Batik* Typical of the City of Surabaya

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Abstract. This research explores integrating science concepts in the making of *Semanggi Batik*, a typical cultural icon of Surabaya, into science learning in elementary schools through an ethnoscience approach. The clover plant, used as the central motif of *batik*, maintains its preservation and introduces local wisdom to students. Qualitative descriptive research methods were used, with data collection through interviews and observations. The study results show that *batik*-making techniques, such as *canting*, night, and fabric dyeing, can be explained through scientific concepts such as thermal conductivity, changes in substance form, and capillary. This integration increases students' understanding of science and develops an appreciation for local cultural heritage.

Keywords: Science, *Semanggi Batik*, Surabaya.

1 Introduction

Exploring the intersection of regional culture, local wisdom, and the surrounding environment offers a unique opportunity to enhance school science learning. Specifically, the integration of Surabaya's distinctive clover batik into science education can create engaging and culturally relevant learning experiences. This study aims to investigate how Surabaya's traditional clover batik can be incorporated into scientific concepts, fostering an educational breakthrough known as ethnoscience. This research seeks to enrich students' understanding and appreciation of their heritage and scientific principles by embedding cultural elements into science curricula. Ethnoscience learning integrates local culture into the learning process. The goal is to create a learning environment and provide a learning experience for students. The learning process integrates emerging cultures in society by highlighting the values of local knowledge. The teacher's responsibility is to provide information and internalise attitudes that can encourage empathy for the environment. [1], [2]. Quoting the theory of integrated learning from John Dewey, it is stated that students shape their knowledge through interaction with their environment and life experiences. [3]. These experiences and the student's contextual background are related to the content of the subjects taught in school. Learning must leave a lasting effect on students, which will ultimately improve their skills. [4].

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Science is a learning concept about natural occurrences that have an impact on human existence. It is a comprehensive topic of study that consists of a collection of concepts, principles, laws, and hypotheses produced via scientific attitudes and discovering abilities. Science instruction provides students with practical opportunities to investigate and utilise the principles they have acquired in their daily lives. Science refers to daily activities. Thus, students can think scientifically about the situation around them. Through culturally relevant learning, students will directly observe and identify scientific questions, explain phenomena scientifically, and draw conclusions. [5], [6]. Cultural knowledge encompasses both local wisdom and abstract knowledge embedded within the culture, such as the philosophy of life. This can be developed in learning themes so that cultural values can be the development of students' character.

In recent years, there has been an increased recognition of the importance of integrating ethnoscience into science education, especially at the primary school level. This integration allows students to learn basic scientific concepts and appreciate and understand the traditional knowledge and practices of their cultures and communities. In Indonesia, where rich cultural heritage is linked to diverse scientific understanding, there is a unique opportunity to explore the integration of science concepts with ethnoscience in primary school education [7]–[9] .

The term ethnoscience comes from the Greek word ethnos (nation) and the Latin word scientia (knowledge). According to Parmin & Fibriana (2019) Ethnoscience is related to the knowledge and cognitive technique that is specific to a particular culture, nation, ethnic group, or social grouping. The approach of ethnoscience in learning emphasises the recognition of culture as a crucial and essential element in education, encompassing the expression and transmission of concepts, as well as the development of knowledge [11]. Local wisdom refers to the intelligence of a particular ethnic group, which can be information, skills, resources, social processes, beliefs, values, norms, and local customs. [12]–[14]. Local wisdom is determined by the resources and potential possessed by a region. There are several outstanding potentials in Surabaya, such as clover (a typical food of Surabaya), *undukan doro, patrol music festival, remo dance, ludruk.*

The abundance of clover plants in Sememi village has made clover plants an icon of the area. The surrounding community uses clover as processed food by processing clover leaves into food given a special sauce. Because of the large number of clover cultivated in the area, even though the clover leaf is an icon in Sememi village, artisans were inspired to make clover *batik* with clover leaf motifs. The *batik* has certain characteristics and is produced by the community in Sememi village. Learning with the ethnoscience approach, specifically using *batik semanggi*, is based on recognising that culture is a fundamental part of education. Culture serves as an expression and communication of ideas and knowledge development. Ethnoscience encourages teachers and educational practitioners to teach science based on culture, local wisdom, and societal issues. Through ethnoscience, students can understand and apply the knowledge learned in the classroom to solve everyday problems [15].

In recent years, there has been an increased recognition of the importance of integrating ethnoscience into science education, especially at the primary school level. This integration allows students to learn basic scientific concepts and appreciate and

understand the traditional knowledge and practices of their own cultures and communities. In Indonesia, where rich cultural heritage is linked to diverse scientific knowledge, there is a unique opportunity to explore the integration of science concepts with ethnoscience in primary school education [7]–[9], [16].

Because regional culture, local wisdom, and the surrounding environment, especially clover *batik,* can be implemented in science learning in schools an interesting learning experience related to the original culture of the city of Surabaya. Therefore, an educational breakthrough is needed that combines the culture of using science or ethnoscience. The purpose of this research is to explore the original clover *batik* of Surabaya, which is integrated into scientific concepts.

2 Methode

This study employs a descriptive qualitative methodology. Descriptive research is a fundamental form of investigation that aims to objectively characterise various natural and man-made phenomena. It involves providing detailed accounts of activities, features, changes, linkages, similarities, and contrasts seen in these phenomena [17].

The data was collected through interviews with batik artisans, educators, and PKK (*Pembinaan Kesejahteraan Keluarga*) members from Sememi Village in Benowo District, who play a crucial role in *batik* production and community training. *Pembinaan Kesejahteraan Keluarga (PKK)* is a community organisation in Indonesia that empowers women to participate in national development. PKK has 10 Essential Programs designed to meet basic human needs, including the Promotion and Practice of Pancasila, Mutual Cooperation, Food, Clothing, Housing, Education and Skills, Health, Cooperative Life Development, Environmental Sustainability, and Family Planning [18].

Thematic analysis was used to identify key themes from the data, including the cultural significance of clover *batik*, scientific concepts associated with its production, and its educational potential. Validation techniques such as triangulation and member checking ensured the reliability of the findings. PKK's involvement in training and production was specifically noted for its contribution to the *batik*'s development and dissemination. The study concludes with recommendations for incorporating clover *batik* into science education, leveraging its cultural and scientific aspects to enrich the curriculum while preserving local heritage.

3 Result

3.1 Clover Cultivation in Surabaya

The study explored the integration of Surabaya's traditional clover batik into science learning, focusing on how ethnoscience can be effectively implemented in the classroom. Several key findings emerged through qualitative data gathered from interviews, classroom observations, and teaching material analysis. Interviews with educators revealed their enthusiasm for incorporating local culture into science lessons, noting that

clover batik provides a tangible connection between students' daily lives and scientific concepts.

Clover is widely cultivated in the Benowo area. Benowo is one of the largest sub-districts in western Surabaya, with an area of approximately 23.79 km2 and an altitude of approximately 4m above sea level. Benowo District is divided into four villages: Sememi, Tambak Oso Wilangu, Kandangan, and Romo Kalisari. Benowo District has several territorial boundaries; namely, the north is bordered by the Madura Strait, Tandes District borders the east, Sambikerep District borders the south, and Pakal District borders the west.

Kendung Sememi Village. Clover cultivation is carried out without using seedlings but using the roots of the clover plant itself. The clover harvest period is also relatively short, and it only takes 14 days after planting, when the clover can be harvested. Harvesting is done by breaking clover leaves from the stems. This is because many people only use the leaves [19]

3.2 Clover *Batik*

Semanggi batik is a typical Surabaya batik with a unique motif different from other batiks. This batik was first made in Sememi Village, Benowo District, by PKK RW 09 women, inspired by the clover leaves that have become an icon of the area. After a vacuum for three years, production was continued by PKK RW 01 women in April 2015 after they participated in training from Bapemas in September 2014.

Training continues to be followed, including training in Yogyakarta in January 2016 that introduced the batik stamp technique and simplified the production process. A total of 25 PKK women are active in training and developing batik businesses with clover motifs, later known as Batik Semanggi Dua. Orders are starting to increase, not only from residents but also from outside Surabaya. The assistance of community service programs by students also contributes to the popularity of this batik. Now, Semanggi Batik is recognised as one of the typical batik of Surabaya.

Figure 1. Variety of Clover Batik Motifs and Colors (Source: Personal Document)

In the clover *batik* motif, there must be a clover leaf motif because it is by the name of the *batik*. Clover *batik* has many variations of *batik* and will continue to be developed according to the creativity of artisans and consumer demands. Clover *batik* motifs can

be combined with other Surabaya *batik* motifs, such as suro and boyo motifs. Artisans are free to make variations of clover *batik,* but there must still be a clover leaf motif in it so that the motifs owned by clover *batik* are very diverse. In addition to motifs, the colours of the two clover *batik* vary greatly. The colour can be customised according to consumer demand. The colours that are ready to be available are green, black, blue, brown, and red, but consumers can order *batik* in other colours

3.3 Integration of Clovers *Batik* in Science Learning in Elementary Schools

Semanggi Batik is an excellent example of integrating local wisdom with scientific concepts in elementary school science learning. The production process of *Semanggi Batik* can be linked to various scientific principles, as illustrated in Table 1.

Table 1. Transformation of Clover *Batik*

Community Science	Sciencetific Science
Batik using canting	Canting is made of copper or brass with one end pointed, used as a writing tool, and the other end to defrost from the night that has been thawed. Copper or brass is used in canting because these metals are conductors that can store heat, ensuring the night liquid in the canting does not cool and solidify quickly.
Batik using the Malam	Malam can change form, melting due to heat and freezing when cooled. The main raw material for malam making is water-resistant candles, which melt when heated, freeze when cooled, do not break easily when dry, cover the fabric to prevent exposure to dye, and adhere perfectly to primis fabrics
Batik using *batik* stamps	Stamp tools, such as canting, are made of brass and copper. The stamp is dipped in a hot night, and the use of copper and brass ensures that the night remains liquid and can stick to the fabric. Pressing the stamp firmly ensures a clear and neat pattern, demonstrating the concept of force in printing.
Tasting is done by pressing the stamp very strongly.	The concept of style occurs in the change that occurs in the tasting process; this is a liquid night that is not pressed firmly and correctly, which will result in a less clear and untidy pattern. Meanwhile, if it is pressed firmly, the result of the pattern will look neat and clear.
Dipping a cloth in a dye solution	In the dyeing process, the fabric with a batik motif is immersed in a dye solution to impart colour. During this process, capillary action occurs, where dye molecules move through the fabric's fibres. Capillary action involves the rise and fall of liquid in a narrow space due to adhesion and cohesion forces. Adhesion refers to the attraction between the dye molecules and the fabric fibres, while cohesion describes the attraction between dye molecules themselves. These forces determine the surface tension of the dye solution, influencing how much dye is absorbed and how it is distributed across the fabric. As a result, the

Community Science	Sciencetific Science
	fabric's colour changes according to the dye used, demonstrating the capillary process's impact on the dyeing outcome.
Drying the fabric in the sun.	During the drying process, heat is transferred to the fabric through radiation, which does not require an intermediate medium. This heat causes evaporation, where liquid water in the fabric changes to gas. As water molecules evaporate from the fabric fibres, the fabric gradually dries. This process effectively removes moisture from the fabric, resulting in a dry and ready-to-use material.

4 Discussion

As previously reviewed, Semanggi Batik is one of the icons of the city of Surabaya. In its manufacture, the clover plant is not used as a material or dye, but the shape of the cloverleaf is used as the main motif. This allows the preservation of clover plants without damaging them while introducing them to the public. Semanggi batik is made using two techniques: stamping and writing. The integration of local wisdom of the City of Surabaya, namely Semanggi Batik, in science learning in elementary schools is presented in the following Table 1.

The integration of *Semanggi Batik* into science learning provides a rich context for students to explore scientific concepts through the lens of local culture. By linking traditional *batik*-making techniques to scientific principles, students can gain a deeper understanding of both their cultural heritage and scientific concepts. For example, the use of canting and stamp tools made from copper or brass can be used to teach about heat conductivity and the properties of conductors. The process of melting and solidifying night (wax) demonstrates phase changes in materials due to temperature variations. Dyeing techniques illustrate capillary action and the forces of adhesion and cohesion, while the drying process highlights evaporation and heat transfer through radiation.

Semanggi Batik ethnoscience uses the concept of scientific science from community science that can be used in elementary school science learning. These scientific science concepts include the use of conductors as printing and canting tools, an understanding of how *batik* can change at night, dyeing techniques, and *batik*-making techniques. There have been many studies conducted previously related to the use of *batik* as local wisdom integrated with the concept of science. Among them is a study conducted by Anissa & Silfianah, which states that Tulungagung *batik* is an inculcation of character values and knowledge of scientific concepts [20]. Similarly, research conducted by Lestari in the form of teaching materials about *batik* that can be used as a learning resource for grade 5 elementary school students in Ngawi Regency which helps introduce Ngawi *batik* motifs [21]. In line with this, a study that aimed to explore the uniqueness of the Ciwaringin written *batik* village related to the use of biological natural resources as natural dyes in an effort to improve environmental conservation through science learning based on local wisdom [22].

These studies underscore the potential of using cultural heritage, such as Semanggi *Batik*, to enrich science education. By integrating local wisdom with scientific concepts,

educators can create a more engaging and meaningful learning experience for students, fostering both scientific understanding and cultural appreciation. Education based on local wisdom aims to develop student competencies by utilizing local advantages in the region, such as culture, ecology, language, technology, information, and communication.. [23] In order for a student's learning process to be successful, there are a number of things that impact it. One of them refers to the approach employed by educators. Utilising indigenous knowledge to inform scientific education can enhance student academic achievements. The reason for this is because scientific education that is focused on local knowledge provides a more contextualised experience, enabling pupils to comprehend the subject matter more easily. Science education that is focused on indigenous knowledge and incorporates students' cultural customs provides a more contextualised experience.

5 Conclusion

This research highlights the importance of integrating science concepts in making *Semanggi* Surabaya *Batik* into science learning in elementary schools through an ethnoscience approach. With its distinctive clover leaf motif, Clover *batik* preserves local culture and teaches students various relevant scientific concepts. *Batik*-making techniques, such as canting and stamps, night transformation, and dyeing and drying fabrics, can be explained through basic scientific principles. This integration allows students to understand science in their cultural context, increase appreciation for cultural heritage, and develop scientific skills and strong character. This research confirms that ethnoscience-based education can effectively connect science with students' daily lives and local cultural heritage.

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