

Adult Gesture in Collaborative Mathematics Reasoning in Different Ages

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Submission date: 14-Jan-2020 11:30PM (UTC+0700)

Submission ID: 1241879583

File name: Noto_2017_J._Phys._3A_Conf._Ser._895_012048.pdf (1.21M)

Word count: 5421

Character count: 27695

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To cite this article: M S Noto *et al* 2017 *J. Phys.: Conf. Ser.* **895** 012048

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Adult Gesture in Collaborative Mathematics Reasoning in Different Ages

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Abstract. This article describes the case study on postgraduate students by using descriptive method. A problem is designed to facilitate the reasoning in the topic of Chi-Square test. The problem was given to two male students with different ages to investigate the gesture pattern and it will be related to their reasoning process. The indicators in reasoning problem can obtain the conclusion of analogy and generalization, and arrange the conjectures. This study refers to some questions—whether unique gesture is for every individual or to identify the pattern of the gesture used by the students with different ages. Reasoning problem was employed to collect the data. Two students were asked to collaborate to reason the problem. The discussion process recorded in using video tape to observe the gestures. The video recorded are explained clearly in this writing. Prosodic cues such as time, conversation text, gesture that appears, might help in understanding the gesture. The purpose of this study is to investigate whether different ages influences the maturity in collaboration observed from gesture perspective. The finding of this study shows that age is not a primary factor that influences the gesture in that reasoning process. In this case, adult gesture or gesture performed by order student does not show that he achieves, maintains, and focuses on the problem earlier on. Adult gesture also does not strengthen and expand the meaning if the student's words or the language used in reasoning is not familiar for younger student. Adult gesture also does not affect cognitive uncertainty in mathematics reasoning. The future research is suggested to take more samples to find the consistency from that statement.

1. Introduction

The gesture is a movement towards the body that person does in understanding problems. According to Alibali and DiRusso [1], the functions of gesture can help children to an understanding of numbers to others. In other words, the gesture may help children to pass on their knowledge to the respondent. According to Reynolds and Robert [2], the students make a gesture of collaborating is a source of diagnosis or as information for teachers. This research makes a study of two graduate students gestures collaborate in conducting mathematical reasoning with the statistical material. The three functions of gesture that is: first, the gesture is used to achieve, support, and return the focus to the problems. Second, gesture strengthens and expands the meaning of the word if the student or the language used in problem-solving is not familiar. Third, it is possible in some circumstances, the gesture is an index of an uncertainty level cognitive that replaces the understanding (the changes cognitive). Reynold and Robert [2] see three of these functions on students who collaborate in solving problems of graph speed time and graphical representation of a bus trip. This research addresses the different perspectives, by observing the changes of understanding about what and how an understanding of the changes that occurred when two students collaborate in generalities (reasoning) of a problem on the topic of chi-square test in statistics courses.

The research of Reynold and Robert [2] gives the conclusion that the gesture of the students made an impact in the case of collaborative learning mainly limited to formal language in understanding problems. Students must seek to dynamically together understanding the issue through gesture to solve it. This study remains a question, whether the gesture is unique to each, or whether it is possible to find patterns of the gesture used students, from gesture between different age, gender, etc. Harisman, Noto, Bakar and Amam [3] have studied the patterns of inter-gender gesture. The conclusions of the study, some gesture showed by female students are: often lower his head, less confident, shy, often nodded when the transfer of cognitive understanding, advancing the body movements directly towards the interviewer and ask questions if there are things that are not understood. Some gestures shown by male students are: play the hand, still see the problem, think long when it cannot answer the question, stay quiet when changing cognitive understanding. The researchers giving two students seven questions (problem-solving) on the topic of geometry. In this study, the students do not collaborate in solving the problems is given, but working on the problem separately. Furthermore, each student interviewed with semi-open questions, and the conclusion is about gesture patterns of genders. The gesture almost a consistent pattern to the seven questions provided.

In this study, we see how the gesture of two graduate students (with different ages) collaborates in the reasoning problem. Things that will be observed adapted to gesture function expressed Reynold and Robert [2], namely: (1) how the gesture used to achieve, support, and return the focus on the problem that sees from gradations of age-associated mathematical reasoning processes? (2) How gesture to strengthen and expand the meaning if the words of the student or the language used in solving unfamiliar problems as seen from the age gradation attributed to the process of mathematical reasoning? (3) How gesture affects cognitive uncertainties that may gesture can be used as a vehicle to replace the understanding (cognitive change) as seen from the age gradation attributed to the process of mathematical reasoning?

The reference to this study is research by Graham [4], which examines how the spontaneous gesture of children of all ages on the counting topic. The findings of this research are the role of gesture might serve to see the children's understanding of counting they do. Furthermore, Alibali, Flevares, and Meadow [5] conducted a study in which 20 teachers and 20 students see the sketch video footage of the 12 children that explains the solution to the problem of the equation. Based on this gesture the children can show important information about their problem-solving strategies. Six children revealed the same strategy in speech and gesture and the other six states of different strategies. The study investigated whether children from disclosing information may include a gesture that is accessible and understandable to others. The results of the study revealed that adults are not trained to express their understanding of the gesture.

This research will study whether to stimulate the understanding of others in learning collaborative need the gesture shown by adults (graduate students). Graduate students that have been subjected to this research are two male students with a different age. One of them is an adult that has had experience in teaching for 19 years, and the other has three years of teaching experience. A graduate student that is the subject of research is a lecturer at different universities.

This study is important to a university professor, whether adults need to express their understanding by using gestures or body movements when the student is difficult to understand the spoken language of their lecturers. To assess that, starting with assessing whether adults are going to show their gesture when faced with the problem or if they are not accustomed to trained in using the gesture as disclosed Alibali. Caused by these reasons, this study is very important to do as instructional decision-making in teaching. Why viewing from the perspective of collaborative inter-age is to answer whether age adults affects them in demonstrating gesture when confronted with problems. Various kinds of questions come to mind is whether older people will always keep their movements or even more expressive than children. When adults are expressive in understanding the problem, whether it will affect change or stabilization of their understanding of the opponent's discussion, in the context of school, of course, other people it is their students. Not many researchers that speak about the gesture of the level of adults.

Research Alibali and Meadow [6] conducted entitled *Gesture-speech mismatch and mechanisms of learning: what the hand reveals about a child's state of mind* are still talking at the level of children that study about the relationship between their saying with a gesture they have shown when explaining their understanding of the material in the series. Previous research by the Church and Meadow [7] also conducted a study evaluating the discrepancy between gesture and spoken language of children as the index changes in the knowledge that they have. The study examined two implications mismatch between gestures and speech of children in explaining a concept, namely: (1) Is child gesture and speech, show an underlying inconsistency in understanding a child's understanding of the concept? (2) Do mismatch gesture and speech is a result reflection of this inconsistency, reflecting the acceptance or rejection of the concept that was their understanding?

Meadow and McNeill [8] also still researching about the gesture's function in children. Beside the gesture is a sign that children's understanding of the concept, gesture also serves as an identifier of cognitive changes in children. That gesture has privileged access, meaning children may know about a concept or information, but can't say. Thus, it can be said that gesture serves as an extra window to make a child's mind develops. The gesture probably is more than just to show an understanding of the child, but involved in the process of cognitive change itself.

The study further revealed that this question would guide research on gesture will enter the new millennium. It has also been disclosed by Reynolds and Robert on the research before, probably because such research is doing in 2002 which has entered the new millennium on research gesture. Why is the gesture only at the level of the children? Goodwyn and Acredolo [9] confirmed they show that children learn sign language to develop signs to understand something at the early age of development, rather than to understand something in words. It is also revealed by Iverson and Meadow [10] who studied children born blind, with the aim of exploring the use of gesture to people who are blind. Four children born blind tested for three situations discoursed (narrative, reasoning, and spatial) and compared with a group of children that see but closed their eyes. Blind children do the gesture, although not all children make the gesture, and the gesture resembles the children that see but blindfolded. The results of this study show that the gesture can replace the function of communication.

There is some research that examines the gesture teenager like Roth [11] that conduct research on students. As a result, developmental psychology indicates shift function and frequency of use of the cue from an early age to early adolescence. Kelly and Church [12] also conduct research gesture towards adults, where the study was to compare the ability of children and adults to detect the information conveyed through hand movements. According to the Meadow and McNeill [8], the gesture is the language that is easier for the baby to master cognitive skills using the gesture conveyed by others. If the gesture is part of communicating then this research will review for the perspective, how two adults exposing their gesture when faced with problems such as reasoning. This is done because if a teacher or

lecturer communicates processed must show whether the gesture so children easily understand the material if there is a verbal language that is less familiar to them or teacher or lecturer is quite silent and only read out the learning material in front of the class.

2. Method

This study was a descriptive study to see gesture two graduate students in solving the problems of mathematical reasoning with the topic of chi-square. How the two post-graduate students collaborate to understand something is by design the reasoning problems. This study saw a different perspective because most research always looks at how children are three aspects of it in solving problems. It is forgotten is that if children can understand the problem with the gesture, the teacher should teach to develop and train their gesture to make students or their students better understand the material presented. In the first study, we will see how the gesture of adults with different ages in reasoning problems. It is important to give an idea to train adults (teachers) in issuing a gesture to solve problems. The study involved two students of different ages because researchers wanted to see whether age affects adults gesture that they show in understanding the problem. Based on that reason, there is a big question on us how adults (teachers) to communicate to their students, whether requiring gesture or just sit quietly in front of the class.

Participants in the study were two post-graduate students of different ages. One of them was 41 years old and the other 28 years old. The age difference is to choose to find how age affects the gesture made when collaborating in reasoning problems. Do mature a lecturer/teacher will increasingly leave their gesture of solving problems. Judging from teaching experience, participants aged 41 years have had experience teaching for 19 years and the other for three years teaching experience. Both participants have a GPA of almost the same order do not to affect their academic ability in understanding and reasoning problems. Both students also have gained an advanced statistics course in the second semester.

The task given is a matter of reasoning, containing the indicators proposed by Sumarmo [13], namely: First, draw conclusions analogy, generalisation, and arrange conjecture. Second, draw a logical conclusion based on inference, check the argument's validity, and make a valid argument. Third, compile evidence directs, indirect, and mathematical induction. In a matter of reasoning, just load indicator (1) and (2). However, before the process of reasoning takes place, the two students should understand the problem first. Researchers chose questions about indicators reasoning because it is the ability to help high-level participants to think deeply. The task given is to generalise how to find the expected frequency (f_e) of observed frequencies (f_o) of the topic's square test.

The formula of square test:
$$X^2 = \sum_{i=1}^k \frac{(f_o - f_e)^2}{f_e}$$

The form of the first and second question will be given the shape of its expected frequencies while in the third form, participants will find its frequency expectations. Once they find the answers to expected frequencies, we ask participants to generalize counting or how a formula to find the frequency of a given expectation. Here the one examples of three given problems is displayed as follows.

Table 1. We collect the following observations to decide whether gender and happiness of married have correlation and will feed all the observed frequencies and the expected frequencies

(f_o)	Gender		Total
	Men	Women	
The Satisfaction of Married			
Very Happy	30	45	75
Happy Enough	50	45	95
Not Happy	20	10	30
Total	100	100	200

Table 1. Cont.

(f_e)	Gender		
	Men	Women	Total
The Satisfaction of Married			
Very Happy	37,5	37,5	75
Happy Enough	47,5	47,5	95
Not Happy	15	15	30
Total	100	100	200

The source of the problem: Wahyudin [14]

After understanding the case of one, two and three, determine the formulation of how to determine the expected frequency of observation.

Both students must understand the problem with ten minutes. After that, the two students collaborate in solving the problem. They are free to debate, influencing the understanding, or change the understanding. We tell the students to only do discussions without notifying them to use gesture, so the gesture that occurs are natural.

We collect the data by providing reasoning test of both students. Furthermore, the two students will collaborate in solving problems of reasoning. The students' collaboration will be recorded from the beginning to the end of the discussion. We analyse the video footage to assess the students' gesture shown to answer the three problems outlined in the introduction. The result of collaboration between the two students will be presented in prosodic cues such as time and conversation. The form of gesture that appears will helpful in understanding the gesture given by two students.

3. Results and Discussion

After giving the reasoning problem to the BM (41 years) and AMH (28 years old), we obtain the gesture form from his understanding of the reasoning for 10 minutes until obtaining generalisation about the current form of collaboration is as follows.

Table 2. Protocol from Conversation and Gesture





Time	Conversation	Gesture BM (41 years old)	Gesture AMH (28 years old)
00:01sec- c-00:34 Sec	There has been no conversation	Silent, calm, but occasionally looked nervous and less confident	Playing a pen and end at 34 seconds into nodded while playing lip
			
00:35sec- 00:41 Sec	AMH : Do you understand problem number one? BM : I was even scared about the problem number three; could you please to read it. AMH : Oh yes, the first paragraph, it is dangerous BM : Hahahaha.. There is a typo, 15 y can I read it, I failed to focus. AMH : Let's just 15 y it's true BM : Oh yes, let's just say it's true	The thrusting paper shows the writing error. 	Stay play a pen and quiet. 

Table 2. Cont.














00:42 Sec-01: 28 Sec	BM	:	How can I solve problem number one? Is there a formula?	Switch position sat approached AMH	Put the paper on the table and get ready to write
	AMH	:	Not a paper to write off?		
	BM	:	Just write out here, try number one, please teach me		
01:28 Sec-01:48 Sec	AMH	:	It's the data, from here to here, we find the empty, well how do we solve it?	More subduing the body of the paper and to consider seriously	Cross out the f_o and f_g on the matter of naming the columns of the same location with the letter a, b, c, and d
	BM	:	Means we have to find from where it can be 39.4?		
	AMH	:	Yeah, well, we suppose these data a, b, c, d for its observation frequency, then a, b, c , and d also for frequencies up to his expectations, the expected frequency of a is already there, just search for the others?		
01:48 Sec-02:30 Sec	AMH	:	Well now how do I find the value b, c , and d here by looking at the data before	Move his legs to the left while straightening	Forming quotes by hand
	BM	:	What should I use? Can I use a comparison?		
	AMH	:	I already know how to solve this.		
	BM	:	How do I solve it?		
	AMH	:	Want to know the formula?, Please try first, because we want to shape the understanding. Please try to solve it by yourself.		
02:30 Sec-02:31 Sec	BM	:	You mean this 39.4?	Continue to pay attention to problems seriously and listen to explanations AMH	Stay calm and pointing to the problem on paper
	AMH	:	Yeah, where is the result come from? Why if the observed frequencies have a value 54, the frequency of its expectations is 39.4?		
02:32se c-03:16se c	AMH	:	Is there a calculator? There should be.	Opened the jacket and seemed enthusiastic, and participate put out smartphone	Turning on the calculator contained in the smartphone from his pants pocket and keep calm
	BM	:	There should be a formula, if there is no formula, we cannot solve?		
	AMH	:	Yeah, but the instruction of the problem is to find the formula.		
	BM	:	Oh, to find the formula ...		

Table 2. Cont.

03: 16 Sec – 04:00 Sec	AMH	:	We try first; I test my guess, I already know the formula, it seems true, that's right, I got the formula	Glancing an eye toward AMH to ask for an explanation	Stay calm 
	BM	:	I'm lazy to think right now, how do I solve it?		
	AMH	:	Please don't cheat on me, later, the reasoning problem can not be executed		
	BM	:	No problem, we're being collaborate		
04:01 Sec – 06:00 Sec	BM	:	I will make corrections, how your logic?	Enthusiastic and play hands like to request an explanation	Describe the pattern of answering on paper 
	AMH	:	There is value 54, and there was 39.4 right?. Relating to 54 it was 85, 83, and 179. So the chances of 34.9 are formed by the numbers right?, I created the matrix, the matrix is answered 39.4, right? From where? Using existing value, it turns out there is 83 divided by 179 times 85. 83 divided by 179 times 85. So that, now how did that happen? Was the term already directly into the formula right? How the logic of thinking?		
06:00 Sec- 08:17 Sec	BM	:	Why would it be 83 divided by 179 times 85?	Keep writing, and occasionally nodding and smiling	Stay calm, pointing to some of the numbers in problems
	AMH	:	Well, that was the expected frequency, some rows, divided by the total, times the number of columns, well, how about this b problem? 83 divided by?		
	BM	:	179, Yes 179 times?		
	AMH	:	31?		
	BM	:	No		
	AMH	:	It becomes this, be this, it means times?		
	BM	:	times 31?		
	AMH	:	No		
	BM	:	Oh, times 94 right?		
	AMH	:	Yeah, like that, for the c, how?		
	BM	:	Means, 96 divided by 179, then times?		
	AMH	:	Come on, times with?		
	BM	:		BM : 31?	
				AMH : No	
				BM : 85?	
				AMH : Yeah, okay the last one, the d?	
				BM : Okay, the last one right, 96 divided by 179, times 94?	
				AMH : Correct, finished	

Gesture analysis from the Table 2 is to answer the three question and associating it with the reasoning process that draws conclusions analogy, generalisation, arrange conjecture and draw logical conclusions based on inference, check the argument validity, and make the valid argument. Before the process of reasoning, the two students must understand the problem. In this process, we see how the gesture uses to achieve, maintain, and re-focus on the problem to solve. It can be seen at minute 00: 01 - 00: 34, BM appeared calm and occasionally looked nervous, but AMH seems to play pen and at the end of 00:34 minutes showed a nod. If viewed from a gesture that indicated at the beginning of understanding,

suspensions seemed BM has not yet understood the problems and AMH seem to have understood the issues indicated. If seen how the gesture shows the focus on the problem is we can see in minute 00: 35 Sec - 00: 41 Sec, BM shows a gesture of paper handed to AMH and spoke context typing errors, while AMH does not realise it and stay calm and focus on the problem.

BM saw not focus on the question because he was talking about things outside the context of the question. AMH looks very focus, he showed a quiet gesture, focus on the question and does not even realise it before typing errors notified by BM. When viewed from the perspective of age, in the context of this study shown that age does not affect one's understanding. Furthermore, the process to generalize the results related to the process of mathematical reasoning and associate it with how the gesture (movement) to strengthen and expand the meaning if the words of AMH & BM or the language they use in problem-solving is not familiar, can we see from the gesture in the 01: 28 Sec - 01:48 Sec, 2:32 Sec - 3:16 Sec, 4:01 Sec - 6:00 Sec. At this time-intervals AMH try to expand the meaning of intent about the BM that seems less familiar with the language and numbers on the question, where the gesture showed AMH is crossing out on (f_e) and (f_o) on the question about naming the columns in the same place with the letter a, b, c , and d , then pull out a calculator in his smartphones from his pocket and keep

quiet, and a portrait of answer patterns on paper. In Figure 1, we can see AMH shape pattern made on the process to generalize and find the pattern.

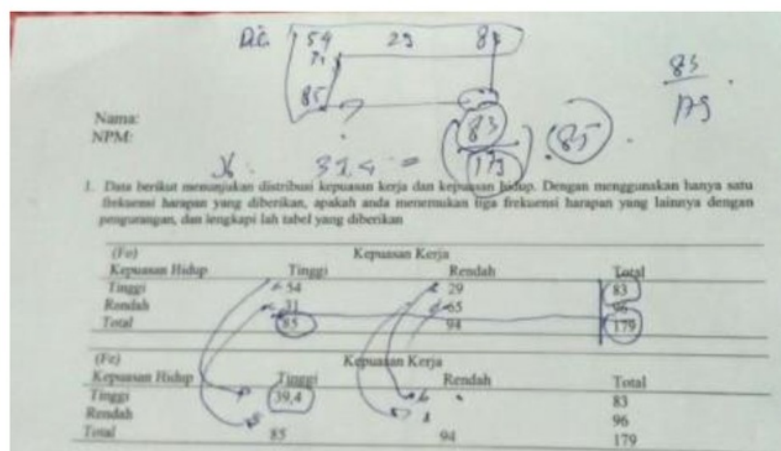


Figure 1. The pattern created by AMH to expand (clarify) the meaning of the BM

Furthermore, BM shows a gesture of curiosity to the explanation or expansion meaning that AMH described. Gesture shown by BM is, move closer to a sitting position on the AMH 00 min: 42 Sec-01: 28 Sec. BM opens the jacket, looked enthusiastic, come pick up and turn on HP Sec, 02:32 Sec-03: 16 Sec, and enthusiastic as well as playing a hand like asking for an explanation at minute 04:01 Sec - 6:00 Sec. All the gesture is made by both students in the process of obtaining a general formula for determining the expected frequency of the Chi-Square test. The terms of the age are seen that the age factor does not affect the gesture of the two students when they want to generalise the right formula.

Furthermore, when seen from how the gesture (movement) affects cognitive uncertainty, perhaps the gesture can be used as a vehicle to replace the understanding (cognitive change), seen from the gesture given by AMH affect cognitive certainty BM. When looking at AMH quiet gesture, BM immediately moves a seated position for an explanation. Furthermore, BM also shows the gesture of not understanding and not being able to do reasoning with the context of generalisation. It can be seen in Sec-06:00 08:17 Sec where BM continued to write and occasionally nodded and smiled, indicating that it may generalise the problem well. Furthermore, AMH continues to bear the quiet gesture indicating

that AMH has been able to generalise the problem from the beginning. It can be demonstrated by a second gesture on Sec 06:00 - 08:17 remained calm, pointing to some numbers in problems. It indicates AMH unchanged or unaffected by BM understanding. When viewed from the age, it is concluded that gesture on students being more mature age did not affect changes in the understanding of the younger students, even younger students who are influencing changes in the understanding of the students in a more mature age.

After a process of discussion, some questions posed to the students, why it happened, based on interviews revealed that AMH is a lecturer of statistics and BM is teaching calculus course. At the beginning of the study, it is ignored because our view is academic ability, as well as two students alike, have obtained an advanced statistics course in the second semester.

4. Conclusions and Implications

From the results of the study, we conclude that age is not the main factor affecting gesture, which appeared at the time of the reasoning problems given. In this case, the gesture shown by students who are more mature age did not show the first achieve, maintain, and focus on solving the problem. The gesture also did not strengthen and expand the meaning, if the words of the student or the language used in problem-solving are not familiar to younger students. The gesture more mature age student also does not affect cognitive uncertainty for younger students at the time of mathematical reasoning. Particularly, in this case, it turns teach experience that became the dominant factor of the gesture shown as more aware of the problem, capable of clarifying and expanding its meaning, and cognitive changes may affect other students. For further research, it is advisable to take more samples to see the consistency of the statement.

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Acknowledgments

Thanks to Mr. M. Win Afgani (UPI graduate student, doctoral program) already provide feedback ¹³ 1 this article and assisting during the research process. Thanks to Mrs. Marwia Tamrin Bakar (UPI graduate student, the program as a doctor) who have been willing to accompany the researchers recorded the collaborative process from the beginning to the end.

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