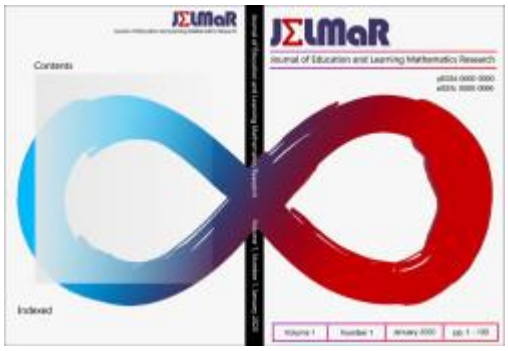

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Student Gestures when Solving Local Wisdom-Based Mathematics Problems

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***Abstract**: When solving math problems, students make spontaneous movements called gestures. The purpose of this research is to find out the variations of gestures that appear when students solve math problems related to rotational geometry based on local wisdom. The qualitative approach used in this research is a descriptive research type. Test questions, documentation results, observations, and interviews were used as research instruments. The subjects of this study were four students in class XI for the 2022/2023 academic year at SMA Negeri Balung. The results showed that the group of students with high abilities used gestures more than students with low abilities. Students with high ability in solving math problems use 11 iconic gestures, 8 metaphoric gestures, and 24 deictic gestures. Meanwhile, the group of students with low abilities used 7 iconic gestures, 6 metaphoric gestures, and 12 deictic gestures. Based on the distribution of the number of student gestures when solving math problems, the gesture that appears the most is the deictic gesture, and the one that appears the least is the metaphoric gesture.*
Keyword: gestures, math problem solving, geometry

INTRODUCTION

According to Panglipur & Putra (2019, p. 44) mathematics is one of the compulsory subjects that must be given to students with the aim of providing provisions for the ability to think logically, systematically, analytically, critically, and creatively and have the ability to cooperate in the learning process, so that it can be said that learning mathematics is very important. The importance of learning mathematics is inseparable from its role in aspects of life, one of which is that many problems are presented in mathematical form. According to Islamiah et al. (2018) the main purpose of learning mathematics is to solve problems.

Students must be able to solve math problems. In accordance with the opinion of Yunaeti et al. (2021, p. 11), one of the abilities that students must master by learning mathematics is solving mathematical problems. Problem solving is considered one of the most important cognitive functions used in everyday life because solving mathematical problems is considered the most important part of mathematics (Aljaberi, 2015, p. 121). Mathematical problems can develop students' thinking. The problems that arise make students try to solve what they face, so students must use various methods such as thinking, trying, and asking questions to solve problems.

The development of student thinking through the integration of mathematics and culture is an interesting context that can bridge mathematics with everyday life. Students know how to use existing knowledge and skills to solve math problems when the problems are related to real-life conditions (Putra & Panglipur, 2019, p. 27). According to Shadiq (Nggaba & Ngaba, 2021, p. 99) the context of the problem is important to motivate students to solve problems because the problems are not too abstract, not too simple, and not too difficult to solve. One of the local wisdom contexts that can be used is batik cloth.

Batik has been designated by UNESCO as the Masterpieces of Oral and Intangible Heritage of Humanity since October 2, 2009. In addition to their beauty, batik motifs contain many mathematical concepts that have a hierarchical, structured, systematic, and logical arrangement from the simplest to the most complex (Sulisawati et al., 2021, p. 57). This statement is reinforced by Umaisaroh et al. (2022, p. 112), who say that if you pay

close attention, batik motifs have the quality of rhythmic or patterned regularity. Various forms of regularity in batik are geometric transformations. Artistic forms in batik are obtained through the transformation of points, lines, or flat planes through translation (shift), reflection (mirroring), rotation (rotation), or dilation (multiplication).

Geometry transformation is a very interesting material if the concept can be understood well, but some students have difficulty learning this material. According to Murtinasari et al. (2019, p. 71) Conception itself is the result of thoughts that are built intuitively by each student. When this conception is wrong, it will lead to the wrong perception or understanding for further study where mathematics is a related subject, especially geometry. Based on research conducted by Albab et al. (2014, p. 338) students have difficulty understanding the concept of transformation, which includes translation, reflection, rotation, dilation, and combinations of geometry transformations, which dominates their overall errors as conceptual errors (Zanthy & Maulani, 2020, p. 19). Of course, students' difficulties in understanding the material in a way that causes conceptual errors can be overcome if they have good knowledge and understanding of the concept of transformation and how to apply it to solving problems.

When solving problems, students make spontaneous movements. One of the studies related to this spontaneous action was revealed by Williams et al. (2012, p. 183) on Theories of Embodied Cognition. This theory explains that a person's cognitive abilities are related to that person's thinking. This theory is also based on the fact that the body is involved in the human thinking process. When faced with a problem, a person naturally thinks about it for a moment and spontaneously reacts to it by interacting with body movements.

Spontaneous movements occur in student communication. Because human movements are usually accompanied by speech. This movement associated with speech is called a gesture. McNeill says that "The gestures I mean are the movements of the hands and arms that we see when people talk" (McNeill, 1992, p. 1). According to him, gestures are the movements of the hands and arms that we see when people talk.

This needs to be underlined because gesture is a movement along with speech. Then a gesture appears when communication is successful. So, in this study, students were grouped to discuss how to solve math problems. The gesture classification used refers to the classification developed by David McNeill, including iconic gesture, metaphoric gesture, and deictic gesture. Iconic gestures contain formal relationships that are closely related to the content of what is being discussed semantically. Metaphoric gesture describes the content of what is being said abstractly. A deictic gesture is a gesture that is shown to indicate an object.

Here is one example of Iconic gesture, which is Revatul Ridho's research on gesture in solving function problems (Elvierayani, 2016, p. 14):

Figure 1. Iconic Gesture

Students use their hands and fingers to condition how intersecting graphs look. The student's gesture is accompanied by a remark: "I remember that the functions are intersecting and parallel".

Based on previous research, namely Revatul Ridho's research, the three types of gestures are commonly done by students when solving math problems. As explained above, geometry transformation material becomes one of the most difficult for students. Geometry transformation is a branch of geometry that deals with changing the position or shape of geometry objects. Rotation is one type of geometry transformation. As the name suggests, rotation means a rotation that is determined by the center point of rotation, the direction of rotation, and also the size of the angle of rotation. Because this material is warmly discussed or discussed in class XI, the researcher uses math problems related to rotation in class XI as a research reference.

Based on the description of the problem above, the researcher is interested in conducting a study entitled "Student Gestures when Solving Local Wisdom-Based Mathematics Problems".

METHOD

This study used a qualitative approach with descriptive research. In this study, researchers tried to describe students' gestures when solving local wisdom-based math problems in groups. The research was conducted on Thursday, June 22, 2023, and held at SMA Negeri Balung.

The subjects in this study were XI grade students in the 2022/2023 academic year at SMA Negeri Balung, as many as four people. The subjects were grouped based on the ability seen from the student's score list as well as recommendations from the math teacher.

Table 1. Student Grouping

No	Student	Group Student	Category
1	ARF	Group 1	High Ability
2	MAT		
3	AED	Group 2	Low Ability
4	AFP		

The data collection procedures of this study are tests related to local wisdom-based geometry rotation problems to bring out variations in student gestures when solving mathematical problems, documentation in the form of audio-visual recordings when students solve mathematical problems to observe the number of gestures that appear and categorize these gestures, observation of each student gesture that appears on the video results from the beginning to the end of working on the problem, and interviews to find out in depth about gestures made by students when solving problems.

Data analysis in this study involves data reduction to sort out data that is relevant to the research objectives and discard data that is considered unnecessary, data presentation by describing and categorizing student gestures in David McNeill's gesture classification, and drawing conclusions to find out the number and variety of gestures made by students when solving local wisdom-based mathematics problems.

RESULT AND DISCUSSION

From the observations that have been made of 2 groups, namely group 1 (high ability students) and group 2 (low ability students), there are 68 student gestures that appear when solving math problems, including Iconic gesturese, metaphoric gesturese, and deictic gestures. The following is a distribution table of the three gestures found and the percentage of each gesture. From the observations that have been made of 2 groups, namely group 1 (high ability students) and group 2 (low ability students), there are 68

student gestures that appear when solving math problems, including Iconic gesturese, metaphoric gesturese, and deictic gestures. The following is a distribution table of the three gestures found and the percentage of each gesture.

Table 2. Distribution of The Number of Gestures

Gesture Classification	Group 1	Group 2	Total	Percentage
Iconic gesture	11	7	18	26,47%
metaphoric gesture	8	6	14	20,59%
deictic gesture	24	12	36	52,94%
Total	43	25	68	100%

1. Iconic Gesture

Iconic gestures contain formal relationships that are closely related to the content of what is being said. This gesture appeared in Group 1 when ARF spoke to MAT to confirm something. At the same time, ARF's hand holding a pen moved to follow the picture of the motif in the problem.

Figure 2. Iconic Gesture

ARF : *This is from here to here, does that mean 180°?*

Iconic Gesture : *Along with the words "from here to here" ARF's hand made a movement following the picture of the motif on the question paper.*

In Figure 2, it can be seen that the gesture that appears has the same function as speech. The gesture expresses the speaker's point of view and illustrates the close relationship between speech and body movement. Semantically, the student describes the phrase "from here to here", while the gesture shows the same flexible picture. ARF thinks about things that need to be considered before solving problems and sequencing the information obtained. This is evidenced by the results of the researcher's interview with the subject. The transcript of the interview results reads as follows:

Researcher : *In this video, you are doing hand movements. What are you showing your friends?* (by showing the video recording)

ARF : *Like making a trajectory to show my friend the changes in the motif image in the test question.*

Researcher : *What is the reason you made that movement?*

ARF : *To make it easier for me to explain to my friend*

Researcher : *Did it help you when your friend did the movement?*

MAT : *Yes, I understand better.*

Researcher : *How did you solve the problem?*

ARF : *I determined the rotation first because the question was unknown, so I looked at the picture to determine the rotation.*

Based on the results of observations and interviews with subjects, the iconic gesture also appeared in group 2. This gesture appeared when AED was discussing with AFP the direction of rotation.

Figure 3. Iconic Gesture

AED : *This means it rotates here.*
AFP : *Yes, it rotates here.*
Iconic Gesture : *Along with the words "rotating here" AED and AFP's hands make a rotating motion on the question paper.*

In Figure 3, it can be seen that group 2 is discussing the direction of rotation on the question paper. Both subjects are trying to understand the problem related to what is known and asked in the test question. The gesture that appears has the same function as speech. AED used his pen by making a circular motion on the question paper. The same movement was followed by AFP using his index finger.

2. Metaphoric Gesture

Metaphoric gesture describes the content of what is discussed in the abstract. This gesture occurred in group 1 when MAT was making sure that the calculation was not wrong and the answer was correct.

Figure 4. Metaphoric Gesture

MAT : 0×-3 and plus -4. Oh yeah, right -4
Metaphoric Gesture : *Making taps in the air*

The movement made by MAT illustrates what is being discussed, but abstractly. In this case, MAT is reviewing the answer. MAT thinks about whether he is sure of his answer, analyzes and evaluates the procedures used to determine whether they are correct, and analyzes and evaluates the results obtained to determine whether they are correct. Metaphoric Gesture occurred four times where MAT used a pen and made taps in the air four times.

The same gesture occurred when AED asked what was known in the test question and what should be written on the answer sheet. AFP made three taps on the question sheet to tell the steps to solving the test question.

Figure 5. Metaphoric Gesture

AED : *This means what is known first?*
AFP : *Straight away, A first (while tapping 3 times*).
Metaphoric Gesture : *Making taps on the question paper*

From Figure 5, it can be seen that AFP is telling and convincing his colleague that the first thing to write is the coordinates of point A. This is evidenced by the results of the researcher's interview with the subject. The transcript of the interview results reads as follows:

Researcher : *What are you doing in this video?* (by showing the video recording)
AFP : *That was my friend asking what to write first, so I said just write A, so that's why I showed the coordinates of A in the test question.*
Researcher : *What is the reason you made that movement?*
AFP : *So that my friend knows what I mean*
Researcher : *Does it help you when your friend does the movement?*
AED : *Yes, if I don't use the movement, I don't understand.*

3. Deictic Gesture

A deictic gesture is a movement intended to show an object. In group 1, a deictic gesture appeared when ARF told MAT that the direction of rotation of the batik motif in the test question was clockwise, so θ was negative. At the same time, ARF used his index finger to show the picture of the batik motif in the test question.

Figure 6. Deictic Gesture

ARF : *This is clockwise, which means -90˚.*
Deictic Gesture : *His index finger points to the picture of the batik motif on the test question.*

In Figure 6, ARF wants to show that the word "this" is aimed at an object, namely the batik motif in the test question. The use of ARF's index finger is a characteristic of deictic gestures. It can be seen that ARF set up a problem-solving strategy. ARF's pointing gesture was done to draw the interlocutor's attention to the object in question. This is evidenced by the results of the researcher's interview with the subject. The transcript of the interview results reads as follows:

Researcher : *What are you doing in this video?* (by showing the video recording)
ARF : *This is me pointing to the picture of the batik motif in the test question.*
Researcher : *What is the reason you made that movement?*
ARF : *I want to show my friend that the direction of rotation of the batik motif is clockwise, so the value is negative, namely -90˚.*
Researcher : *Did you have any difficulties solving the test questions?*
ARF : *No, because, besides, we have gotten this material before. The test questions are also accompanied by pictures, so it's easier to project them.*

Based on the results of observations and interviews with subjects, the Gesture also appeared in group 2. This gesture appeared when AED was confirming something on AFP regarding rotation.

Figure 7. Deictic Gesture

It can be seen that AED pointed to the picture of the batik motif on the test question because he was still unsure about the size of the rotation. The deictic gesture that appeared was different from that of subject ARF in group 1 because AED did not use his index finger but used a pen when pointing to an object. AED tried to understand the problem related to the extent to which the batik motif in the picture was rotated.

Based on the results of the above analysis related to student gestures when solving local wisdom-based mathematics problems, the following is a graph of student gesture use between groups 1 (high ability students) and 2 (low ability students).

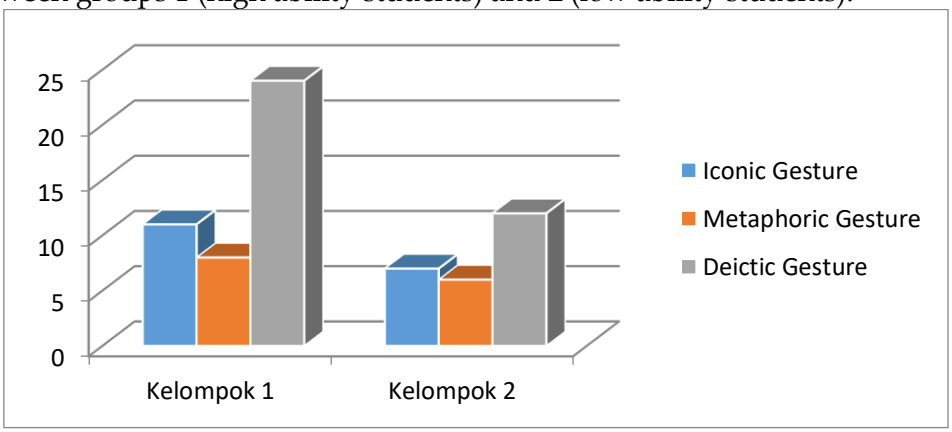

Figure 8. Graph of Gesture Usage in Groups 1 and 2.

From figure 8, it can be seen that gestures that appear a lot in each group are deictic gestures because, when solving problems, subjects interact and discuss in such a way as to point to images of batik motifs in the test questions, so deictic gestures are used more often. While the gesture that appears the least is the metaphoric gesture, in terms of local wisdom-based geometry, rotation problems do not describe much abstraction. The graph also shows that the distribution of the number of gestures of the three gestures (iconic gesture, metaphoric gesture, and deictic gesture) is more widely used by group 1, namely students who have high ability, than group 2, who have low ability.

In the context of previous research on the gesture analysis of students when solving mathematical problems, there are similarities between the results of research (Elvierayani, 2016, p. 14) and (Oktavianita & Wahidin, 2022, p. 4805). The results of the study are in line with the two researchers findings that in solving math problems, students use iconic gestures, metaphoric gestures, and deictic gestures. The most widely used gesture is the deictic gesture, and the least used is the metaphoric gesture. In addition, in this study, there are additional findings that, in addition to attracting the attention of the interlocutor and pointing to the object being discussed, the function of gesture can simplify and clarify information, make the interlocutor focus, and reduce errors in solving math problems in groups.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the gesture that appears most is a deictic gesture, and the gesture that appears least is a metaphoric gesture. Group 1 (high-ability students) in solving problems related to geometric rotation used 11 iconic gestures, 8 metaphoric gestures, and 24 deictic gestures. While group 2 (low-ability students) used 7 iconic gesture, 6 metaphoric gesture, and 12 deictic gesture.

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REFERENCES

Albab, I. U., Hartono, Y., & Darmawijoyo. (2014). Kemajuan Belajar Peserta didik pada Geometri Transformasi Menggunakan Aktivitas Refleksi Geometri. *Jurnal Ilmiah Cakrawala Pendidikan*, *33*(3), 338–348. https://doi.org/10.21831/cp.v3i3.23%0A78

Aljaberi, N. M. (2015). University Student's Learning Styles and Their Ability to Solve Mathematical Problems. *International Journal of Business and Social Science*, *6*(4), 121–134. https://www.researchgate.net/publication/331731138

Auliya, R. N. (2016). Kecemasan Matematika dan Pemahaman Matematis. *Jurnal Formatif Jurnal IImiah Pendidikan MIPA*, *6*(1), 12–22. http://dx.doi.org/10.30998/formatif.v6i1.748

Elvierayani, R. R. (2016). Gesture Matematis Siswa dalam Menyelesaikan Masalah Fungsi. *Jurnal Reforma*, *4*(1). https://doi.org/10.30736/rfma.v4i1.13

Islamiah, N., Purwaningsih, W. E., Akbar, P., & Bernard, M. (2018). Analisis Hubungan Kemampuan Pemecahan Masalah Matematis Dan Self Confidence Siswa SMP. *Journal On Education*, *1*(1), 47–57. https://doi.org/10.31004/joe.v1i1.10

McNeill, D. (1992). *Hand and Mind: What Gestures Reveal about Thought*. The University of Chicago.

Murtinasari, F., Noviani Sulisawati, D., & Lutfiyah. (2019). Desain Kaos Geometri sebagai Media Pemahaman Konsep Bentuk pada Segiempat untuk Siswa Sd Kelas III Geometry T-Shirt Design as a Media for Understanding the Concept of Forms Quadrangle for Elementary School Students Grade III. *Emasains*, *8*(1), 70–76. https://ojs.mahadewa.ac.id/index.php/emasains/article/view/273/221

Nggaba, M. E., & Ngaba, A. L. (2021). Kemampuan Berpikir Aljabar Siswa dalam Menyelesaikan Masalah Matematika Berbasis Kearifan Lokal. *Satya Widya*, *36*(2), 97–104. https://doi.org/10.24246/j.sw.2020.v36.i2.p97-104

Oktavianita, S., & Wahidin, W. (2022). Gestur Siswa Slow Learner dalam Belajar

Matematika Menggunakan Aplikasi Wordwall di Sekolah Dasar. *Jurnal Basicedu*, *6*(3), 4802–4811. https://doi.org/10.31004/basicedu.v6i3.2941

Panglipur, I. R., & Putra, E. D. (2019). Identifikasi Level Kinerja Novice Melalui Kemampuan Berpikir Kritis Siswa (Interpretasi, Analisis). *Prismatika: Jurnal Pendidikan Dan Riset Matematika*, *2*(1), 43–50. https://doi.org/10.33503/prismatika.v2i1.573

Putra, E. D., & Panglipur, I. R. (2019). Analisis Level Kinerja Practitioner Melalui Aktivitas Belajar Siswa. *Jurnal Pendidikan Matematika (JUDIKA EDUCATION)*, *2*(1), 25–35. https://doi.org/10.31539/judika.v2i1.700

Sulisawati, D. N., Amalia, D., & Djamali, M. F. (2021). EKSPLORASI KONSEP DILATASI ETNOMATEMATIKA PADA BATIK TEMBAKAU JEMBER. *Prismatika: Jurnal Pendidikan Dan Riset Matematika*, *4*(1), 56–64. https://doi.org/10.33503/PRISMATIKA.V4I1.1441

Umaisaroh, Supandi, S. R., Agustin, I. H., Maylisa, I. N., & Dafik. (2022). Kerangka Aktivitas Pembelajaran Berbasis Riset dengan Pendekatan STEM: Penggunaan Software Berbasis Android untuk Meningkatkan Metaliterasi Siswa dalam Mendesain Motif Batik Khas Situbondo Menggunakan Konsep Geometri Tranformasi dan Pewarna Alami. *Ebook CGANT Universitas Jember*, *0*(0), 2021–2022. http://ebook-cgantunej.or.id/index.php/cgant/article/view/6

Williams, C. C., Walkington, C., Boncoddo, R., Srisurichan, R., Pier, E., Nathan, M., & Alibali, M. (2012). Invisible proof : the role of gestures and action in proof. *North America Chapter of International Group for the Pychology of Mathematic Education*, 182–189. http://www.pmena.org/

Yunaeti, N., Arhasy, E. A., & Ratnaningsih, N. (2021). Analisis Kemampuan Pemecahan Masalah Matematik Peserta Didik Menurut Teori John Dewey Ditinjau Dari Gaya Belajar. *Journal of Authentic Research on Mathematics Education (JARME)*, *3*(1), 10–21. https://doi.org/10.37058/jarme.v3i1.2212

Zanthy, L. S., & Maulani, F. I. (2020). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Materi Transformasi Geometri. *Gammath : Jurnal Ilmiah Program Studi Pendidikan Matematika*, *5*(1), 16–25. https://doi.org/10.32528/gammath.v5i1.3189