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Exploration of Sam Poo Kong Building Heritage as Starting Point in Geometric Transformation Course

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Abstract

Sam Poo Kong is one of Semarang's city cultural heritages. This historical structure features intriguing architecture as well as being a popular tourist destination. This study aims to explore Sam Poo Kong's building as a starting point in the geometric transformation course. Besides, the study method is descriptive in qualitative terms with the ethnography approach, namely the type of research to describe and acquire data as a whole, comprehensive, and in-depth. The result is an ethnomathematics exploration of Sam Poo Kong's historic buildings, representing mathematical concepts including reflection, translation, rotation, dilation, and cultural values. Based on implementation in transformation class, students can quickly grasp which Sam Poo Kong's building portrays transformation.Students can identify and describe the Sam Poo Kong building's transformation forms, which include: 1) reflection on the temple as a whole, ornaments, and Sam Poo Kong entrance gates; 2) translation on the statues, roofs, lanterns, and poles; 3) rotation on the *bedug*, reliefs, incense holders, lanterns, and anchors; and 4) dilatation of the inner and outer rooflines of the Sam Poo Kong building. This can stimulate students to envisage the types of transformation, which makes the information easier to learn.Moreover, this study can benefit teachers for local wisdom context reference in geometric transformation and following researchers for further study.

Keywords: Ethnography, Ethnomathematics, Sam Poo Kong, Transformation

Abstrak

Sam Poo Kong merupakan salah satu cagar budaya kota Semarang. Struktur bersejarah ini menampilkan arsitektur yang menarik serta menjadi tujuan wisata yang populer. Tujuan dari penelitian ini adalah untuk mengeksplorasi bangunan Sam Poo Kong sebagai titik awal pembelajaran dalam materi transformasi geometri. Selain itu, metode penelitian yang digunakan adalah deskriptif kualitatif dengan pendekatan etnografi, yaitu jenis penelitian yang mendeskripsikan dan memperoleh data secara utuh, menyeluruh, dan mendalam. Hasilnya adalah eksplorasi etnomatematika bangunan bersejarah Sam Poo Kong, yang mewakili konsep-konsep matematika termasuk refleksi, translasi, rotasi, dilatasi, dan nilai-nilai budaya yang terkandung di dalamnya.Berdasarkan implementasi di kelas transformasi, siswa dapat dengan mudah memahami bangunan Sam Poo Kong mana yang menggambarkan transformasi.Siswa dapat mengidentifikasi dan menggambarkan bentuk transformasi dari bagian bangunan Sam Poo Kong, yaitu 1) refleksi pada bagian kelenteng secara keseluruhan, ornamen, dan gerbang pintu masuk Sam Poo Kong, 2) translasi pada bagian patung, atap, lampion, dan tiang, 3) rotasi pada bagian bedug, relief, tempat dupa, lampion, dan jangkar; dan 4) dilatasi pada bagian atap dalam dan bagan garis atap luar bangunan Sam Poo Kong. Dari hal tersebut dapat menstimulus siswa untuk visualisasi bentuk-bentuk transformasi sehingga mempermudah siswa dalam mempelajari materi tersebut.Selain itu, penelitian ini dapat bermanfaat bagi guru untuk referensi konteks kearifan lokal dalam transformasi geometri dan peneliti berikutnya untuk studi lebih lanjut.

Kata kunci: Etnografi, Ethnomathematics, Sam Poo Kong, Transformasi

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INTRODUCTION

Mathematics is one of the primary materials in education (Hasibuan et al., 2018) and contributes substantially to the growth of science and technology (Kusmaryono, 2014; Yeh et al.,

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2019). This highlights the necessity of learning mathematics. One of the important areas of mathematics to study is geometric transformation (Aktaş &Ünlü, 2017; Fife et al., 2019). Geometric transformation is essential to acquire since it can develop students' spatial competency and critical thinking (Guven, 2012; Yanik, 2014). However, the geometric transformation remains challenging for students to comprehend (Guven, 2012; Ramlan & Hali, 2018; Evidiasari et al., 2019).

Students encounter difficulty in transformation material is when students find transformation problems for complex shapes (Morris & Paulsen, 2011). Besides, students also facing problems with proof of transformations algebraically (Naidoo, 2010) and placing the image points corresponding to objects. For instance, students have not generalized that the reflection of point A (x, y) to the Y-axis will result in the image A '(- x, y). Another issue experienced by students is related to the direction of transformation. The difficulties are influenced by several factors, teacher-centered learning and monotone context (Yeni, 2011; Burais et al., 2016).

Duckworth (2013) asserts that teacher-centered teaching prevents the development of student education, where students are not given the freedom and responsibility to develop knowledge. Students tend to memorize concepts without knowing their meaning. Learning utilizing this method can lead to poor student learning outcomes. The low learning outcomes of students, according to Ardiyani et al. (2018), are due to several factors, including: (1) teachers have not yet linked learning to the real-life or everyday life of learners; (2) teachers continue to use a traditional teaching model that emphasizes lecture and task; (3) students are passive during the classroom activities, and (4) student-to-student engagement and student-to-teacher interaction are infrequent.

Therefore we need an appropriate context that connected real-life in providing geometric transformation material. According to Wahidin & Sugiman (2014), one of the significant learning mathematics approaches is the Indonesian Realistic Mathematical Approach (PMRI). Since 2001, the PMRI approach has been widely used to improve student interest, attitudes, and low student skills (Prahmana et al., 2012; Bustang et al., 2013; Nursyahidah et al., 2013, 2018; Fahrurozi et al., 2018; Nuraida & Putri, 2020). The one context that has been used in previous studies and shown beneficial outcomes in mathematics class is Javanese Ethnomathematics (Nursyahidah et al., 2013, 2018, 2020, 2021b; Arbowo et al., 2018).

The principle of a realistic mathematics approach beginswith learners visualizing concrete objects or their surrounding environment before progressing to the abstract level (Zulkardi & Putri, 2006). Several contexts for mathematics teaching activities can be used, including traditional games (Nursyahidah et al., 2013), folklore, legends, community habits (Nursyahidah et al., 2018, 2021a, 2021b), the story of the puppet (Arbowo et al., 2018; Risdiyanti & Prahmana, 2020), historical buildings (Fachrurozi et al., 2018), and formal forms of mathematics (Puspasari, 2015).

One of the contexts that can be used as a starting point in the geometric transformation course is Sam Poo Kong, the local wisdom of Central Java located in Semarang City. The author chose the context of Sam Poo Kong as a starting point for this research because the buildings and architecture

within it could demonstrate transformation materials, specifically translation, rotation, reflection, and dilation.Besides, Sam Poo Kong could also show character education based on its history (Julianto, 2015). So that student have the opportunity to interpret mathematics, demonstrate mathematical accuracy and cultural wisdom, and become more motivated to learn mathematics collaboratively. According to the explanation above, the researchers are interested in exploring Sam Poo Kong's heritage building as a starting point for geometric transformation learning. This study aims to reference further researchers or teachers to apply the Sam Poo Kong context in geometric transformation class and insight to explore other local wisdom to implement in mathematics class.

METHODS

The focus of this study is to explore the ethnomathematics parts of the building of Sam Poo Kong and its decorations that can be used as starting point in geometric transformation class. This study is descriptive qualitative with an ethnographic approach. The ethnographic approach investigates fundamental patterns and perspectives on individuals or members of particular cultural communities (Gay et al., 1996). Besides, the ethnographic approach utilized in this research intends to investigate and obtain a description and in-depth analysis of a cultural group through extensive fieldwork over a certain period. This study was carried out from October to December 2020 in three stages: pre-field data analysis, field data analysis, and overall data analysis (Abdullah, 2016). Additionally, this research also included observations of using the Sam Poo Kong context as a starting point in the transformation course for students grade ninth at one of Semarang's junior high schools. The technic of data collection included observation, interview, field note, documentation, and review of the literature.

RESULTS AND DISCUSSION

Sam Poo Kong as Starting Point in Geometric Transformation Course

Sam Poo Kong is a cultural heritage building located in Semarang that must be preserved based on the principle of the Decree of the Mayor of the Semarang District No. 646/50 2 of 4 February 1992. Additionally, Sam Poo Kong is brimming with historical and cultural significance. This temple, which is identical to Chinese ethnicity, is influenced by local Javanese culture and Islam. This is based on the history of Zheng He's expedition to the 'Western Ocean' between 1405 and 1433 on commercial and political missions during the reign of the Ming Dynasty's third emperor, Zhu Di (Julianto, 2015). Zheng He's fleet is believed to stop at Simongan Beach Semarang in 1416, precisely in Batu Caves, because one of the helmsmen, Wang Jing Hong, was sick and need treatment. In 1417, Wang Jing Hong created a statue of Zheng He or known as Cheng Ho, for the community's devotion and remembrance and the beginning of establishing the Sam Poo Kong Temple. Zheng He, who is

thought to be Muslim by ethnic Chinese and Javanese, is revered for his services. This might benefit this context for character development by perceiving Indonesia's diversity of cultures and religions and the necessity of tolerance. Additionally, because this context has never been employed in mathematics learning previously, it might serve as a reference for the research of local wisdom in mathematical education.

Based on the historic architecture of the Sam Poo Kong building, Sam Poo Kong can utilize to represent transformational materials, including reflection, translation, rotation, and dilation. Sam Poo Kong is famous for students since it has an attractive architectural building and is one of Semarang's vacation places. The context of Sam Poo Kong is a fascinating alternative to begin teaching the notion of transformation. Besides, this context can encourage students to connect the ideas to acquire in everyday situations.

Furthermore, to demonstrate the architecture and history of the Sam Poo Kong building, in this study, researchers packaged it with an interactive video. Meanwhile, the researcher also illustrated how to use Google Earth to discover further Sam Poo Kong structures and allows students to explore by themselves when in the online class. Google Earth enables students to learn more about Sam Poo Kong and to experience the tour digitally as if they were there in person. Figure 1 is the illustration of Sam Poo Kong's exploration utilizing Google Earth.

Figure 1. Sam Poo Kong's exploration using Google Earth

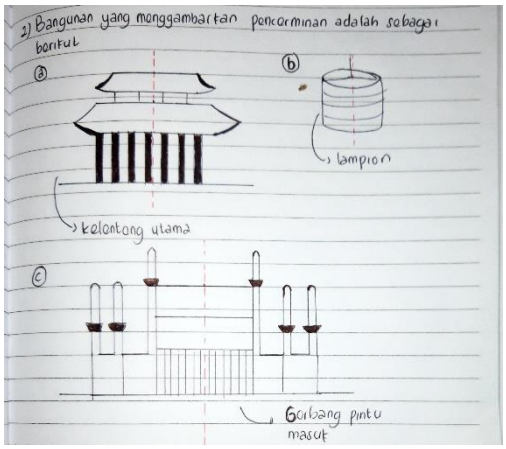
Besides, the following explains the geometric transformation exploration in the Sam Poo Kong building and its implementation in a ninth-grade transformation class.

Reflection

This reflection material can be represented from a variety of symmetrical Sam Poo Kong building structures by transforming one of the lines into a mirror to make it easier for students to grasp the idea of reflection. Figure 2 is an overview of the Sam Poo Kong buildings that represent.

Figure 2. Sam Poo Kong building representsa reflection

In Figure 2. it can be seen that the yellow line is a symmetric line that represents a reflection. This may make it easier for students to grasp the idea of reflection by observing the Sam Poo Kong building directly or through other digital visual forms. Most of the architectural buildings in Sam Poo Kong are symmetrical, which may represent a material for reflection.Additionally, the symmetrical design of the Sam Poo Kong Temple structure is a characteristic of Chinese architectural styles that adhere to the concepts of balance and symmetry (Adhigwhinyo & Handoko, 2017). Besides, students' responses to reflection questions are included Figure 3.



Translation:

2. The buildings that describe the reflection are as follows
a. Main temple
b. Lantern
c. Entrance gate

Figure 3. The student's answer to a reflection-related query

The results of students' answers in Figure 3 show that students can already describe the Sam Poo Kong building, which depicts a reflectionand explains its characteristics. These results can be explained by students with interviews as follows.

Researcher : "*What does this red line (showed in figure 3) signify*?"
Student 1 : "*That's a mirror, ma'am, which indicates a reflection.*"
Researcher : "*Okay, what is the shape and size of the shadow formed against the original shape?*"
Student 1 : "*The shape is the same, Ma'am, because it's symmetrical.*"
Researcher : "*Well, how about the distance and position of the image to the mirror?*"
Student1 : "*Mmm (thinking for a while), the distance of the image to the mirror is the same as the shape being reflected. Then if the position is also the same, Ma'am,Pardon Ma'am, I mean the position of the image with the original shape is reversed, Mom, like when we look in the mirror.*"

Translation

One part that can be used to represent translation material in the Sam Poo Kong building is the arrangement of gigantic poles, roofs, stairs and various other ornaments. See the following Figure 4 for more details.

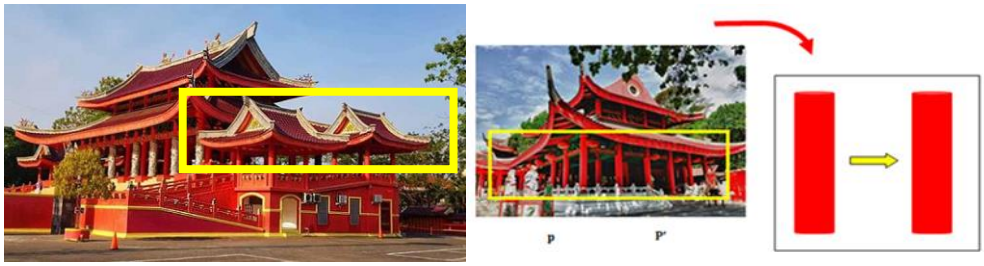
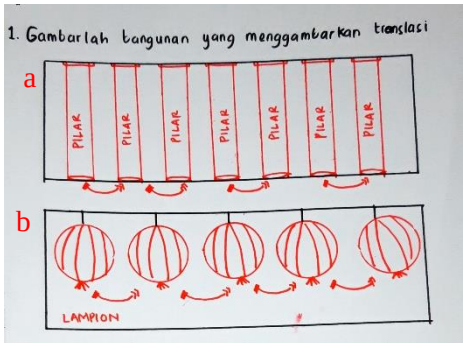


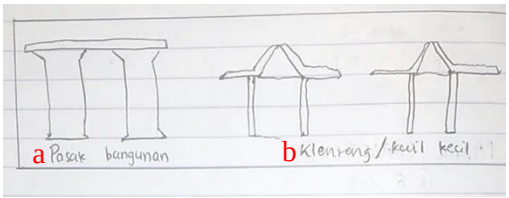
Figure 4. Sam Poo Kong building represent a translation

Figure 4. shows examples of some parts of Sam Poo Kong building that can be translated. This exciting context will make it easier for students to see how the idea of translation is in real life. Besides, students can explore more translation concepts in deep meaning.Furthermore, as illustrated in Figure 2, the *joglo*-style roof is a classic Javanese home design (Hermawan & Prihatmaji, 2019), with a pointy end of straw characteristic of Chinese roofs (Marcella, 2014). This shown the Sam Poo Kong building's acculturation of Javanese culture. Additionally, the following are student answers regarding reflection questions.

Translation:

1. Draw the building that represents translation
   a. Pillar
   b. Lantern





Translation:

a. The building pegs
b. Small of temples

Figure 5. The student's answer to a translation-related query

Students' responses in Figure 5 demonstrate that they can clearly describe the Sam Poo Kong building, representing a translation. During the interview, the subject said if the red arrow showed translation.These results can be explained during the following discussion.

Researcher : "*Why are lanterns and poles a building that shows translation?*"'
Student 2 : "*From the video, it can be seen that the lanterns are swaying, Ma'am, indicating a change in position. As for the pole, it seemed as if it had moved from one place to another, as shown in the video.*"
Researcher : "*Then, if the position changes, does the size also change?*"
Student 2 : "*No,Ma'am, the size and shape remain the same, only the position changes.*"

Rotation

The ornaments and carvings of the buildings in the Sam Poo Kong building may represent rotation. The rotation of this building is unique, where there is a *bedug* that indicates the acculturation of Chinese and Islamic culture. The following Figure 6 is a figure of the rotation material in Sam Poo Kong building.

Figure 6. The ornament and sculpture carving of Sam Poo Kong represent rotation

A *bedug* is depicted in Figure 6a as a sign of worship time for Muslims. The *bedug* placement at the Sam Poo Kong Temple's main hall is influenced by Admiral Zheng He's history as a Chinese Islamist. This confirmed culture assimilation between adherents of the Tridharma (Confucianism, Taoism, and Buddhism) and Islam.

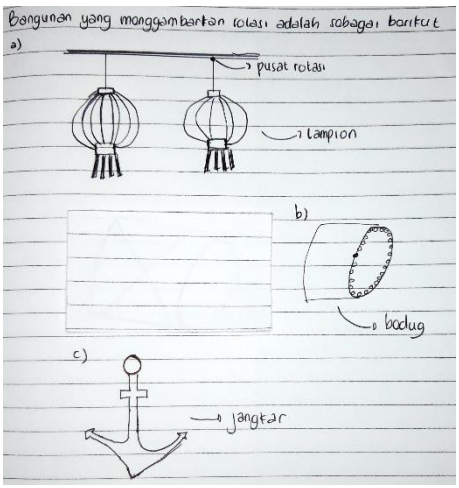


Figure 7. The student's answer to a rotation-related query

Students could sketch the ornament that describes the rotation, as evidenced by their results in Figure 7. Additionally, students might explain that these ornaments can be rotated due to a center of rotation. It can be described as follows by students through interviews.

Researcher : "*Why are lanterns, bedug, and anchors including rotation?*"
Student 1 : "*Because there is a center of rotation, Ma'am. Like the anchor, it's almost the same shape as the hour hand, Ma'am.*"

Dilation

One of the aspects that is special about Sam Poo Kong is the roof design. Almost the entire roof architecture of this Sam Poo Kong building has a long roofline at the bottom, and the outer line of the roof is getting smaller. This is represents dilation. See Figure 8 for more details.

Figure 8. The Sam Poo Kong building that represents dilation

This can be seen in Figure 8. The red lines on each stage have different lengths of the same architectural theme. This will help students think creatively on which Sam Poo Kong architecture reflects dilation. Furthermore, practically almost all the roofs of Sam Poo Kong are stacked roofs that are shaped downward with the roof's edge tapering upwards. According to one of Sam Poo Kong's tour guides, the stacked roofs show the typical philosophy of Javanese people who are always accepting and humble.

Meanwhile, the roof's edge pointing upward indicates that if the Chinese people desire prosperity, they will continually seek more or ascend; they do not wish to down. This demonstrates cultural acculturation between China and Java and the character value of remaining humility regardless of their wealth.In addition, several parts of Sam Poo Kong can describe the dilation, as shown in the following picture.

Figure 9. The Sam Poo Kong building that depicts dilation

As illustrated in Figure 9, the greenwood trim on the inside of the Sam Poo Kong roof shows dilation, which looks as if it is reducing. As we know, the temple in Chinese architecture is generally red and yellow, but in Sam Poo Kong, it also incorporates a third color, namely green. According to Mulyadi in CNN Indonesia (2018), the Sam Poo Kong Foundation's management, the green color of

the Sam Poo Kong temple is identical to the color of Islam. In Chinese architecture, red represents fire and connotes prosperity, fortune and favors decorum; and yellow symbolizing soil and signifies values and majesty, as well as being defined by loyalty (Zhang, 2019).Meanwhile, the green color in Islam architecture is a soft color connected with the natural world,symbolizing will at labor, persistence, stable thinking, trust, and personality (Nejad et al., 2016).

Translation:

1. Here is a building that exemplifies the dilation
- Because it's getting smaller
- The roof line up is getting bigger

Figure 10. The student's answer to a dilation-related query

According to the students' answers in Figure 10, students illustrated buildings that represent dilation correctly. Students also sketched building structures that were not in the video; student 3 re-exported the Sam Poo Koong building using Google Earth and found buildings that depicted dilation other than parts of the Sam Poo Kong roofline. However, in the student's answer, the student wrote incorrectly that it should be getting smaller if the outer roofline is getting bigger.These findings can be explained in further detail during the subsequent interview.

Researcher : "*What buildings show dilation?*"
Student 3 : "*There is a green inner roof and stripes on the outer roof.*"
Researcher : "*Why does the green roof get smaller?*"
Student 3 : "*Because if you look inside, the square shape is getting smaller.*"
Researcher : "*What about the shape of the outer roofline?*"
Student 3 : "*It's the same; the roofline is getting smaller and smaller.*"
Researcher : "*If it gets bigger, it's dilation, right?*"
Student 3 : "*As far as I know, it's dilation, enlargement, or reduction. If you look at the green roof from the square inside out, it also enlarges, Ma'am.*"

Additionally, after the students finished the transformation worksheet, the researchers asked questions related to the cultural values derived from the Sam Poo Kong building. Throughout the group discussion period, students were able to comprehend and integrate cultural values into everyday life. The following interviews contain additional details.

Researcher :"*Okay, after you observed the interactive Sam Poo Kong video and completed the Transformation Student Worksheet, are there any cultural values that you may apply in your daily life from the buildings of Sam Poo Kong that reflect transformation?*"
Student 4 : "*As humans, we must be tolerant individuals towards each other*."
Researcher :"*Why is tolerance considered a cultural value that consists in Sam Poo Kong building?*"
Student 2 : "*Maybe because there are Chinese, Javanese, and Islamic culture elements in Sam Poo Kong's video, Mom. As a result, we must show tolerance for the Chinese.*"
Researcher :"*Are we only tolerant of Chinese ancestry?*"
Student 4 : "*No, ma'am, we must be accepting of anyone around us.*"
Researcher :"*That is right, we have to be tolerant in our daily life to everyone around us.Any else?*"
Student1 : "*Ohh, earlier in the Google Meet class, Ma'am stated that the symmetrical Sam Poo Kong building shows balance. Thus, perhaps we should be able to become individuals capable of balancing our time, for example, between fun and studying, Mom.*"
Student 3 : "*Suppose I'm not wrong, in the video mentioned. Humble like a Javanese, correct? since the roof is dropping. For hard-working, cause the shape of the roof is pointed, right?"*
Researcher :"*Yes, that's right.*"

Based on the study results, it is found that Sam Poo Kong can be used as a learning context in geometric transformation material and makes it easier for students to grasp the idea of geometric transformation. This is consistent with several previous research, which indicate that daily life in mathematics learning will be more meaningful and can boost students' logical comprehension skills. History and architecture of Sam Poo Kong building as context also can demonstrate character education through multicultural ethnic and religion. This statement is supported by Arbowo et al. (2018), who claims that the usage of context with the background of character values can help develop the character for students. This background is used as a starting point for learning geometric transformation, which can be packed in an interactive video that explains the history of Sam Poo Kong and its integration into transformation material.

Moreover, the use of the Sam Poo Kong context in geometric transformation learning can alter students' perceptions of mathematics by demonstrating that it exists and becomes ingrained in society's culture. By using Sam Poo Kong as a local learning framework, this article will serve as a context resource for geometric transformation learning materials. Thus, this exploratory analysis contributes to the context review, which can be used as a starting point for learning mathematics within the context of Indonesian traditional wisdom.

CONCLUSION

The findings of this study indicate that the historical building of Sam Poo Kong may be used as a context for a starting point in the geometric transformation class. This historic building can be used

as a learning environment, enabling students and community members better to understand the correlation between local wisdom and mathematics. Besides, the building and its architecture can represent the material of geometric transformation, including reflection, translation, rotation, and dilation. This context can make it easier for students to recognize geometric transformation because it is close to students' everyday lives. Additionally, a learning design can be developed to assist pupils in grasping mathematical ideas, especially considering the architecture of the Sam Poo Kong structure. The instructional design that allows teachers to contextualize the historic Sam Poo Kong building can be done through educational tours or digital visualizations of Sam Poo Kong Building and explore geometric transformation and character education.

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