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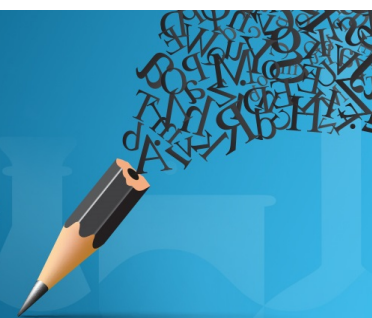


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Gesture Learning Mathematics, Spontaneous?

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Abstract. Mathematics learning should be designed to introduce learners' power of mathematical meaning to the below to real-world models. Gestures in learning also have a very important role in delivering materials and focusing the attention of students. The gestures of teachers and students that appear during the learning process prove that the body is involved in learning interactions. This study aims to decrypt gestures that are produced spontaneously in mathematical learning. The research was conducted at the elementary and high school levels. The research subjects are teachers and students. Data collection is done by observing /recording audio visually the learning process of mathematics in class, then the collected data is analyzed exploratively with qualitative analysis techniques. The results of research were described into 2 (two) categories, namely the gesture of the teacher delivering the material and the gesture of the students solving mathematical problems. Both show that the gestures produced during the mathematical learning process appeared spontaneously and had meaning integrated with speech.

INTRODUCTION

Learning is essentially a process of interaction between learners and their environment, so that behavior changes in a better direction. The main task of teachers in learning is to condition the environment to support behavior changes. Mathematics learning is very important in the framework of quality personal formation. Mathematics can not only be seen as a science that attaches importance to cognitive abilities, but mathematics is also strongly related to the formation of commendable attitudes and behaviors [1]. Gestures in learning also have a very important role in delivering materials and focusing the attention of students. The gestures of teachers and students that appear during the learning process prove that the body is involved in learning interactions. This is reinforced by [2] who reveal that to convey ideas in learning, limbs are involved in it.

Gesture is widely regarded as a "universal language" [3]. In addition [4] research interpreted the term gesture as a form of nonverbal behavior, which is a way of communicating through body movements. Naturally, gesture is a nonverbal communication medium used to express yourself through movements that appear consciously or unconsciously (reflex motion), this means that gestures can be a substitute for speech, because it is a form of nonverbal communication where the actions of the body are seen communicating certain messages. The ultimate goal of understanding the implications of nonverbal (gesture), especially in communication between diverse learners is to navigate and prevent accidental miscommunication [5]. Freedman ([6]) argues that gestures are facilitators of verbal expression. Gestures are intended to achieve more adequate verbal expression. In addition [7] said that hand movements and body movements can be considered as gestures.

In the context of mathematics learning [8] argue that teacher gestures can help learners in learning activities. Teacher gestures can help direct learners to take and understand the implied meaning of any hand gestures or facial expressions that teachers make. [8] even emphasized that student gestures that mimic teacher gestures during the

learning process make it easier for learners to understand lessons. Therefore gestures not only indicate learners are ready to learn, but gestures can really help learners learn [4].

The research of [9] explains that gestures have been shown to play a key role in mathematical reasoning and to be an indicator that mathematical understanding is embodied inherently linked to action, perception, and the physical body. In this context, gesture didefinisikan collaborative gestures as gestural exchanges that take place as learners discuss and explore mathematical ideas, using their bodies in concert to accomplish a shared goal. Learners (teacher and student) use collaborative gestures to extend mathematical ideas over multiple bodies as they explore, refine, and extend each other's mathematical reasoning. In addition, research [4] reveals 2 (two) types of gestures in mathematics learning, namely Matching Gesture and Discrepancy Gesture. Matching gesture is a type of representational gesture which is characterized by conformity when observing, pointing, and revealing/mentioning problems, while discrepancy gesture is a type of representational gesture which is characterized by discrepancies when observing, pointing, and revealing/mentioning problems, because they are distracted.

Gesture teachers at the time of learning contribute to the gestures of learners. Learners may imitate the teacher's gestures, or spontaneously the learner may also come up with other gestures as accentuation/affirming ideas or ideas that they have about mathematical concepts. The student's gesture in learning can also represent attitudes, emotions, feelings and how to express them in certain situations. [10] also revealed gestures as an integral part of speech that contributes to expressing thoughts spontaneously. Gesture can be said as a representation of what is thought and can serve as an accentuation that confirms nonverbal information. These gestures represent an important case of extended cognition in that they demonstrate how body actions can influence and extend over multiple learners' mathematical reasoning in a way that is fundamentally different from traditional modes of exchanging mathematical information (i.e., speech and written work). The modality of gestures thus can serve to distribute collective problem solving [9].

The interaction of teachers and students in the mathematical learning process is very important to achieve learning objectives. The teacher's gesture in delivering the material will give a message and influence the learner, because mathematics is often considered difficult. Unwittingly when the learning process occurs in class, gestures are actually widely produced, because it plays an important role to support learning activities. Focusing on the role of gestures in the learning process, the researchers describe the cognitive mechanisms of gesture roles as mental strategies that help learners to reduce cognitive load when discussing math problems ([11], [8], [6]). Gestures in mathematics learning are produced by teachers and students, occur spontaneously and represent the thinking process. Specifically in this study, gesture exploration focused on teachers and students, namely the teacher's gesture when presenting the material and the student's gesture when solving math problems. These two aspects are determined to be the focus of research, because both activities are assumed to be very important in learning mathematics, are interrelated and allow many gestures to be produced.

Based on the description above, the problem in this study is how does gestures in mathematical learning occur spontaneously?. This study aims to decrypt gestures that are produced spontaneously in mathematical learning.

METHOD

This research is descriptive research with qualitative approach. The research was conducted at the elementary and high school levels, with the research subject of teachers and students. The main instrument in this study is the researcher himself, because the researcher plans, designs, implements, collects data, analyzes data, draws conclusions and makes reports, while the supporting instrument is in the form of observation sheets. Data collection is done by observing and recording audio visually the process of learning mathematics in the classroom. Furthermore, the collected data is analyzed using qualitative analysis techniques, namely reducing data, analyzing data and displaying data. Qualitative data analysis is conducted explanatively and continues continuously until complete, so that the data is saturated. The measure of saturation of data is characterized by the absence of new data or information. The results of data analysis are presented in the form of snippets of figure which are screen shots of recorded videos, accompanied by an explanation of the gestures produced in the image.

RESULTS AND DISCUSSION

The research was conducted by recording the mathematics learning process carried out by teachers and students in the classroom. The learning process is carried out naturally as the activities that have been carried out by teachers and students, so the gestures that appear during the learning process are not manipulative because they occur naturally.

Math learning should be designed to introduce learners' power of mathematical meaning to the below to real-world models. The goal is as scaffolding (help) for learners to understand mathematical relationships that can serve as mathematical models of real systems, thus helping learners to give meaning to the material studied, as well as provide a formal approach to solving problems. Gestures in this study are described in 2 (two) categories, namely:

1. Gesture conveying material

According to experts, gestures play an important role in supporting verbal communication, so that when delivering learning materials in the classroom, the teacher's gesture will strengthen mathematical ideas or ideas/concepts. Mastery of mathematical materials and the way they are delivered are an absolute requirement for math teachers. Here's the teacher's gesture that appears at the time of delivering the material.



FIGURE 1. (a) Stand Facing Position and (b) Emphasis on Important Points

When delivering learning materials, teachers use gestures to communicate ideas to students [9] standing, sitting and class mobility slightly affect the acceptance of information submitted to students. Speaking while standing gives a more authoritative effect and mastering the class well let alone supported by careful eye contact towards the learners, because it can attract attention and involve them in class interaction. The attitude of sitting constantly during the learning process will actually show a defensive and personal attitude that is lacking in spirit, but if supported by adequate voice intonation, then a little bit helps overcome the saturation of learners. Furthermore, when delivering learning materials, teachers come face to face with students. In this condition, the teacher does not lean excessively towards the students, so it does not seem aggressive. When emphasizing important points, the teacher shows a relaxed position while pointing repeatedly at his points or by giving different marks to the writing, eye contact is maintained and expressive gestures, so that the mathematical concepts conveyed are meaningful, because they are supported by convincing gestures. This is reinforced by [12] that there are many ways movements can have mathematical meaning.

The follow-up to Figure 1 above is that the teacher looks at each student one by one for a few seconds, this situation indicates the learner feels noticed, and they will automatically turn their attention. In delivering the material, the voice intonation marks a section that shows the arguments or emphasis in detail on important aspects that learners should know. Teachers can manipulate the use of tones over and over again with the same information, but the goal can be to show something new and interesting to know. Sound intonation can be located at the beginning, in the middle or at the end of the learning.



FIGURE 2. Gesture Settled Controlled

When students ask questions, the teacher is in a listening position, and does not make finger-tapping movements, scratching their heads, or staring around, or attitudes that indicate a disturbing or tense mood. The teacher gives an impression by listening to questions, nodding his head, and leaning towards the learner, smiling or following the emotions of the interlocutor, and making eye contact. Such a teacher's attitude, it will usually be easier to give persuasive encouragement to students, so they will enthusiastically listen to the explanation of the material delivered by the teacher, including when doing work. This is confirmed by [9] that gestures provide a window into understanding how the body can be leveraged to help students reason about mathematical ideas as they work jointly on challenging tasks.

All actions or gestures have a special meaning, as [13] asserts that gesture gives meaning, is realized and appears interactively. It should be understood that in the learning process teachers not only provide lesson materials, but more than that teachers must provide an easier understanding and understanding by learners. On this understanding gesture plays an important role as a supporter in delivering the subject matter. The goal is to get the attention of the students, so that the learners are interested and can quickly absorb the material delivered.

2. Gesture Solving Math Problems

A good mathematical learning process is expected that students can learn and understand mathematics well and then be able to solve math problems in daily life. Teaching students problem solving, enabling students to be more analytical in making decisions in their lives. If the student is trained to solve problems, then the student will be able to make decisions, because it will be more skilled in collecting relevant information, analyzing information and realizing the need to double-check the results obtained.



FIGURE 3. (a) and (b) Sample for Focus on Resolving Issues

In general gestures that arise when learners solve the dominant mathematical problem of serious expression, focus on the problem solved, and involve the limbs especially both hands. Gestures play an important role in math learning. [11], and [8] argues that hand gestures can lay the groundwork for new knowledge for learners to learn and understand mathematics. In addition, [14] states that the proper use of gestures can help learners construct mathematical knowledge, and generally learners imitate teacher gestures in solving math problems [11], and people explore mathematical ideas deeply when they are encouraged to collaboratively co-construct body movements [15].

Eye cues (views) made by students when paying attention to the teacher's explanation has a variety of meanings, if the spotlight is sharp then the indication that the learner has a high spirit of optimism / curiosity to the information conveyed, when the gesture appears bowing his head and glance up indicates the attitude of surrender / acceptance as the information is conveyed, but there is a belief that they understand and can obtain results (e.g. the information heard can be used to solve problems). This condition is reinforced by [16] Gesture is a sign of physical behavior or an expression of feelings. In addition, students use collaborative gestures to extend mathematical ideas over multiple bodies as they explore, refine, and extend each other's mathematical reasoning [9].

Based on the study, students will focus on the teacher's face for approximately 80% of the overall time. Students not only focus on the teacher's eyes, but focus on the eyes for a few minutes, then move to the nose or lips, then return to the eyes. They may stare at the table occasionally, but always come back to look the teacher in the eye. [17] revealed that when teachers teach about mathematical concepts, then at that time students will routinely produce gestures along with speech according to what they listen to. Gestures can be productively used to help students notice and subsequently correct their pronunciation errors, both segmental and suprasegmental errors [18]. Gestures are associated with powerful forms of understanding [19], so that in the process of learning mathematics every gesture that appears in the hands, facial expressions gives meaning.

CONCLUSION

All actions or gestures have a special meaning. It should be understood that in the learning process teachers not only provide lesson materials, but more than that teachers must provide an easier understanding and understanding by learners. Gesture is a spontaneous movement of the body and its parts and is the result of subconscious processing in its efforts to express feelings and desires hidden in the heart. Based on the results of research and discussion, it can be concluded that gestures in mathematics learning are produced spontaneously:

1. The teacher gestures when delivering material are expressive, including movements of the hands, face, and voice intonation that reinforce mathematical concepts so that they are meaningful. gesture plays an important role as a supporter in delivering the subject matter. The goal is to get the attention of the students, so that the learners are interested and can quickly absorb the material delivered. Each gesture produced comes from what is thought (happens spontaneously), so it will hint at the form of attention, the teacher's seriousness, as well as the pleasure of learners in following every learning process they go through.
2. The student gesture when solving the problem is also an expression of expression but predominantly involves hand movements. When solving problems, students tend to focus on working on the problem but make a sound. Gestures of students tend to follow the teacher's gestures, especially in the steps taken by the teacher in solving problems.

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