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COMMOGNITIVE STUDENTS' DURING DISCUSSION IN SOLVING SKEWNESS AND KURTOSIS PROBLEM

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ABSTRACT

Abstract: The purpose of this study, to analyze students' commognitive activities during discussion activities in solving skewness and kurtosis questions. The research method used in this research is descriptive qualitative for semester 3 students of State University of Malang in the 2020-2021 academic year. Based on the results of the analysis of the completion of LKM 1 and LKM 2, all groups consisting of 17 groups have not met the commognitive component. So that pre-service students randomly took several groups, namely group 1 and group 15 as research subjects. Their SK1 does not interpret the final result and then SK1 also does not reflect its skewness and kurtosis curves. Whereas for SK15 they also had errors in writing the symbols from the range, then their SK15 also did not describe the skewness and kurtosis curves, and SK15 also had errors in writing the formulas for the size of the location Q_1 and Q_3 and errors in using the formula to find the value of the kurtosis.

INTRODUCTION

Activity is an inclination that occurs in a person, either consciously or unconsciously, to execute a specific action. In learning process activities, activity can be defined as the overall driving force (energy) in pupils that produces continuity and offers direction so that learning objectives can be attained with relative ease (Sudiono, 2020). Student activities in the learning process may include listening, discussing, interviewing, role acting, making observations, gathering or writing reports, and problem solving, among others. A discussion activity is a common element of the instructional process.

Discussion activity is a conversation between two or more individuals in which they exchange ideas and provide relevant information for debating a certain topic or problem in order to reach a consensus. This is consistent with the opinion (Sunaengsih & Sunarya, 2018) that discussion activities are one of the learning activities conducted to provide students with opportunities to discuss a particular problem or topic by submitting opinions, exchanging ideas, and arriving at joint conclusions from discussions. Through indirect conversation activities, students will actively participate in their groups.

Sfard (2008) presented a commognitive perspective to investigate mathematical communication in the cognitive process. According to the cognitive theory proposed by (Sfard, 2008), learning mathematics depends on how a group communicates mathematics using a language that is easily understood by other members of the group. This commognitive approach is likewise dependent on student engagement in learning (Sfard, 2015).

Prior cognitive research has emphasized the importance of content knowledge in general learning (Berger, 2013; Nardi et al., 2014; Tabach & Nachlieli, 2016; Zayyadi et al., 2019; Tasara, 2018); (Fauzi et al., 2019). In contrast, no research has been undertaken on student communication during discussion activities, according to my research.

The relationship between cognitive and discussion activities is based on student participation in discussion activities. Participation in discussion activities can include, for instance, expressing opinions, transmitting ideas or information, exchanging ideas, and offering advise on responses from friends. This is consistent with the belief (Walkington et al., 2015) that during the discussion process in small groups, students will be indirectly driven to present questions and comments, and these activities will stimulate students' mathematical communication in groups.

Based on PRE-SERVICE students' online lectures for third-semester students on solving skewness and kurtosis problems. Some students find it challenging to interpret the statistical results they have generated. This is consistent with the belief (Ningsih, 2020) that interpreting statistical results poses the greatest challenge for pupils. To overcome these obstacles, statistical abilities such as the capacity to evaluate information, conduct analysis, make conclusions, and apply the obtained results to the topic at hand are required.

On the basis of the current problems, it is possible to conclude that discussion activities are related to commognitive in terms of learning involvement. By exchanging knowledge with their peers, participation in this project will help students overcome their difficulties in evaluating their statistical data. Therefore, researchers are inspired to study "Commonsense Analysis of Students During Discussion Activities in Solving Skewness and Kurtosis Problems".

METHOD

This research employed a descriptive qualitative methodology. This research enrolled 35 students from Department of Mathematics, Universitas Negeri Malang. This study's data collection method was based on discussion activities in the WhatsApp group and the outcomes of the completion of LKM 1 and LKM 2 based on the commognitive component proposed by (Sfard, 2008) that is 1) word use in the form of words, variables and functions 2) Visual mediators in the form of symbols such as numbers, tables, algebraic expressions, equations, and graphs and 3) Narrative in the form of definitions, proofs, and theorems.

This study utilized assignment papers, interview guides, and recording devices as its tools. The assignment sheet consisted of LKM 1 and LKM 2, each containing a single question. LKM 1 was a student worksheet with questions on the skewness material, whereas LKM 2 was a student worksheet with questions on the kurtosis material. In addition, the subject was interviewed to corroborate student responses that remained ambiguous regarding the cognitive component. The researcher's recording device utilizes an active presenter application to capture the discussion activities in the WhatsApp group, the presentation of group discussion outcomes using Google Meet, and interviews.

Table 1. Research Design

Commognitive Component	Description	Indicator
Word Use	Word use is the use of examples, notations or symbols used by students in solving problems, for example using words, variables and functions.	- Students can understand about the collection of scores of statistical methods. - Students can write down what is asked in the question correctly - Students can write statistical symbols correctly based on a collection of scores from the statistical method
Visual Mediator	Visual mediators are mathematical objects used by students such as symbols or iconic representations.	- Students can describe distribution tables based on known statistical method scores - Students can also draw curves based on the final calculation results to find skiewness and kurtosis.
Narrative	Narrative is a procedure for proving the results of the completion carried out by students	- Students can write formulas according to the questions asked in the questions. - Students can give reasons why they use the formula.
Routine	Routines are described in the form of repetitive knowledge organization	- Students can use word use, visual mediator, and narrative to solve the problem. - Students can explain the completion procedure based on word use, visual mediator, and narrative used.

RESULTS AND DISCUSSION

The research subjects were requested to complete LKM 1 and LKM 2 regarding the content of skewness and kurtosis based on the findings of the study. The research subjects were instructed to write their responses to the findings of their conversations, and then to present the results of their discussions. In addition, the research respondents were questioned to investigate the cognitive component of their responses. In addition, from 35 students, researchers selected two of seventeen groups to be analyzed based on the achievement of the commognitive component, namely the word use used by students in writing what was known in the questions, the visual mediator used, the narrative used to respond to skewnees and kurtosis problems, and the approach used. using word usage, visual mediation, and textual storytelling as criteria. The research participants were coded as SK1 and SK15. The subject of group 1 is SK1 and the subject of group 15 is SK15.

Before beginning the learning process, pre-service students requested that undergraduates form groups. After the construction of the group is complete, pre-service students request that undergraduate students create a WhatsApp group composed of themselves and pre-service students as supervisors in the event that they encounter difficulties while working on issues. After the formation of everything, learning can occur. The five phases of PBL learning are as follows:

Before learning commences, students have viewed video content on skewness and kurtosis on sipejar as part of the problem-orientation phase. The pre-service students then assessed their comprehension using a series of questions about skewness and kurtosis.

The second stage is the organization of learning; since the formation of groups and WhatsApp groups occurred prior to the start of learning, the next step is for group members to exchange information regarding skewness and kurtosis topic, after which pre-service students present LKM 1 and LKM 2 to be discussed with their respective groups separately. Then, pre-service students monitor student activity within the WA group to ensure that students comprehend the offered assignments.

In the third level, which consists of an individual or group investigation, students and group members consider sharing knowledge to solve problems within the WA group. If students have trouble during the conversation, pre-service students will provide assistance through the WA group of each group.

The fourth stage is developing and presenting the results of problem solving. At this point, pre-service students request that group representatives email them the outcomes of their conversations. After all groups have compiled the findings of their talks via email, pre-service students evaluate the group's responses based on the cognitive component. After pre-service students examined the group's responses, it was determined that none of the 17 groups met the cognitive requirement. As a result, pre-service students randomly picked two groups, groups 1 and 15, as research subjects. The selection of these two groups was based on the fact that the representation of each group lacked several cognitive components. Google Meet was utilized for the presenting of the discussion's results. The following are the outcomes of the presentations made by the two groups, SK1 and SK15, regarding the outcomes of their discussions. In their Google Meet presentations, the two groups communicated the outcomes of their discussions with great fluency. They can describe to all of their friends the outcomes of their discussions, specifically LKM 1 and LKM 2. During their presentations, the two groups receive feedback from their fellow group members regarding the outcomes of their discussions. The recommendation offered to SK1 was that they did not record the conclusions derived from the final results of calculating skewness and kurtosis, nor did they draw the curve derived from the final results of calculating skewness and kurtosis. SK15 also fails to explain the skewness and curvature curves in the final calculation results. SK15 is also less accurate in formulating the method for identifying the position of Q 1 and Q 3 and makes errors in utilizing the formula to determine the kurtosis value.

Following the presentation of the findings of the completion of the SK1 responses to the LKM 1 questions on the skewness topic, an interview will be conducted to study the commognitive component of students' responses to the SK1 discussion results.

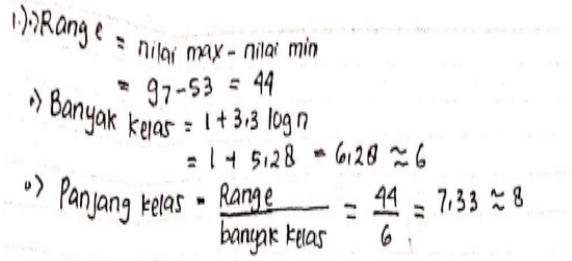


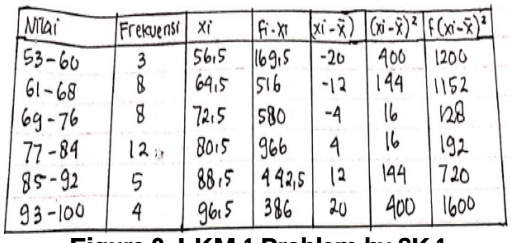
Figure 1. LKM 1 Problem by SK 1

In Figure 1, the response of SK1 may be noticed. In completing LKM 1 for the skewness question, SK1 uses the UTS score of the statistical approach to determine the range, number of classes, and class length. In order to determine the range, SK1 sorts the UTS values from lowest to highest. After sorting the UTS scores, the range value can be determined by subtracting the highest score from the lowest score, or the maximum value minus the minimum value. SK1 then applies the formula $1+3.3 \log_n$ to get the number of classes, where n is the number of UTS scores using statistical methods. SK1 then utilizes the previously searched range and class length information to determine the class length. This demonstrates that SK1 has met the first cognitive requirement, which is word use. SK1 was able to document the range, number of classes, and length of classes in writing and to verbally describe the outcomes of their conversations through interviews with researchers. The following is the result of the interview conducted by the researcher with SK1.

Researcher	:	"In question number 1 you have written down the range, the number of classes, and the length of the class using words, not using symbols in statistics, what I want to ask you is, do you know the statistical symbols of the range, the number of classes and the length of the class?"
BS,IAR,TR	:	Yes, we know the statistical symbols of Range =R , Number of classes =K, Length of class =P, but we are used to slurring words to write them down".
Researcher	:	"Earlier, you have written down the range, class length, and many classes. How do you determine the value of the range, class length, and number of classes based on the UTS score of the statistical method?"
BS,IAR,TR	:	"Well, earlier, we determined the range based on the highest mid-term score minus the lowest mid-term score, Sis. Then to find the number of classes we use the formula $1 + 3{,}3 \log n$, where n is the number of mid-term scores of statistical methods. Next, to find the length of the class, we use the value of the range divided by the number of classes"
Researcher	:	"On the question of LKM 1, what is asked in the question?"
BS,IAR,TR	:	"What is asked in the question, we are asked to determine the value of the skewness"
Researcher	:	"Do you think there is a relationship between what you wrote earlier about the range, the number of classes
	:	and the length of the class and determining the skewness value later, please explain!"

BS,IAR,TR : "Yes, it has something to do with when we have looked for the value of the range, the number of classes, and the length of the class, we can create a grouped data distribution table, after that we can find the grouped data average, standard deviation, mode and finally we can find the skewness value"

After completing the search for the range, the number of classes and class length were displayed. SK1 entails drawing a grouped data distribution table based on the range value, the number of classes, and the class length previously calculated. Because there are six classes in the table, the table will contain six columns. Then, if the class length is 8, the length of the newly formed class is 53-60, and the length of this class should be recorded in the sixth column. highest score possible However, SK1's response does not describe the slope curve in the skewness value computation findings. This suggests that SK1 has not met the second cognitive requirement, visual mediator.



Nilai	Frekuensi	xi	fi·xi	$xi-\bar{x}$	$(xi-\bar{x})^2$	$f(xi-\bar{x})^2$
53-60	3	56,5	169,5	-20	400	1200
61-68	8	64,5	516	-12	144	1152
69-76	8	72,5	580	-4	16	128
77-84	12	80,5	966	4	16	192
85-92	5	88,5	442,5	12	144	720
93-100	4	96,5	386	20	400	1600

Figure 2. LKM 1 Problem by SK 1

Figure 2 demonstrates that SK1's response accurately characterized the distribution table of grouped data based on the UTS score value of the statistical approach. There are numerous descriptions of the top row in the grouped data distribution table, including value, frequency, x i (middle value), (X,) (x i-X)2, and SB (standard deviation). SK1 must extract the skewness value from the four lines aforementioned. The following are the results of the interview conducted by the researcher with SK1 regarding the image of the group data distribution table.

Researcher : "In the grouped data distribution table picture, how do you draw it, why there are 6 columns for many classes, then the length of the class is in the range up to 8, please explain!"

BS,IAR,TR : Yes, because as we previously calculated, the number of classes is equal to 6, so we made a column of 6. Then the length of the class, after we calculated it was in the range of 8, so the range of values formed was 53-60 ".

Researcher : "In the first row in the table image after that value there is a frequency. How do you know if the range of values from 53-60 has a frequency of 3, Explain!"

BS,IAR,TR : "We can find out if the value range 53-60 has a frequency of 3 based on repeated scores in the 53-60 value range"

Researcher : "Then how to find the value of x_i, Explain!"

BS,IAR,TR : "We are looking for the value of x_i based on the value range 53-60, if it is sorted, it should be 53,54,55,26,57,58,59,60. Since the range of values is 8, then we look for the middle value of the 8th range value, which is the value 57 ,58 then we calculate as follows $\frac{57+58}{2}$ = 56,5"

Researcher : "In the final answer you have calculated the skewness value, why don't you draw the skewness curve when it is very important?"

BS,IAR,TR : "Yes, because we still don't understand the skewness material, and the time given to work on the questions is also too short, so yesterday we only calculated the skewness value without giving conclusions and drawing the curve"

After completing the distribution table of grouped data, the following step is to SK1 seek a solution to this LKM 1 problem by developing the formula required to calculate the skewness value. The formula for determining the skewness value consists of multiple steps, including calculating the average value of grouped data by multiplying the frequency value by the middle value. Calculating the standard deviation is the next stage, followed by locating the mode value and then the skewness value. This implies that SK1 has satisfied the third cognitive component, namely narrative, based on the steps of utilizing the formula to calculate the skewnees value. The narratives consist of definitions, formulas, and theorems.

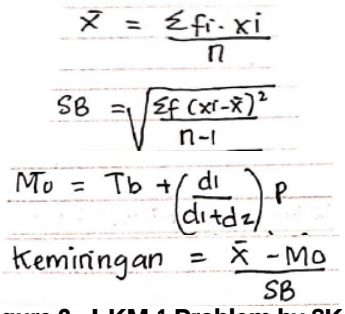


Figure 3. LKM 1 Problem by SK 1

Figure 3 demonstrates that SK1's response was able to compose its narrative in the form of formulas for the mean, standard deviation, mode, and skewness value. A narrative is a method for demonstrating the results of the work completed by students. This text is composed of definitions, proofs, theorems, and formulas. On SK1's response, the narrative used to answer LKM 1 questions is based on the data distribution table. The subject used grouped data algorithms to calculate the mean, standard deviation, and mode, given the query involves grouped data. In addition, the narrative provided by SK1 is coherent for determining the skewness value. The following is the result of the interview conducted by the researcher with SK1

Researcher	:	"In question number 1 why do you use the formula for the mean, standard deviation, and mode using the formula for grouped data?"
BS, IAR, TR	:	Yes, because in the question there is a collection of scores for the statistical method, after we looked for the range value, the number of classes and the length of the class, it turned out that the data produced was grouped data. Therefore, we used the grouped data formula to find the mean, standard deviation and mode."
Researcher	:	"In solving this skewness problem, what formula did you use to solve this LKM 1?"
BS, IAR, TR	:	"We used grouped data formulas, namely looking for the average formula, standard deviation, mode and finally looking for the skewness value,"
Researcher	:	"How to find the skewness value, please explain!"
BS, IAR, TR	:	"To find the skewness value, we used the first Pearson-type coefficient formula to make it easier for us and to shorten the processing time."
Researcher	:	"There really is a difference, using the first Pearson-type formula is the same as the second in terms of shortening the time in finding the skewness value, please explain!"
BS, IAR, TR	:	"Yes, because if we use the first Pearson type formula, we only need to look at the data that often appears in the frequency column. Meanwhile, if we use the second Pearson type formula, we have to find the value of the median location and then we can find the median value."
Researcher	:	"Are there other alternative answers to find the skewness value so as not to waste time working on it?"
BS, IAR, TR	:	"To the best our knowledge, we do not know another way to answer, we only started from the formula to complete this LKM 1"

After SK1 completes writing the formula, SK1 then does calculations depending on what was previously written. In this final stage, SK1 organizes steps and calculates the fulfillment of LKM 1 questions based on the usage of words, visual mediators, and previously written narratives. The group's responses reveal that SK1 determines the skewness value by first determining the average value, then determining the standard deviation value, then determining the mode value, and finally determining the slope value by dividing the average value minus the mode value by the standard deviation. SK1 was unable to interpret the final result of the calculation when determining the slope value or skewness value, despite the fact that it is crucial to see the slope of the curve. This suggests that SK1 is still lacking the fourth cognitive component, routine. The suggested routines involve recurrent knowledge structuring through the use of language, visual mediators, and previously written narratives.

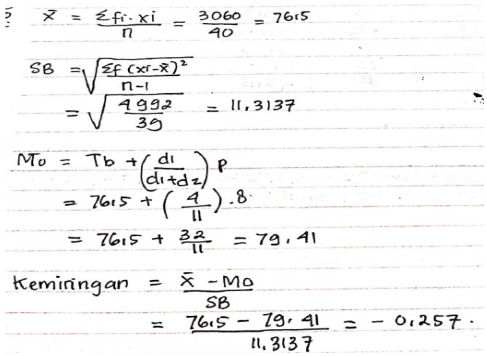


Figure 4. SK1. LKM 1 Problem by SK 1

Figure 4 depicts SK1's algorithm for computing the skewness value. The described procedure is a repeating arrangement of knowledge. The objective of this routine is for SK1 to be able to employ mathematical operations based on word use, visual mediators, and narrative when solving problems. However, in the final result of searching for skewness, they did not record the interpretation of their final calculation results. This is due to the fact that they have yet to recall the various curve forms when the skewness value is negative. Upon interview confirmation by the researcher, it was discovered that SK1 had not memorized the various shapes of curves when the skewness value is negative. The following is the result of the interview conducted by the researcher with SK1. = $\frac{\bar{X}-Mo}{SB}$

Researcher : "Why do you use such a solution to find the skewness value"
BS, IAR, TR : "Yes, because we are referring to the first type of skewness formula, which is slope = $\frac{X-Mo}{SB}$, which means we will have to find the average value first, then the mode, and the standard deviation"
Researcher : "Is there an alternative answer other than the method you are using?"
BS, IAR, TR "We still haven't found an alternative answer other than the answers we have written"
Researcher : "Why don't your answers give an interpretation of the skewness value that you have calculated?"
BS, IAR, TR : "Yes, yesterday we didn't memorize the various forms of curves if the skewness value was negative"

Researcher : Then why don't you look again at LKM 1, right there, the brief material has been explained?
BS, IAR, TR : "Yes, yesterday I wanted to see it, I just didn't think about it anymore because I was in a hurry"
Researcher : "Next time, don't be in a hurry to work on it and look back at the completion of your answer"
BS, IAR, TR "Well"

The results of the completion of the answer from SK1 to the LKM 2 question regarding kurtosis will be shown below. In order to complete LKM 2, SK1 considers the range, number of classes, and length of each class based on the collection of UTS scores. Regression evaluation. In order to determine the range, SK1 first sorts the UTS values from lowest to highest. After sorting the UTS scores, the range value can be determined by subtracting the highest score from the lowest score, or the maximum value minus the minimum value. SK1 then utilizes the formula 1+3.3 logn, where n is the number of UTS scores for regression analysis, to determine the number of classes. SK1 then utilizes the previously searched range and class length information to determine the class length. This demonstrates that SK1 has met the first cognitive requirement, which is word use.

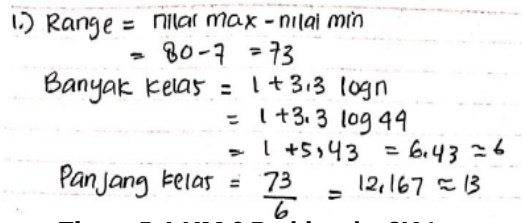


Figure 5. LKM 2 Problem by SK 1

Figure 5 demonstrates that SK1 students who completed LKM 2 were able to write down the range, number of classes, and class lengths, as well as verbally explain the outcomes of their discussions during interviews with researchers. The outcomes of the researcher's interview with SK1 for LKM 2 are as follows.

Researcher : "In question number 1 LKM 2, you have written down the range, the number of classes, and the length of the class using words, not using symbols in statistics, what I want to ask is, Do you know the statistical symbols of the range, the number of classes and the length of the class? "

BS,IAR,TR : Yes, we know the statistical symbols of Range =R , Number of classes =K, Length of class =P, but we are used to using words to write them down".

Researcher : "Earlier, you wrote the range, class length, and many classes. How did you determine the range value, class length, number of classes based on the UTS score of the regression analysis?"

BS,IAR,TR : "Well, earlier, we determined the range based on the highest mid-term score minus the lowest mid-term score. Then to find the number of classes we use the formula $1 + 3{,}3 \log n$, where n is the number of mid-term scores for regression analysis. Next, to find the length of the class, we use the value of the range divided by the number of classes, bro."

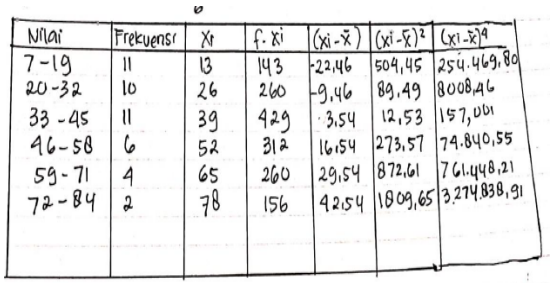
Researcher : "In this LKM 2 question, what is asked in the question?"

BS,IAR,TR : "What is asked in the question, we are asked to determine the value of the kurtosis"

Researcher : "Do you think there is a relationship between what you wrote at the beginning about the range, the number of classes and the length of the class and determining the kurtosi value later, Explain!"

BS,IAR,TR : "Yes, it has something to do with when we have looked for range values, many classes, and class lengths, we can create a grouped data distribution table from the set of mid-term scores for regression analysis, after that we can find the average grouped data, standard deviation, and finally we can find the value of the kurtosis"

After locating the range's value, the number of classes and class length are determined. The next step in completing LKM 2 for SK1 is to create a grouped data distribution table based on the range value, the number of classes, and the class length previously determined. Because there are six classes in the table, the table will contain six columns. Then, if the length of the class is 13, the length of the newly formed class is 7 to 19; record the length of this class up to the sixth column. Prior to SK1 writing the class duration, the UTS value scores for the regression analysis have been ordered from lowest to highest score. However, SK1's answer does not describe the sharpness curve in the final kurtosis value calculation result. This suggests that SK1 has not fulfilled the visual mediator cognitive component.



Nilai	Frekuensi	Xi	f. Xi	(xi-x̄)	(xi-x̄)²	(xi-x̄)⁴
7-19	11	13	143	-22,46	504,45	254.469,80
20-32	10	26	260	-9,46	89,49	8008,46
33-45	11	39	429	3,54	12,53	157,001
46-58	6	52	312	16,54	273,57	74.840,55
59-71	4	65	260	29,54	872,61	761.448,21
72-84	2	78	156	42,54	1809,65	3.274.838,91

Figure 6. LKM 2 Problem by SK1

Figure 6 demonstrates that SK1's response accurately describes the distribution table of grouped data using the UTS score of regression analysis. There are multiple descriptions of the top row in the grouped data distribution table, including the frequency value, x_i (median), $\bar{X}$, $(x_i - \bar{X})$ $(x_i - \bar{X})^2$ adn $(x_i - \bar{X})^4$ SK1 must extract the kurtosis value from the six lines presented above. Following is the outcome of the researcher's interview with SK1 regarding the distribution table of grouped data for LKM 2 completion.

Researcher : "In the grouped data distribution table picture, how do you draw it, why there are 6 columns for many classes, then the length of the class is in the range up to 13, please explain!"

BS,IAR,TR : Yes, because as we previously calculated the number of classes is equal to 6, so we made a column of 6. Then the length of the class after we calculated it was in the range of 13, so the range of values formed was 7-19 ".

Researcher : "In the first row in the table image after that value there is a frequency. How do you know if the range of values from 53-60 has a frequency of 11, please explain!"

BS,IAR,TR : "We can find out if the value range 7-19 has a frequency of 11 based on repeated scores in the 7-19 value range "

Researcher : "Next, how to find the value of x_i, please explain!"

BS,IAR,TR : "We are looking for the value of x_i based on the range of values 7-19 if it is sorted, then it is 7,8,9,10,11,12,13,14,15,16,17,18,19. Since the range of values is 13, then we are looking for the median value which is 13"

Researcher : "In the final answer you have calculated the kurtosis value, why do not you draw the kurtosis curve when it is very important?"

BS,IAR,TR : "Yes, because we still do not understand the kurtosis material, and the time given to work on the questions is also too short, so we only calculated the kurtosis value"

After completing the distribution table for grouped data on LKM 2, SK1 searches for a solution to this LKM 2 problem by recording the formula used to get the kurtosis value. The formula for determining the kurtosis value consists of multiple steps, including calculating the average value of grouped data by multiplying the frequency value by the median. The following step is to compute the standard deviation, followed by a search for the kurtosis value. This implies that SK1 has satisfied the third cognitive component, namely narrative, based on the formula writing processes for determining the value of kurtosis.

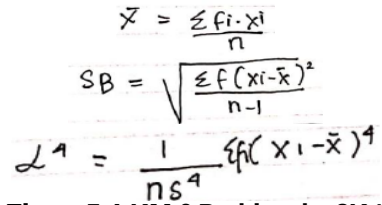


Figure 7. LKM 2 Problem by SK 1

Figure 7 demonstrates that SK1's response to LKM 2 was able to compose its narrative in the form of the average formula, standard deviation formula, and formula for determining the kurtosis value. This text is composed of definitions, proofs, theorems, and formulas. On SK1's response. The narrative used to answer LKM 1 questions is based on the data distribution table. Due to the nature of group data queries, it is necessary to use grouped data to calculate the mean, standard deviation, and kurtosis value. In addition, the kurtosis value can be calculated using SK1's narrative. The following is the result of the interview conducted by the researcher with SK1.

Researcher : "In question number 1 LKM 2, why do you use the formula for the average, standard deviation, and mode using grouped data formulas?"

BS, IAR, TR : Because in the question, there is a collection of regression analysis score data, after we looked for the value of the range, class length and many classes, it turned out that the resulting data was grouped data, therefore we used grouped data formulas to find the average value, standard deviation and the value of the kutosis by using the formula for group data."

Researcher : "In solving this kurtosis problem, what formulas did you use to solve this LKM 2, deck?"

BS, IAR, TR : "We use a grouped data formula, which is to find the formula for the average, standard deviation, kurtosis value"

Researcher : "To find the value of kurtosis you can use 2 different types of formulas that are in the summary of the material for MFI 2. Explain why you use this formula to find the value of kurtosis!"

BS, IAR, TR : "If we use the formula $\kappa = \frac{\frac{1}{2}(Q_3 - Q_1)}{P_{90} - P_{10}}$ it did not work because of the location of $Q_1 = \frac{1}{4}(44 + 2) = \frac{46}{4} = 11{,}5$ while the cumulative frequency is only 11. Therefore, we use the kurtosis formula which is $\alpha^4 = \frac{\sum f_i (x - \bar{X})^4}{nS^4}$ "

After SK1 completes writing the formula, SK1 then does calculations depending on what was previously written. In this final stage, SK1 organizes steps and calculates the fulfillment of LKM 2 questions based on the usage of words, visual mediators, and previously written narratives. As demonstrated by SK1's response, the kurtosis value may be determined by first locating the mean value, then the standard deviation value, and finally the kurtosis value. SK1 was unable to interpret the final result of the calculation when determining the kurtosis value, despite the fact that it is crucial to see the sharpness of the curve. This suggests that SK1 is still lacking the fourth cognitive component, routine. The suggested routines involve recurrent knowledge structuring through the use of words, visual mediators, and previously written narratives.

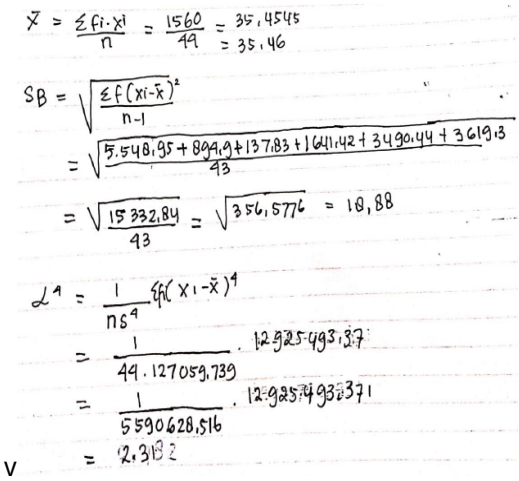


Figure 8. LKM 2 Problem by SK1

Figure 8 depicts SK1's approach for calculating the kurtosis value. The described procedure is a repeating arrangement of knowledge. The goal of this procedure is to enable SK1 to solve LKM 2 questions using mathematical operations based on the narratives given by SK1. However, they do not include the interpretation of their final l calculation findings in the end result of determining the kurtosis value. This is because they have not yet memorized the decision-making process when the kurtosis value exceeds 0.263. Upon interview confirmation by the researcher, it was discovered that SK1 had not memorized the decision-making process if the kurtosis value was more than 0.263. The following are the results of the interview conducted by the researcher with SK1:

Researcher	:	"Why do you use such a solution to find the kurtosis value?"
BS, IAR, TR	:	"Actually we will use $\kappa = \frac{\frac{1}{2}(Q_3 - Q_1)}{P_{90} - P_{10}}$ but because of the location of Q_1=11.5, it is not possible for us to use this formula. Therefore, we use the second choice of formula, which is $\alpha^4 = \frac{\sum f_i (x - \bar{X})^4}{n s^4}$"
Researcher	:	"Is there an alternative answer other than the method you are using?"
BS, IAR, TR		"We still haven't found an alternative answer other than the answers we have written"
Researcher	:	"Why don't you write an interpretation of the kurtosis value when the score is more than 0.263?"
BS, IAR, TR	:	"Yes, Sis, sorry, yesterday we didn't memorize the various forms of curves if the kurtosis value was more than 0.263"
Researcher	:	Then why don't you look again at LKM 2, right there, the brief material has been explained?
BS, IAR, TR	:	"Yes, sis, yesterday I wanted to see it, but I didn't think about it anymore because I was in a hurry"
Researcher	:	"Next time, don't be in a hurry, deck in working and look back at the completion of your answers"
BS, IAR, TR		"Okay we will"

The findings of completing the answer from SK15 to the LKM 2 inquiry regarding the kurtosis material are presented below. The researcher could not explain the SK15 group's responses to LKM 1 because they were nearly identical to LKM 2. In Figure 13, SK15 considered range, number of classes, and class duration based on UTS scores while completing LKM 2 for the kurtosia question. Regression evaluation. In order to determine the range, SK15 first sorts the UTS values from lowest to highest. After sorting the UTS scores, the range can be determined by subtracting the highest score from the lowest score, or the maximum value minus the minimum value. Moreover, SK15 employs the formula 1+3.3 $\log_n$ to determine the number of classes, where n is the number of UTS scores for regression analysis. SK1 then utilizes the previously searched range and class length information to determine the class length. However, the SK15 class's lengthy symbol is less legible when written. After the researcher validated with SK15, it was discovered that the class length symbol had been written incorrectly. This demonstrates that SK15 has met the first comprehensible component, word use. The following is an interview between SK15 and the researcher

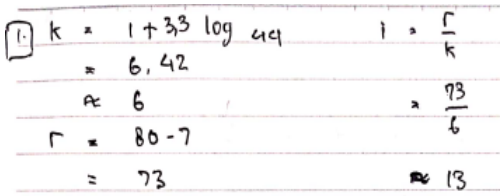


Figure 9. LKM 2 Problem by SK 15

The researcher and SK15 were interviewed in the paragraphs that follow.

Researcher	:	"In writing the range symbol, the number of classes, and the length of the class, is there something that is not quite right?'
ANA, RWL	:	"Yes, something is wrong, you should use all capital letters, is it OK?"
Researcher	:	"Yes, it's true that you have to use all capital letters"
Researcher	:	"Furthermore, in writing the class length symbol, is there something wrong?"
ANA, RWL	:	"Oh yeah, we just realized that the symbol is wrong, it should be the P symbol"
Researcher	:	"Didn't you double-check your answers before they were submitted?"
ANA, RWL	:	"No, because at that time the assignment was about to be collected, so I didn't have time to correct it again."
Researcher	:	"Next time, it should be re-examined, yes, the answer is"
ANA, RWL	:	"Okay, we will"
Researcher	:	"Earlier, you have written down the range, class length, and number of classes. How do you determine the value of the range, class length, and number of classes based on the set of mid-term scores on the regression analysis?"
ANA, RWL	:	"Well, earlier, we determined the range based on the highest mid-term score minus the lowest mid-term score. Then to find the number of classes, we use the formula $1+3.3 \log_n$ where n is the number of regression analysis mid-term scores. Next, to find the length of the class, we use the value of the range divided by the number of classes."
Researcher	:	"In the question of LKM 2, what was asked about the deck question?"
ANA, RWL	:	"What was asked in the question, we were asked to determine the value of the kurtosis"
Researcher	:	"Do you think there is a relationship between what you wrote earlier about the range, the number of classes and the length of the class and determining the skewness value later, please explain!"
ANA, RWL	:	"Yes, it has something to do with when we have searched for the value of the range, the number of classes, and the length of the class, we can create a distribution table for grouped data, after that we can find the average of grouped data, standard deviation, mode and finally we can find the sharpness value. "

After completing the query for the range, the number of classes and class length are displayed. The next step for SK15 is to create a grouped data distribution table based on the range value, the number of classes, and the class length that was previously determined. Because there are six classes in the table, the table will contain six columns. Then, if the length of the class is 13, the length of the newly formed class is 7 to 19; record the length of this class up to the sixth column. The scores for the statistical technique are sorted from lowest to highest before SK15 publishes the class length. However, SK15's explanation does not describe the tapered curve in the kurtosis value calculation results. This suggests that SK15 has not met the second cognitive requirement, visual mediator.

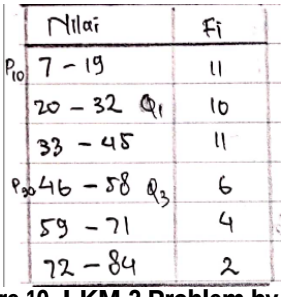


Figure 10. LKM 2 Problem by SK15

Figure 14 demonstrates that SK15's response accurately characterized the distribution table of grouped data based on the UTS score for regression analysis. In the top row of the table displaying the distribution of grouped data are the value and the frequency. Using

the two lines above, SK15 must determine the kurtosis value. Listed below are the results of the researcher's interview with SK15 in relation to the picture of the group data distribution table.

Researcher	:	"In the grouped data distribution table picture, how do you draw it, why there are 6 columns for many classes, then the length of the class is in the range up to 13, please explain!"
ANA, RWL	:	Because as we previously calculated the number of classes is equal to 6, so we made a column of 6. Then the length of the class after we calculated it was in the range of 13, so the range of values formed was 7-19 ".
Researcher	:	"In the first row in the table image after that value there is a frequency. How do you know if the range of values from 53-60 has a frequency of 11, please explain!"
ANA, RWL	:	"We can find out if the range of values 7-19 has a frequency of 11 based on repeated scores in the range of 7-19"

After completing the distribution table for grouped data on LKM 2, SK15 will search for a solution to this challenge by developing the formula required to calculate the kurtosis value. The formula used to get the kurtosis value involves multiple steps, including locating $Q_1, Q_3, P_{10} P_{90}$. After locating the position of $Q_1, Q_3, P_{10} P_{90}$, the value of $Q_1, Q_3, P_{10} P_{90}$ should be sought. However, in the step of finding the location of Q_1 and Q_3, there is an error in writing the formula, $Q_1 = \frac{1}{4}(n + 1)$ and $Q_3 = \frac{3}{4}(n + 1)$ even though the amount of data is $\sum f = 44$ (even data). The final step is to discover the kurtosis value. The stages involved in formulating the formula for determining the value of kurtosis demonstrate that SK15 still lacks the third component of cognition, notably narrative.

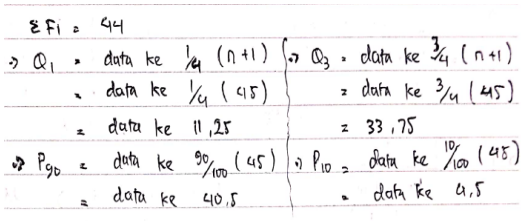


Figure 11. LKM 2 Problem by SK 15

According to Figure 15, the answers from the SK15 discussion regarding the location values of Q_1 and Q_3 are still incorrect. It should be $Q_1 = \frac{1}{4}(n + 2)$ and $Q_3 = \frac{3}{4}(n + 2)$ because there are several score data for regression analysis$\sum f = 44$ (even data). It was determined through interviews that SK15 did not comprehend whether the formula for selecting places for single and even numbers of data differed. The following are the results of the interview conducted by the researcher with SK15.

Researcher	:	"Why are you looking for the location of Q1 and Q3 using this formula?"
ANA, RWL	:	"We use the formula for the location of Q1 and Q3 to find out where Q1 and Q3 are in what data"
Researcher	:	"Are you sure that the formula you are using is correct?"
ANA, RWL		"Yes, we are sure that the formula for finding the location of Q1 and Q3 is correct"
Researcher	:	"Just look at $\sum f = 44$ (even data), Does $\sum f$ affect the use of the location formula Q1 and Q3?"
ANA, RWL	:	"Yes, We don't understand if this has any effect or does it not relate to the number of odd and even data?"
Researcher	:	"Take a look at the notes related to the previous layout size material"
ANA, RWL	:	"Okay"
Researcher	:	"To find the kurtosis value, you can use 2 different types of formulas in the MFI material summary 2. Explain why you use the formula to find the kurtosis value!"
ANA, RWL	:	"Yes, Sis, we use the formula $\kappa = \frac{\frac{1}{2}(Q_3 - Q_1)}{P_{90} - P_{10}}$ to find the kurtosis value"
Researcher	:	"If you use the formula to solve this LKM 2, are you looking for where Q_1 is in what data?"
ANA, RWL	:	"Place $Q_1 = \frac{1}{4}(44 + 1) = \frac{45}{4} = 11{,}25$"
Researcher		"Is the location of $Q_1 = 11{,}25$ on the cumulative frequency?"

After SK15 completes writing the formula, the subject then calculated depending on what was previously typed. In this final stage, SK15 organizes steps and calculates the fulfillment of LKM 2 questions based on the usage of words, visual mediators, and previously written narratives. It is evident from SK15's response that there is still an error in the application of the Q_1 and location formulas Q_3, and that SK15 is incorrectly applying the kappa formula to solve this LKM 2 question. This suggests that SK15 is still lacking the fourth cognitive component, routine.

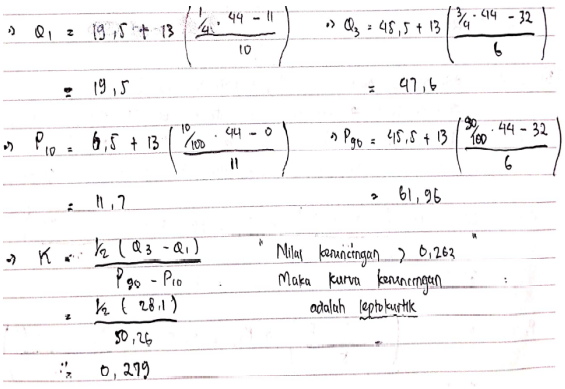


Figure 12. LKM 2 Problem by SK 15

In terms of identifying the formula for the position of Q_1 and Q_3 and determining the value of the kurtosis, the results of the SK15 answers in writing the narrative are still erroneous, as shown in Figure 15. SK15 is also incorrect in its formula selection; it should use the formula $\alpha^4 = \frac{\sum f_i(x-\bar{X})^4}{nS^4}$ to calculate the kurtosis value. Therefore, in the process of finishing LKM 2, the completion procedure is incorrect because SK15 chose the improper formula, which automatically affects the completed completion stages. The following is the result of the researcher's confirmation of the interview with SK15.

Researcher	:	"Why do you use such a solution to find the kurtosis value?"
ANA, RWL	:	"Because we feel that using the formula $\boldsymbol{\kappa} = \frac{\frac{1}{2}(Q_3-Q_1)}{P_{90}-P_{10}}$ it will be easier"
Researcher	:	"Do you realize that the location of Q1=11.25 and the cumulative frequency is 11?"
ANA, RWL	:	Yes, we are aware of it, we think it doesn't matter if Q1=11.25 even though the cumulative frequency is 11
Researcher	:	" You can use the formula if the location of each Q1, Q3, P10, and P90 corresponds to the cumulative frequency value. Suppose Q1 = 11.25 then the cumulative frequency must exceed 11.25 so that you can find the location of Q1 "
ANA, RWL	:	"Yes, we understand now, thank you"

Based on the results of the study of the completion of LKM 1 and LKM 2, both groups failed to meet the commognitive component, with each group having a unique commognitive component deficiency. Analyze and assess the problem-solving procedure is the fifth step. At this step, PRE-SERVICE students and group members observe presentations that are delivered simultaneously via the Google Meet video conferencing function. Then, additional group members respond to the outcomes of the group presentations. In the final phase, known as closure, PRE-SERVICE students reflect on the learning process that has been completed and provide some essential notes regarding the skewness and kurtosis material.

Based on the findings of research conducted by researchers through discussion activities utilizing the PBL learning model, it was determined that all students actively participated in the learning process by expressing opinions, exchanging information, and providing suggestions for group member input through the WA group. This is consistent with the notion of (Husamah & Pantiwati, 2014) that learning in a collaborative setting can enhance students' critical thinking skills. Moreover, according to (Walkington et al., 2015), during the discussion process in small groups, students will be driven and compelled to present questions and opinions, which will indirectly boost students' mathematical communication in groups. Through this discussion activity, students can discuss problem-solving with their group members by providing each other with input and exchanging mathematical ideas. This is consistent with the opinion (Dillenbourg & Traum, 2006); (Hesse et al., 2015); (Lazakidou & Retails, 2010);(OECD, 2013); O'Neil, (O'Neil et al., 2010); (O'Shea & Leavy, 2013) that problem solving in group activities refers to activities that involve the active participation of group members to build mutual understanding through the exchange of mathematical ideas. Moreover, discussion exercises might boost higher-order thinking when students actively explore and provide alternate solutions to a particular problem situation. (Birisci, 2017). And based on the findings of prior study (Barron et al., 1998), (Bas & Beyhan, 2010) demonstrate that project-based learning can provide numerous educational benefits, including the development of students' critical thinking and problem-solving skills. Then it was completed (Donnelly, 2006); (Giani & Martone, 1998) suggested that the use of PBL in a blended learning environment can improve learning, because the online environment can make it easier for students to socialize, share knowledge ideas, and reflect together on the problems raised, and if students encounter any difficulties, the tutor/professor will provide guidance. During a Google Meet presentation, the two topics expressed the outcomes of their debate in a manner that was easily understood by other group members. Therefore, the subject has inadvertently executed their commognitive by conveying the results of group talks in a straightforward and easily understandable manner. This is consistent with the notion (Sfard, 2008) that learning mathematics is about how a group communicates

mathematics in a way that is easily understood by other group members using their own language. In addition, when the two subjects delivered the findings of their discussion, the other groups responded to the presentation of the subject's completed answers. This is consistent with the idea of (Sfard, 2008), which indicates that the perspective of involvement in learning is the most significant in the development of an individual's social participation. In other words, the participatory learning paradigm emphasizes students' interactions with their entire community

CONCLUSION

Based on the results of the discussion regarding the cognitive analysis of students during discussion activities involving the solution of skewness and kurtosis problems. The conclusion of this study is that students must be able to understand statistical results based on the results of their completed calculations while addressing problems. According to the results of the examination of the completion of LKM 1 and LKM 2, neither group met the cognitive requirement. In the discussion of the SK1 data, they did not interpret the final statistical results based on the values of skewness and kurtosis; this was due to the routine cognitive component. Also, SK1 fails to explain the skewness and kurtosis curves when it is coupled with the cognitive component, specifically the visual mediator. As for SK15, many classes and class lengths do not use capital letters, if it is associated with the commognitive component, namely word use, and their SK15 does not describe the skewness and kurtosis curve, if it is associated with the commognitive component, namely the visual mediator. Then, in SK15, there was an error in writing the formula for the size of the location of Q 1 and Q 3, as well as an error in determining the value of kurtosis if it was related to the commognitive component, which is related to narrative and routine.

Based on the preceding conclusions, the first recommendation for students is that they must be able to comprehend the final results of their statistical calculations and always take the effort to recorrect previously written responses to prevent symbol writing errors. The second suggestion for future research is to implement the PBL model and Learning Management System (LMS) technology to expedite online learning using the PBL paradigm. There are numerous LMS types, including Moodle, LAMS, Blackboard, Collage, and Sakai. This LMS is an online collaboration platform that integrates a variety of internet-based applications that permit students to do a variety of tasks online in collaboration.

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