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Research Article

An experiment on connecting, organizing, reflecting, and extending (core) learning model and learning styles: the interaction and effects on mathematical communication skills [1]

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Abstract

The mathematical communication skills of students in SMP Negeri 1 Sumber Jaya were still relatively low. It might be caused by the unvaried learning models applied by the teachers and the teachers' low awareness of the students' learning styles. The purpose of this study was to determine: (1) the effect of the CORE learning model on students' mathematical communication skills; (2) the influence of learning styles on students' mathematical communication skills; and (3) the interaction between CORE learning model and learning styles on students' mathematical communication skills. This research employed a quasi-experimental approach by using a 2-way ANOVA of unequal cells as the hypothesis testing method. The instrument used was a test of communication skills and a student learning style questionnaire. The results of this study are: (1) there is an influence of the CORE learning model on students' mathematical communication skills; (2) there is an influence of students' learning style tendencies on their mathematical communication; (3) there is no interaction between the application of the CORE model and the learning style of students' mathematical communication skills.

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Introduction

Mathematics is important as a basis of logic and quantitative solutions that can be used for other problems (Pahrudin et al. 2020; Yasin et al. 2019; Suherman et al. 2018), so, if a student has good logic skills, then it will be easier for him to communicate mathematically. Students are not only required to memorize formulas when studying mathematics but also to understand the benefits of mathematics for themselves and their environment (Agustiana, Putra & Farida 2018; Thahir et al. 2019). Mathematical communication skills are one of the mathematical power that must be developed early (Fatimah & Zanthy, 2019). At present, without good communication skills, it is difficult for students to be able to develop mathematical abilities as determined learning goals (Aminah, Wijaya & Yuspriyati 2018).

Good mastery of mathematical communication skills enables students to use logic in a mathematical pattern and can communicate mathematical ideas into tables, media, symbols, or diagrams (Pratiwi et al. 2020a). Mathematical communication skills can be divided into two aspects, namely written and oral communication (Melya & Supriadi 2018). Written communication skills can be seen in the form of pictures, tables, or graphs while verbal communication skills can be verbal expressions or explanations of a mathematical theory.

Based on the observations, it appeared that the students' mathematical communication skills were not as good as what was desired. The weak mathematical communication skills were caused by the application of unvaried learning

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models and teacher-centered learning. Thus, there were not enough opportunities for students to communicate their ideas related to solving a problem in mathematics. The best alternative for solving this problem is to use a cooperative learning model (Yasin et al. 2020; Pahrudin et al. 2020; Pratiwi et al. 2020)

Figure 1.
Cooperative Learning (Anis 2019)

Various types of cooperative learning have been developed by experts, one of which is the CORE (Connecting, Organizing, Reflecting, and Extending). Connecting can be interpreted as inviting the students to connect new knowledge to be learned with prior knowledge. Organizing is asking the students to organize their knowledge. Reflecting is training students to be able to explain the information they have gained. Extending is to discuss the knowledge that has been learned which subsequently will be expanded (Irawan 2018). Students are also trained to connect, find meaning, be active, work together in groups, and emphasize mathematical communication in the CORE learning model (Konita et al. 2019). Some relevant studies also provide results that this type of learning model has a positive and effective impact on learning in the classroom (Auliani et al. 2018; Irawan, 2018; Muizaddin & Santoso, 2016; Siregar et al. 2018). In addition to the external factors that have been explained before, internal factors are also important in influencing mathematical communication skills, one of which is the learning style of students.

Learning style is one important factor that can influence the academic achievement of students, so teachers should pay attention to this in classroom learning (Haryono & Tanujaya 2018). Marpaung (2016) explains that learning styles have a special role in the process of teaching and learning activities in the classroom. Students who are forced to learn by teachers in ways that are not appropriate to their learning styles will likely hinder the process of absorbing the information that the teacher has given in the classroom. Some relevant research also states that there is a link between the students' learning styles tendency and their academic abilities (Iriani & Leni 2013; Khoeron, Sumarna & Permana 2014; Marpaung 2016; Sundayana 2018). Therefore learning styles cannot be ruled out during learning.

Some relevant studies have discussed how the CORE learning model and learning styles can influence students' academic outcomes (Auliani, Karim & Amalia, 2018; Irawan 2018; Khoeron, Sumarna & Permana 2014; Muizaddin & Santoso 2016; Sundayana 2018). However, no research looks at the interaction between CORE learning models and learning styles on students' mathematical communication skills. Based on the description, the purpose of this study is to determine the effect of the CORE learning model on mathematical communication skills, knowing the influence of learning styles on mathematical communication skills and knowing the interactions between CORE learning models and learning styles on mathematical communication skills.

Methods

This study employed quasi-experimental research with a 2×3 factorial design. Tests and questionnaires were the main instruments in this study. The tests were used to retrieve data on students 'mathematical communication skills while the questionnaires were used to group students' learning style tendencies. The learning style questionnaires were validated in terms of content validity, internal consistency, and reliability while the mathematics learning achievement test instrument refers to the criteria of content validity, difficulty level, differentiation power, and reliability.

The data analysis technique used was normality and homogeneity tests as the prerequisite tests. The hypothesis was tested using a two-way ANOVA test and then continued with a double comparison test (Scheffe).

Results, Discussion and Conclusion

Based on the data of mathematical communication skills, the results of the normality test of the learning model groups (CORE and conventional) and the learning styles questionnaire (visual, auditory, and kinesthetic) concluded that the H0 is received, so that the sample comes from a normally distributed population. The results of the homogeneity test also concluded that all H0 is received so that it can be concluded that the samples come from a homogeneous population. Next, two-way ANOVA with unequal cells was carried out. The summary of the test is presented in Table 1.

Table 1.

Summary Analysis of Two Way Variance Analysis

Sources	JK		DK		RK	
Learning Model (A)	503975,872	1	251987,9	2392,113	3,101	0,05
Learning Styles (B)	503847,055	2	251923,5	2391,502	3,109	0,05
Interaction (AB)	340,261	4	85,065	0,808	2,484	0,05
Error	8532,632	81	105,341			
Total	1016695,820	89				

Based on Table 1, it can be concluded that: (1) In the learning model (A), there are differences in ability mathematical communication between the CORE learning model and the conventional learning model; (2) in the learning styles (B), the three types of learning styles have different effects on mathematical communication skills; (3) in the interaction (AB), there is no interaction between the types of learning styles and learning models on students' mathematical communication skills. If H_{0B} is rejected, it is necessary to do more tests to determine significant mean differences. A summary of the marginal averages is presented in Table 2.

Table 2.

The Marginal Averages of the Learning Models and Learning Styles

Learning Models	Learning Styles			Marginal Visual
	Visual	Audio	Kinestetik	
CORE	80,3659	58,4091	CORE	80,3659
Conventional	55,0000	54,8077	Conventional	55,0000
Marginal Mean	67.9339	55.5114	Marginal Mean	67.9339

In the first hypothesis, H0A is rejected, hence, it can be concluded that the mathematical communication skills of students who were taught using the CORE learning model are better than students who were taught by using the conventional learning model. These results also complement previous studies related to CORE learning models such as (Beniasih et al. 2015; Irawan, 2018; Satriani et al. 2015; Syahrir & Ilmanda, 2017) which provide results that the CORE learning model can provide good results on science learning outcomes, mathematical reasoning abilities, mathematical problem-solving abilities, and the ability to understand students' concepts.

In the second hypothesis, H_{0B} is rejected so it is necessary to do an inter-columns double comparison test between learning styles types visual (μ.1), auditory (μ.2), kinesthetic (μ.3). The summary of the inter-columns double comparison test is presented in Table 3.

Table 3.

The Summary of Inter-Columns Double Comparison Test

No.	H_0	$F_{observed}$	$F_{0.05;\,2;n}$	Test Decision
1	$\mu_{.1} = \mu_{.2}$	19.7023	6.00	H_0 is rejected
2	$\mu_{.1} = \mu_{.3}$	7.8565	6.00	H_0 is rejected
3	$\mu_{.2} = \mu_{.3}$	8.9946	6.00	H_0 is rejected

Based on Table 3 and Table 2, it can be concluded that students with visual learning styles have better mathematical communication skills compared to students with auditory and kinesthetic learning styles. Students with auditory learning styles have better mathematical communication skills compared to students with kinesthetic learning styles.

These results had been previously estimated that students who have a visual learning style will be more active than students with kinesthetic and auditory learning styles, so students with an auditory learning style are better in understanding the learning material. The results of this study complement some of the previous studies about the influence of students' learning style tendencies on learning achievement (Khoeron, Sumarna & Permana 2014; Marpaung 2016; Prasetya 2012; Ramlah, Firmansyah & Zubair, 2015) and mathematical problem-solving abilities (Widiyanti 2011).

In the third hypothesis of Table 1, H_{0AB} is accepted, so there is no need to do a further comparison test. It can be concluded that in each type of learning style, the CORE learning model produces better mathematical communication skills than conventional learning models.

In the third hypothesis, H_{0AB} is accepted, so there is no need to do a further comparison test. Two things can be concluded, namely: (1) in each type of learning style, CORE learning model produce better mathematical communication skills than conventional learning model; (2) in each learning model, students with visual learning style have better mathematical communication skills than students with auditory and kinesthetic learning styles, and students with auditory learning styles have better mathematical communication skills than students with style kinesthetic learning. The results of this study are no different from the research hypothesis. This happens because, in the CORE learning model, the students are more active in the process of teaching and learning activities while students with visual learning styles are also always active in teaching and learning activities.

Based on the theoretical foundation and the analysis and results of data processing, it can be concluded that there is an influence between the application of the core learning model and learning style on students' mathematical communication skills. In detail, it can be said that the CORE learning model gives better effects on mathematical communication skills compared to the conventional learning model. Students with visual learning styles have better mathematical communication skills than students with kinesthetic and auditory learning styles. Lastly, there is no interaction between groups of learning models (CORE and conventional) and categories of learning styles (visual, auditory, and kinesthetic) on students' mathematical communication skills. Therefore, the researchers suggest that the CORE learning model should be applied in the classroom, and students should be treated according to the tendency of their learning styles.

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