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Research Article

An Analysis of Mathematical Connection Ability of Madrasah Ibtidaiyah (MI) Teachers as Seen from Teaching Style

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Abstract

Many mathematics teachers hardly implement mathematical connections during the learning process. Only a few teachers can link mathematics to other topics, disciplines, or real life. As a result, the learning process gets stuck easily. The objectives of this research are: (1) to know the mathematical connection ability of teachers; (2) to analyze the mathematical connection capability of teachers seen from teaching style; (3) to find out the differences of teachers' mathematical connection capability seen from teaching style. Concurrent triangulation was adopted as a research design in which the qualitative and quantitative research was simultaneously done. The cluster random sampling was adopted in which participants were all teachers in *Madrasah Ibtidaiyah* Eks Karesidenan Surakarta (Islamic Elementary School of Eks Karesidenan Surakarta). There are some important findings. 1) The mathematical connection ability of the teachers was at a low level in terms of other topics or crossed-topic connections while it was on the average level in relation to other disciplines and the real and daily life. 2) Seen from teaching styles, the teachers' mathematical connection ability was on a low level in terms of cross-topics connection as (classical, technological, personalization, and interactional) while their mathematical connection ability to other disciplines (classical, technological, personalization, and interactional) and daily life (classical, technological, personalization, and interactional) was in a medium level. 3). Those four teaching styles reviews highlighted that there was no different ability of mathematical connections as seen from the teaching style

Keywords: mathematical connection, teachers of MI, teaching styles

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INTRODUCTION

During a learning process, method or approach holds a prominent role that teachers or lecturers need to properly have. Teachers and lecturers must be able to find the proper teaching methods to reach satisfactory results. One of those is by bringing real life into the learning process. According to the National Council of Teachers of Mathematics (NCTM) (1989), the Mathematical Connection course is needed because the mathematical connection seems to be a prominent part of education. Mathematical connections are the links between mathematical topics or crossed-topic connections, relationships between mathematics to other disciplines or crossed-disciplines connections, and also the relationship between mathematics to real-world or daily life.

Mathematical communication is the students' ability to express mathematical ideas both in spoken and in written forms (NCTM, 2000: 268). Mathematical communications become the abilities that students must master in learning mathematics. On the other terms, verbal communication is an activity to convey meaning through words or sentences conveying ideas, like presentations or interviews. Meanwhile, written communication is an activity to convey meaning by writing words, sentences, pictures, or symbols that contain specific meanings and purposes. As highlighted by Rahmawati in Hartini, et al (2016) that mathematical communication skills are abilities to interpret or express mathematical ideas by using terms, notations, diagrams, tables, and symbols both in spoken and in written forms.

Mathematical connections refer to skills every teacher and student must have and learn. Through mastering these skills, teachers, lecturers, and students can independently look for connections in mathematics. However, mathematical connections are very important to improve the ability of contextual connections or contextual problem-solving. The properly selected contexts will improve students' mindset.

Nonetheless, the current mathematical connection ability of teachers in *Madrasah Ibtidaiyah* (Islamic Elementary School) is still under average. It was

concluded by doing preliminary observations and interviews during the learning activities. This mathematical connection and learning outcome problems may be affected by some factors. However, lecturers, teachers, students, facilities, and learning environments that cause these problems to seem to be true. Educators must be able to choose, determine, and implement learning strategies in accordance with the current learning experience since errors in the method cannot improve connections and learning outcomes. By mastering mathematical connection ability, teachers or lecturers are expected to be able to link each subject matter to other topics. Three kinds of defined mathematical connections are: 1) crossed-topic connections; 2) crossed-disciplines connections, for instance, mathematics to chemistry, mathematics to physics; 3) mathematical connections to daily life. The low mathematical connection might be due to many factors, and some of them might be from teaching style in the classroom.

Those explanations drive us to some research objectives: 1) to analyze the mathematical connection ability of the teachers in *Madrasah Ibtidaiyah* (Islamic Elementary School); 2) to analyze the mathematical connection ability of the teachers in *Madrasah Ibtidaiyah* (Islamic Elementary School) seen from teaching style; 3) to find out the differences of mathematical connections ability of teachers in *Madrasah Ibtidaiyah* (Islamic Elementary School) seen from teaching style.

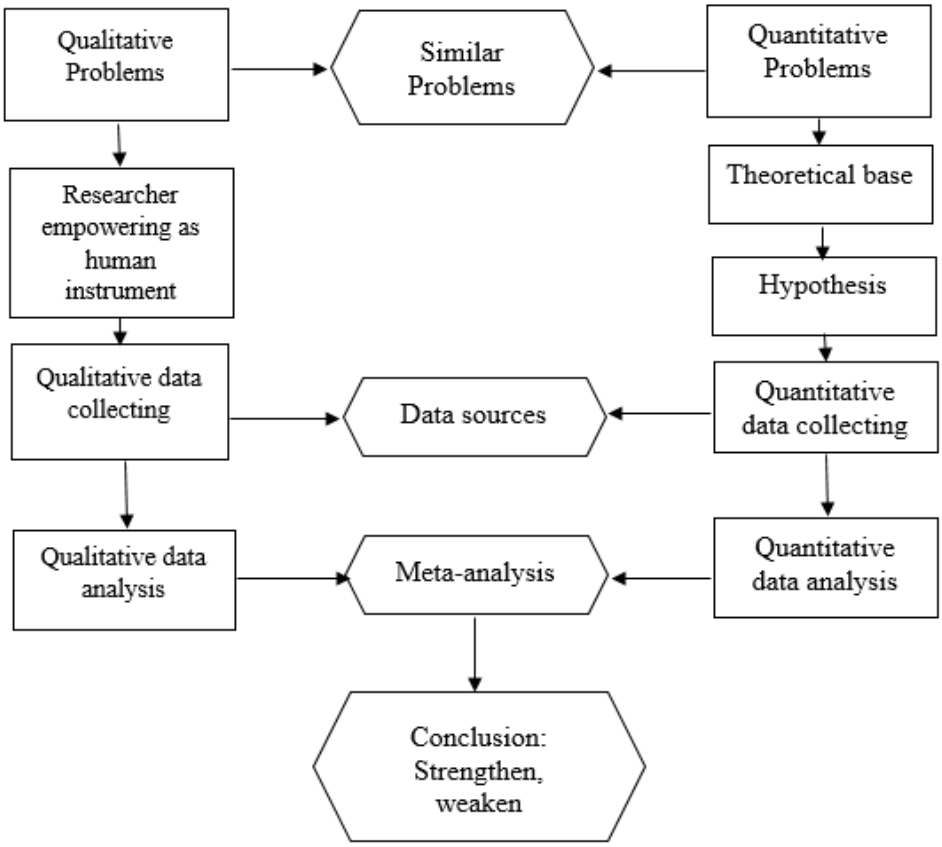
RESEARCH METHOD

This research was conducted from April up to October 2018. A mixed-method design was adopted in which the qualitative and quantitative research were simultaneously combined. This research was specifically designed by implementing concurrent triangulation. Both qualitative and quantitative research was equally and simultaneously done (50% quantitative and 50% qualitative), but it was separately done responding to the specific related research problems.

The populations of this study were all mathematics teachers of grades 4, 5, and 6 in *Madrasah Ibtidaiyah* Eks Karesidenan Surakarta (Islamic Elementary School of Eks Karesidenan Surakarta). Thus, some concrete steps were done to specify the sample such as a) mapping or determining the Regencies in Eks Karesidenan Surakarta area; b) selecting 3 regencies from some in Eks Karesidenan Surakarta area randomly; c) selecting 3 sub-districts under 3 regencies, and 9 specific sub-districts; d)

selecting the mathematics teachers of *Madrasah Ibtidaiyah* (Islamic Elementary School) randomly under those 9 sub-regencies. These steps led the study sample selection to 65 respondents consisting of subject teachers and homeroom teachers with a comparison that 63% were homeroom teachers and 37% were subject teachers.

The sampling technique of this study was probability sampling. This sampling technique provided equal opportunities for each member of the population to be selected as representative samples. In its application, this probability sampling technique would be carried out by means of cluster sampling and continued by pure random sampling.



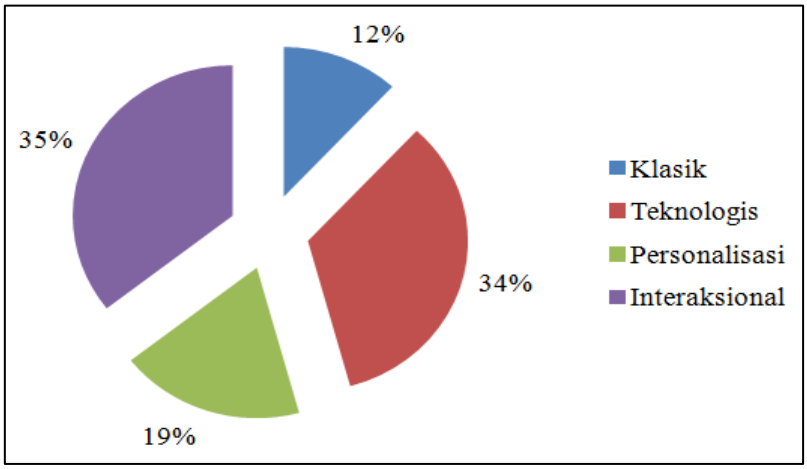
Picture 1. Steps of Concurrent Triangulation research

DISCUSSION

There were 6 respondents out of 65 who were unable to fulfill the instruments of teaching style as well as unable to be reconfirmed. Thus, this research could only involve 59 respondents. This research has 3 notable discussions to be then formulated as research objectives:

1. Teaching styles of teachers (respondents)

In this research, respondents were divided into 4 groups of teaching styles well namely as classical, technological, personalization, and interactional teaching style. Furthermore, the percentages of mathematics teachers' teaching styles can be seen through the provided diagram in Picture 2 as presented below:



Picture 2. Teaching style percentages of teachers in MI

The diagram shows that the mathematics learning process is dominated by teachers who are familiar with interactional and technological teaching styles whose percentages are on average of 35% and 34%. The rests are personalization teaching style in 19% and classical teaching style in 12%.

2. Mathematical connections ability of teachers examined from the teaching style

The discussed mathematical connection ability is divided into 3 types: 1). crossed-topic in mathematics; 2) Crossed-disciplines connections; 3) Mathematics topics to the real world or daily life. The overall analysis of mathematical connections of teachers examined based on their teaching styles can be furtherly seen from the following table.

Table 1. Mathematical connection as seen from teaching styles.

Connection aspects	Averages			
	Classica	Technologica	Personalizatio	Interactional

	l	l	n	
Crossed topics	2.00	2.49	2.00	1.81
Crossed disciplines	2.27	2.74	2.62	2.44
To the real or daily life	2.89	3.15	3.69	3.13

The presented table may find some discussions:

Crossed-topics mathematical connection analysis as seen from teaching styles:

a. Classical

The analyzed data show that teachers' mathematical connection of crossed-topics in mathematics examined based on the teaching styles has an average score of 2 out of 4 or 50% of them could achieve the target. This score indicated a low level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 0 to 65. However, a poor related case was found. Besides their low ability in contextual problem-solving, almost all teachers roughly had a poor understanding of the concept of rectangular and its nature. None of the 9 teachers who used the classical teaching style gives correct answers. Even worst, the prominent error is the assumption that the square was not rectangular.

b. Technological

The analyzed data of crossed-topics mathematical connection ability as seen from the technological teaching style indicate the average value of 2.48 out of 4 or 62.04% achieved. This score indicated a low level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 0 to 65. A poor related case was also found. Besides their low ability in contextual problem-solving, almost all teachers do not understand the concept of rectangular and its nature. There were only 2 out of the 27 teachers applying the technological teaching style who answered correctly and 6 gave careless answers. Even, the prominent error was an assumption that the square was not rectangular.

c. **Personalization**

The analyzed data of crossed-topics mathematical connection ability as seen from the personalization teaching style indicate the average value of 2 out of 4 or

approximately 50%. This score indicated a low level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 0 to 65. It also indicates a poor level of teaching ability. Some problems may cause that low level such as 1) some of the teachers are not familiar about to link mathematics to other topics; 2) some misconceptions may be found in understanding rectangular. Indeed, some teachers said that the square is not rectangular as they argued that the rectangular' length and width have to be different. Even, most of the teachers roughly gave the same answers in contextual questions. This fact can be seen from the teachers' responses.

d. Interactional

The analyzed data of crossed-topics mathematical connection ability as seen from interactional teaching style indicate the average level of 1.81 out of 4 or approximately 45.31%. This score indicated a low level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 0 to 65. It also indicates a poor level of teaching ability as 8 out of 16 teachers in Madrasah Ibtidaiyah (Islamic Elementary School) gave the wrong answer to the contextual questions of crossed-topic problems. It indicates a very poor level of teaching ability though. Some similar reasons are suspected to cause its poor level. 1). Some teachers cannot connect the course to other topics. 2). Some misconceptions arise in understanding rectangular. Some poorly said that the square is not rectangular. The reason was that the rectangular' length and width should be different. Again, almost all teachers alarmingly have the same answers regarding the contextual questions.

To sum up, the crossed-topics of mathematical connection ability analysis examined based on the teaching styles (classical, technological, personalization, and interactional) were 50.00%, 62.04%, 50.00%, and 45.31%. Its average was 57.86%. Those four teaching styles reviews indicate that all are categorized in the low level. However, some cases were suspected as the cause of its low level of mathematical connections ability: 1) some teachers are not accustomed to connecting subject matter to other topics; 2) there are some misconceptions in interpreting rectangular.

Crossed-disciplines mathematical connection analysis as seen from the teaching style

a. Classical

According to the analyzed data, the crossed-discipline mathematical connection ability based on the classical teaching style was on average of 2.78 out of 4, or 69.44%. This score indicated a medium level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 65 to 80. This value was even actually very alarming because it was slightly higher than the lower limit interval. However, it was actually not good enough for teachers although it was higher than the crossed-topics connection. Most teachers did not understand the concept of mathematical connections to other disciplines. In fact, some proudly said that mathematics was the queen of science as mathematics could be applied in other sciences as well. From the 9 teachers who used the classical teaching style, 1 teacher gave careless answers, while the other 3 were not seriously responding to questions. Here I present the careless response of teachers. See the teacher's work below.

b. **Technological**

The analyzed data of crossed-discipline mathematical connection ability as seen from the technological teaching style are on average of 2.74 out of 4, or 68.04%. It is indicated in medium criteria. However, it actually only was slightly higher than the upper limit of the interval at low criteria. This score indicated a low level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 0 to 65. Referring to the provisions issued by the Ministry of Education, the mathematical connection ability with other disciplines has only 3 different points as 65 to 68. There are several cases of findings that are very alarming regarding the teachers' low ability to solving contextual problems. There were about 5 out of 27 MI teachers whose grade is 1.

c. Personalization

The analyzed data showed that the crossed-discipline mathematical connection ability examined based on personalization teaching style was on average of 2.62 out of 4, or 65.38%. This value was also categorized as a medium level. This score

indicated a low level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 0 to 65. Nevertheless, this value was slightly higher than the upper limit of the low criteria. Many teachers could link mathematics to other disciplines. However, it is well known that mathematics is the queen of knowledge or the king of science. It also means the queen and king are servants. In this case, mathematics can be linked to other disciplines such as physics, biology, social sciences, and even religious subject. In the case of the religious subject, mathematics can be applied for zakat calculation, inheritance, determining Eid al-Fitr, and many others. However, only a few teachers are familiar with connecting mathematics to other disciplines. Therefore, this shows unsatisfied findings.

d. **Interactional**

Based on the analyzed data, the crossed-discipline mathematical connection ability in relation to the interactional teaching style of the teachers was on average of 2.44 out of 4, or 60.95%. This value is categorized as a low criterion based on the criteria set by the Ministry of Education Culture by the range of $0 \leq$ to <65. However, this value was also extremely alarming. Most of all teachers could not link mathematics into other disciplines in responding to the contextual problem. In fact, some said that mathematics was the queen of science as mathematics could be applied in other sciences. There were 4 out of 16 teachers who used the interactional teaching style answering the questions carelessly.

The abilities of mathematical connection analysis with other disciplines as consecutively examined based on teaching styles (classical, technological, personalization, and interactional) are 69.44%, 68.84%, 65.38%, and 69.95%. Those four teaching styles reviews indicated that all participants had mathematical connection abilities categorized in medium criteria. However, even it reached the medium level, but it was still in a lower interval so that this result was not satisfying.

Mathematical connection analysis to real and daily life as seen from teaching style:

a. Classical

The analyzed data showed that the mathematical connection ability to real and daily life examined based on the classical teaching style was on average of 2.89 out of

4, or about 72.22%. This value was classified into a medium criterion. The score indicated a medium level of the teacher according to the criteria set by the Ministry of Education as the obtained value was in the range of 65 to 80. However, this value was not good enough as only in the middle of the medium criteria. So, even though it was slightly higher than the value of the mathematical connections ability based on the crossed-topics and crossed-disciplines, it is still not enough for a teacher to have such that limited ability. There was 1 out of 9 teachers who used the classical teaching style gave in order answers. However, only 3 out of 9 teachers answered correctly. This shows that only 3 out of 9 teachers who had a good understanding of the application of mathematical connections to the real world.

b. Technological

The analyzed data of mathematical connection ability to real and daily life as seen from the technological teaching style is on average of 3.15 out of 4, or about 78.70%. It is categorized as the medium criterion. It is also in accordance with the criteria set by the Ministry of Education if the obtained value is in the range of $65 \leq$ the obtained value $<$ 80. However, it almost reaches a high level. Unfortunately, there was still one whose ability is low indicated by score 0. This teacher is indeed different in the crossed-topics connection ability section who also get score 1. While the connection to other disciplines also indicates a low level as he got score 1 instead. Furthermore, just have a look at his work.

c. Personalization

The analyzed data indicated that the mathematical connection ability to real and daily life as seen from personalization teaching style is on average of 3.69 out of 4, or about 92.31%. It is categorized as high criteria in accordance with the criteria set by the Ministry of Education Culture as the obtained value is in the range of 80 to 100. Hence, it shows a good level of ability in which almost all MI teachers have been familiar with the meaning of contextual questions in number 3.

d. Interactional

Based on the analyzed data, the mathematical connection ability to real and daily life in relation to the interactional teaching style was on average of 3.13 out of 4,

or about 76.13%. It was categorized as the medium criteria. It was in accordance with the criteria set by the Ministry of Education as the obtained value was in the range of 65 to 80. However, this value was actually not good enough as it was in the medium criteria. There were only 3 out of 16 teachers in *Madrasah Ibtidaiyah* (Islamic Elementary School) who gave the correct answers. Based on these three connections namely the crossed-topic connection, connection to other disciplines as well as the connection to the real and daily life in relation to the classical teaching style, it could be concluded that the mathematical connection ability of the teachers was in the average of 63.89. Thus, it belongs to the low criteria.

The consequent analysis of the mathematical connection ability in terms of the application of daily life which was examined based on the teaching style showed that the current levels of teachers' mathematical connection ability based on the classical, technological, personalization, and interactional teaching styles were 72.22%, 78.70%, 92.31%, and 76.13%. While the average value was 79.84%. Those four reviews of teaching style were in medium criteria.

3. The difference of mathematical connection ability of teachers in *Madrasah Ibtidaiyah* as seen from teaching styles.

The following table shows the differences in the mathematical connection ability of teachers based on the teaching styles.

Table 2. One-Way Variance Analysis - Mathematical Connection Capabilities

Diversity	Sum squares	df	mean squares	f	Sig.
Mathematical connection ability	34,889	2	17,444	19,451	0,000
Errors	150,667	168	0,897		
Total	185,556	170			

Based on Table 2, it helps us to know some differences between mathematical connection abilities 1, 2, and 3. Then, to know the difference or which of the three highest significant connection capabilities is, it can be analyzed by looking at the

results of further tests (post hoc) like LSD (Least Significant Difference) as presented below.

Tabel 3. Double comparison with LSD test

(I) Connection	(J) Connection	Mean difference (I-J)	Std. Error	Sig.	95% Level of confidence	
					Lower bound	Upper bound
1	2	-0,596*	0,177	0,001	-0,95	-0,25
	3	-1,105*	0,177	0,000	-1,46	-0,76
2	1	0,596*	0,177	0,001	0,25	0,95
	3	-0,509*	0,177	0,005	-0,86	-0,16
3	1	1,105*	0,177	0,000	0,76	1,46
	2	0,509*	0,177	0,005	0,16	0,86

*. The mean difference is significant at the 0.05 level

The highest connection ability can be further seen by looking at the partial averages of each of the mathematical connection abilities as presented in Table 4.

Tabel 4. The descriptive of mathematical connection ability

No	N	Mean	Mean difference	Std. Error	Confidence interval 95%		Min	Max
					Lower bound	Upper bound		
1	57	2,21	0,940	0,124	1,96	2,46	1	4
2	57	2,81	1,076	0,143	2,52	3,09	1	4
3	57	3,32	0,805	0,107	3,10	3,53	2	4
Total	171	2,78	1,045	0,080	2,62	2,94	1	4

Table 4 shows the average score of mathematical connection ability in number 3 is higher than mathematical connection ability numbers 2 and 1. Thus it can be concluded that teachers who teach mathematics in higher class are more capable in answering contextual questions about the relationship of mathematics to the real

world or daily life compared to contextual questions about the relationship between mathematics and other disciplines. In addition, the teachers are also better at answering contextual questions about the relationship between mathematics to other disciplines than at answering the contextual questions about the relationship between mathematical topics

The difference of mathematical connection ability between subject and homeroom teachers

To get the differences of mathematical connection ability between subject and homeroom teachers, one-way MANOVA (Multivariate Analysis of Variance) was adopted to analyze. It brings two kinds of results, namely multivariate test results (Multivariate Test) and univariate test results (Test of Between-Subjects Effects). The univariate test can be considered as a post hoc test. The multivariate test indicates the effect of teachers' status on the ability of mathematical connections. Thus, it can furtherly be analyzed from table 5.

Tabel 5. Multivariate Test: Teachers' Status Effects (Subject vs Homeroom teachers)

Effects		value	f	Sig.
Intercept	Pillai's Trace	0,950	372,145[a]	0,000
Teachers' status	Pillai's Trace	0,104	2,274[a]	0,089

a. *Exact statistic*

b. *Design*: *Intercept* + teachers' status

Its results meet the level of $\alpha = 10\%$. Mathematical connection ability 1, mathematical connection ability 2, and mathematical connection ability 3 produced by subject teachers are different from mathematical connection ability 1, mathematical connection ability 2, and connection ability mathematics 3 produced by class teachers. On the other hand, the univariate test results about the effect of teacher status on each ability of mathematical connections are presented in Table 6.

Tabel 6. Univariate test of the teacher status effects (Subject vs homeroom Teachers) on each mathematical connection ability

sources	related variable	df	mean squares	f	sig.
Corrected Model	Math. con 1	1	0,783	0,902	0,346
	Math. con 2	1	6,935	6,191	0,016
	Math. con 3	1	0,003	0,004	0,950
Intercept	Math. con 1	1	272,338	313,851	0,000
	Math. con 2	1	396,522	353,961	0,000
	Math. con 3	1	623,812	856,851	0,000
Teachers' status	Math. con 1	1	0,783	0,902	0,346
	Math. con 2	1	6,935	6,191	0,016
	Math. con 3	1	0,003	0,004	0,950

Thus, each table section highlights that the ability of mathematical connections 1 and 3 produced by subject teachers has no differences from the ability of mathematical connections 1 and 3 produced by homeroom teachers. Yet, the mathematical connection ability 2 produced by subject teachers is different from the mathematical connection ability 2 produced by homeroom teachers. To see which mathematical connection ability is higher, the following table presents partial averages.

Tabel 7. Descriptive statistics of mathematical connection ability according to teachers' status

	Teachers' status	mean	Std. deviation	N
Math con 1	Subject teacher	2,04	0,976	23
	Homeroom teacher	2,28	0,905	40
	Total	2,19	0,931	63

Math con 2	Subject teacher	2,26	1,054	23
	Homeroom teacher	2,95	1,061	40
	Total	2,70	1,102	63
Math con 3	Subject teacher	3,26	0,752	23
	Homeroom teacher	3,28	0,905	40
	Total	3,27	0,846	63

Those presented data denote that the homeroom teachers are better in answering contextual questions about the relationship between mathematics and other disciplines compared to the subject teachers. In addition, both subject teachers and homeroom teachers have the same ability to solve contextual questions about the relationship between mathematical topics and contextual questions about the relationship between mathematics and the real world or daily life.

CONCLUSION AND SUGGESTION

Research discussion brings a number of conclusive points. Regarding the mathematical connection ability of Islamic Elementary school teachers, the mathematical connections ability of Islamic Elementary school teachers tends to be low as seen from the category of the crossed topic connections. Another problem is that some teachers are not accustomed to linking subject matter to other topics. The ability of mathematical connection to other disciplines is in the medium category as it reaches 68.37% for qualitative and 70.25% for quantitative data. The analysis of mathematical connection ability within its application to the real world or in daily life is categorized as moderate as it goes to be 79.84% for quantitative data and 71.75% for quantitative data

At the same time, the mathematical connection ability examined based on the teaching styles meets some conclusive points. The first is the analysis of mathematical connection ability in terms of the crossed-topics from lowest to high regarding the classical, technological, personalization, and interactional teaching styles. While the ability to connect mathematics to other disciplines and the ability to connect

mathematics to be applicable in daily life based on the teaching styles can be concluded to be in the medium level.

Referring to the conclusions, these following suggestions may take place forward: 1). Due to the low level of mathematical connection ability of Islamic Elementary school teachers, there must be training to practice and understand mathematical connections comprehensively. The lowest mathematical connection results are connections with other topics. As stated in problem number one, almost no one gave correct answers. 2). It's expected that lecturers of basic mathematics of Teacher Education and Islamic Education of *IAIN Surakarta* (State Islamic Institute of Surakarta) to make learning innovations through a contextual approach to improve mathematics learning achievement, especially in algebra. In addition, during the learning process, lecturers should pay attention to the differences in learning styles so that efforts can be made to address problems or difficulties for students to solve mathematical problems.

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