

A study on the use of collaborative learning to enhance mathematical understanding among elementary students

Noor Aida Affida Abdul Rahman, *Mohd Faizal Nizam Lee Abdullah

Department of Mathematics, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris,
35900 Tanjong Malim, Perak, MALAYSIA

*Corresponding author: faizalee@fsmt.upsi.edu.my

Published: 21 September 2022

To cite this article (APA): Abdul Rahman, N. A. A., & Abdullah, M. F. N. L. (2022). A study on the use of collaborative learning to enhance mathematical understanding among elementary students. *EDUCATUM Journal of Science, Mathematics and Technology*, 9(2), 10-15. <https://doi.org/10.37134/ejsmt.vol9.2.2.2022>

To link to this article: <https://doi.org/10.37134/ejsmt.vol9.2.2.2022>

Abstract

This study investigated the use of collaborative learning to enhance mathematical understanding among elementary students. This study will give an overview on the usage of collaborative learning in mathematical teaching and learning as an interactive and interesting alternative approach that helps in enhancing mathematical understanding of learners. Mathematics may be regarded as hard and difficult subject by most learners as they tend to be learning this subject in more traditional approach. This study focuses on the objective to study the interactions of the students during the collaborative learning activities, to investigate students' perception and attitude towards collaborative learning as well as the effectiveness of collaborative learning in enhancing student's mathematical understanding. This study employed the qualitative approach by combining the Communication Study Framework by Sfard and Kieren (2001) and The Pirie-Kieren Theory (1992,1991). The data collected from selective respondents were analysed through the recorded videos of the mathematics lessons on selected sub-topic. From the data, the respondents indicated active interactions during the tasks, and it also indicated that by having collaborative learning, respondents have positive perceptions and attitudes based on their active participations during the group discussions. From the data as well, the respondents' portrayed appropriate level of mathematical understanding based on the selected topic.

Keywords: collaborative learning, mathematical communication, mathematical understanding, elementary

INTRODUCTION

Learning mathematics may be regarded as challenging for most elementary students. Most students have the difficulties to communicate using the mathematical communication, for example, to use appropriate terms or words to describe the solutions of a mathematical problems. When they are struggling with the mathematical communication, their mathematical understanding may also be affected. When these issues occur in the mathematics teaching and learning process, student's perception and attitudes towards mathematics subject also have their own significant effects. The curriculum of mathematics subject in Malaysia Education System has gone through several changes and improvement to fit the requirements needed especially currently where the education system is moving towards the 21st century learning environment. In the 21st century learning environment, the mathematics curriculum is focusing on the enrichment of mathematical thinking, the wisdom in problem solving and decision-making, creativity in making mathematical connections and communication, and thoroughness in appreciating mathematics [8]. According to Farokhah, Nurmulia, Herman, Jupri, Pratiwi, Nurkaeti, and Abidin, [3], mathematical communication ability is important among the students as it enables students to express and explains the mathematical ideas or concepts by using graphs, symbols, and others. As proposed by

most scholars, communication ability is crucial for students in learning as this skills or ability is one of the core learning tools in enhancing the understanding of the topic of learning. This idea is also applied in mathematics learning in schools.

The traditional method of learning in mathematic subjects which is more on teacher-centred learning has cause demotivation among students especially for those who have difficulties to understand the mathematical concepts or instructions. As discussed by Moreno-Guerrero, Rondon Garcia, Martinez Heredia, and Rodríguez-García, [7], the educational institutions are now switching from the traditional and passive didactic approaches of teaching and learning into more innovative practices that positively impacted students learning. Collaborative learning, also has been defined by Moreno-Guerrero, Rondon Garcia, Martinez Heredia, and Rodríguez-García, [7] as learning that is carried out by more than 2 learners, the resources are shared in certain times, different abilities and skills of the learners are required during the activities completion in order to achieve certain goals or learning objectives through interactions, exchanges of experiences or changes of roles within the group in which all of these will impacted the achievement of the learners.

In addition, Swan [10] has proposed that collaborative learning in mathematics teaching and learning process helps and encourages students to tackle the mathematical issues using their pre-existing knowledge and build their understanding better with the help of teachers. According to Davidson and Kroll (1991), cited by Durraman, Sharil and Morsidi [2], collaborative learning is a process of learning that differs with the traditional learning method which allows students to share ideas and work together to accomplish certain goals. As proposed by [4], Collaborative learning took place naturally in a small group of learners with different abilities through their discussion and sharing ideas in solving mathematical problems and they are responsible in achieving the targeted goals of learning. From this, during the collaborative learning, the students or learners are interacting and communication among each other based on their prior or pre-existing knowledge, thus through this process, the mathematical communication abilities enhanced and leads to better mathematical understanding among them. This is due to during the collaborative learning, students or learners are free to deliver and discuss their ideas without having any restrictions or obstructions. According to Laal and Ghodsi [5], collaborative learning term refers to an instruction method in which learners at various performance levels work together to achieve specific goals in a small group.

This study was employed to study the student's interaction during the collaborative learning while solving mathematical problems. In addition, this study also investigated students' perception and attitudes towards collaborative learning in mathematics and the effectiveness of collaborative learning in enhancing student's mathematical communication and understanding.

METHODOLOGY

This study employed the qualitative approach by combining the Communication Study Framework by Sfar and Kieren (2001) and The Pirie-Kieren Theory (1992,19914). The respondents of this study were selected using purposive sampling as it is believed that this type of sampling enables the representation of study's objective. There were 4 selected students of the elementary level from a school. The data collection involved video recording, field-notes from researcher and the samples of the activities done by the respondents. The data gathered was analysed using the Communication Analysis Framework (Sfar and Kieren, 2001) and Theory of Mathematical Understanding Development (Pirie & Kieren, 1992). The selected respondents and parents were consulted regarding on their consent to be involved in this study. They were guaranteed on the confidentiality of their demographic background, and they were given freedom to withdraw from the study at any time they wanted to.

The video recordings were conducted for 3 months. There were 5 recordings involving the Primary 5 respondents during the teaching and learning process of Mathematics subject. For this study, the recordings were conducted on specific day for the duration of 1 hour. During the recording of the session, two units of smartphones were used as a tool of recording. Based on the data form the recorded video, selected respondents were identified and were acknowledged further by the classroom teacher. The teacher was asked to give opinions on each of the selected respondents inclusive of their attitudes,

perceptions, and abilities in mathematics subject. The respondents as well were given the opportunity to write their opinions about mathematics subject and their friends in the group.

The data was furthered analysed using the Pirie-Kieren Theory (1992, 1994) where the data was compared to the 8 loops of understanding. To study the students' mathematical understanding, questioning technique were employed which students were given mathematical questions to be solved and during the activities, students' dialogues were recorded and analysed. In this study as well, researcher has implemented Analytical Model by Powell (2003) while analysing all the recorded videos. By implementing this model, researcher has gone through 7 phases of analysis including watching, explaining, identifying critical situation, mapping, coding, summarising, and developing narrative.

RESULTS AND DISCUSSION

The topic of Numbers and Operations: Addition within 1 000 000 from the mathematics syllabus was selected as per teacher's daily lesson plan. The lesson started with the induction set by the teacher, explaining about the daily issues related to the topic and students were asked to name the key words for the addition problem solving. After several recaps of the keywords in daily mathematical problems, students were instructed to form groups and they were given mathematical problems to be solved within the group.

Question 1: Table shows the total of stamps owned by Syamilah, Suriana and Diana. Count the total stamps owned by all of them.

Name	Total of Stamp
Syamilah	15 200
Suriana	285 stamps more than Syamilah
Diana	2 456 stamps more than Suriana

Table 1: The Tripartite Analysis Table for Numbers and Operations: Addition within 1 000 000

1	N:	We do it one by one
2	D:	We write our name first
3	N,A,W → D:	Looking at D while D is reading the question
4	N, A, W	Reading the question
5	D:	Suriana and Diana ... count their total (referring to the problems to be solved)
6	W → D:	285 stamps more than Shamila
7	A:	This add to this (referring to 15200 + 285)
8	D:	Haa, yes, this add to this (agreeing to A's statement)
9	N → D:	Got this one (Suriana and Diana), let's add all.
10	A → N:	Add all (referring to the word 'total stamps of all')
11	D → A:	Okay, add this one first, right? (Referring to 15 200 +285)
12	A, W → D:	Nodded agreeing
13	N → A:	Haa, show it to teacher (showing the steps to teacher)
14	D → D:	... + 285 ... (D is writing the steps for 15200 + 285)
15	D:	Here, got it already.
16	N → D:	Add it, then you do it here. Teacher doesn't allow this (N requesting D to write the steps on the right side, and not continuing the written operation)
17	N → D:	No need the names (N stating that the individual's name in the question should not be written, only the answers)
18	D → N:	This one is done, right? (Still writing the names referring to the stamps owned by Suriana and Diana)

19	N → D:	No need names (still insisting on the names is not necessary)
20	N → D:	Don't need to write it small. Got lots of paper (referring to the handwriting of D which is small and unclear)
21	D:	Erase and rewrite
22	D	Okay, got 15 485
23	W → D:	It is Suriana, right?
24	N → W:	Suriani la
25	D → N:	Suriana la (correcting N's Error)
26	N, D:	Reading the instructions about Diana
27	D:	Writing the answer for Diana which 15 485 + 2456
28	N → D:	See! Got the answer. Just add it
29	D → N:	Wait la (know how to find grand total)
30	A → N:	Just add. This one add all
31	N	Taking a paper and re-read the question to confirm what have been written match the answer.
32	A → D:	Add all together
33	D:	Writing the answer
34	A → D:	We do it one by one first (A doesn't want to all at once towards 0)
35	A:	Looking at the answer written by D

Based on the table above, it shows that during the group activity, students interacted with each other actively. They have indicated that during the interaction while solving the mathematical problem, they were free to share ideas and correcting their friends. During the discussion as well, students; has indicated mutual agreement on certain statements also they managed to portray some disagreement and manage to overcome the differences. Based on this table, the interaction among the students existed yet the mathematical communication is still yet need to be developed further.

During the collaborative activity done by the students, the interaction among the students has indicated their mathematical understanding based on their pre-existing knowledge and sharing ideas and experiences. Based on the table above, the respondents indicated their communication ability by extracting information, conveying concerns, agreeing to statement, and correcting errors. Based on their interactions, the level of their mathematical understanding can be indicated. Student with better mathematical understanding able to help the group members to recall their pre-existing knowledge. In collaborative learning like group discussion for example, allows students or learners to be more independent and encourages better communication skills among themselves.

Looking at the interaction of the respondents during the collaborative learning, it indicated that respondents have positive perceptions and attitudes towards the collaborative learning. This can be seen through their active participation during discussions and based on their opinions regarding on their group members. The respondent's opinion towards Mathematics can be seen in Table 2.

Table 2: Respondent's Opinion on Mathematics Subject

Name of Student	Opinion
Afief	I love mathematics, especially the problem-solving questions where I fell challenged to extract important information.
Damia	For me, Mathematics is a challenging subject, but I still like it. I like the way my math teacher teaches me. I am happy to do group activity because the classroom will be more exciting. I like all of the topics in Mathematics.
Wan	I like math but I am weak in problem-solving questions. I have difficulties to extract important information from longer sentences.
Naufal	I like the topics of geometry the most. For me, finding the area and volume are challenging. I don't have problem in understanding the questions or instructions.

Based on the data of this study, it is suggestable that collaborative learning encourages better communication ability among learners, and it also contributes to the enhancement of learners' understanding of the topics of learning.

CONCLUSION

Collaborative learning is an alternative approach that promotes more independent learning and opportunity for learners to build their knowledge with the guide from instructors. This approach is focusing more on student-centred as compared to the traditional method which more on teacher centred. By implementing more collaborative learning in mathematics classes, it encourages more opportunities in developing better learners who is all-rounded. As stated by Pietsch (2005), cited by [9], students that involved in collaborative learning demonstrated an alter in their thinking in developing their sense of responsibility for the other group members. This indicated that these students become more mature and possess leadership skills through their involvement in collaborative learning. Collaborative learning also encourages higher self-motivation among the learners, and this leads to better learning process of the students. Highly motivated learners will be more excited to learn new things and in mathematics, when the learners are highly motivated, the learning will be easier and more interesting thus enhancing better mathematical understanding among the learners. This is supported by [6], stating that a highly capable student, apart from internal motivation, the influence of collaborative learning will increase the external motivation in learning.

By having investigated all the opinions and statements by the scholars on collaborative learning, it is suggestable that this approach being implemented in the teaching and learning of mathematics especially at the elementary level. By having more alternative approach in learning maths, learners will be able to have more positive perceptions and attitudes towards this subject.

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