The Effect of Cabri Express in Geometry Learning on Students' Mathematical Communication Ability

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ABSTRACT

Cabri is characterized by an attractive advantage and provides wide-ranging benefits in the teaching of mathematics. Although today there have been many studies on the edges of Cabri, experiments on Cabri-Express have not been widely explored. For this reason, a quasi-experimental study with a randomized posttest only design involving 80 grade VII junior high school students in Ruteng, Indonesia, was conducted to analyze the effect of Cabri-Express in learning geometry on students' overall mathematical communication ability (MCA) and based on students' initial mathematical abilities. The results of the MCA test are the research data, which consists of 5 questions that are then analyzed by t-test and preceded by conducting an analysis prerequisite test. The Hedges equation describes how much influence the Cabri-Express model has on students' MCA. The results showed that the overall MCA of students who were taught using the help of an Cabri-Express was better than students who were taught using the conventional model. From the Hedges equation, an effect size of 1.23 is obtained, indicating that the use of Cabri-Expresses strongly affects students' MCA. These results interpret that students who are ranked 13th in the experimental class are equivalent to those who are ranked 5th in the control class. By clarifying the effect of Cabri-Express on students' MCA, this study recommends the need to use Cabri-Express in mathematics classes. The analysis results can also help researchers explore other material in a relatable context.

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A. INTRODUCTION

The current direction of educational policy is to acquire the skills students need to succeed in the modern world and to help them develop the confidence to put those skills into practice (Bolstad, 2020; Choo et al., 2017; Zorlu & Zorlu, 2021). Likewise, to survive in today's modern society, mathematical communication skills are needed as a thinking tool and help students to develop patterns, solve problems and draw conclusions, as well as a means to communicate thoughts, and ideas precisely and briefly (Glassmeyer et al., 2022; Kusumah et al., 2020; Vonkova et al., 2022). Furthermore, by communicating ideas effectively, students can interpret various valuable data and information (Kilic & Dogan, 2022; Romanyuk et al., 2022). Mastery of students' mathematical communication skills (MCA) has excellent consequences for students. Therefore, teachers must create a learning climate to accommodate students in building the MCA.

Achieving quality education can be enhanced by employing suitable learning methods (Freeman-Green et al., 2015; Juandi & Tamur, 2021). Related to that, UNESCO recommends using ICT to achieve quality education (UNESCO, 2017), so it is alleged that it can promote student MCA. ICT in mathematics learning can increase student retention and motivation and make learning more exciting and interactive (Juandi et al., 2021; Nurjanah et al., 2020; Tamur et al., 2021; Tamur et al., 2020). The use of ICT is now a must because the most significant component of the world's population is Gen Z, who grew up in a technological environment. Integrating ICT in education means conditioning students to learn in their native habitat (Gunbas, 2020).

The use of Cabri is one form of ICT implementation in mathematics learning. Until now, many studies on the effect of Cabri have been carried out (mis: Glassmeyer et al., 2022; Gülburnu, 2022; Kepceoğlu, 2018; Nurjanah et al., 2020) and recommend the superiority of the treatment group. However, the overall effect size of using Cabri from the results of the latest meta-analysis is moderate (Jaya & Suparman, 2021). Although Cabri positively impacts students' academic abilities, it is not yet equipped with agile calculators and equation editors. To fill this gap, the development team released Cabri Express as a complete mathematical toolkit, including an agile calculator (scientific, graphing, and 3D), an equation editor, and dynamic geometry.

Although there is a need to consider its use in the literature, there are not many studies on Cabri Express. This research was conducted to fill the void by conducting experiments to analyze the effect of Cabri Express in learning geometry on students' MCS. This objective was achieved by conducting a quasi-experimental study with a randomized posttest only design involving a group of seventh-grade junior high school students in Ruteng, Indonesia. This goal is achieved by answering the research question, namely how much influence the Cabri Express integration has on students' MCAs. By clarifying the effect of Cabri-Express on students' MCS, this study contributes to the literature and other stakeholders to organize mathematics classrooms by integrating Cabri-Express.

B. METHODS

The sort of research employed is quantitative, which uses numerical information, data collection, and data interpretation to process and summarize information (Bacon-Shone, 2015). The method used is quasi-experimental because other variables are challenging to control. This study included the experimental group which was given the learning treatment using Cabri-Express, and the control group which was treated with the traditional learning model as a comparison. This study used a Randomized Control Group Post Test Only design. The dependent variable of this research is students' mathematical communication skills, while the independent variable is learning using Cabri-Express. The research design is described in Table 1.

Table 1. Posttest-Only Control Group Design

No	Class	Independent Variable	Posttest
1	Experiment	X	Y2
2	Control	-	Y2

with X is application of learning using Cabri-Express, and Y2 is posttest two classes

The population in this study were seventh-grade students of a State Junior High School in Ruteng, Indonesia, for the 2021/2022 academic year. At the same time, the sample of this study was taken from a population of two classes selected by the Cluster Random Sampling technique. Each was randomly selected to be placed in the experimental class and the control class. The sample consisted of 80 students, each of which consisted of 40 students. The method used is quasi-experimental because other variables are challenging to control. In this study, data were collected from the tests of students' mathematical communication skills from the experimental and control classes on the two-dimensional material given after the learning was completed. The mathematical communication ability test instrument used in this study measures three aspects, namely written text, images, and mathematical expressions.

The analysis used is descriptive and inferential statistics. Hypothesis testing, namely the mean difference test, was carried out through a t-test with a significance level of 0.05 after the prerequisite test was met. Data analysis in this study was assisted by the SPSS version 22 program. Further analysis was carried out to measure the magnitude of the effect of using Cabri-Express on students' MCA using the Hedges'g equation (Cohen et al., 2018). The effect size calculation for this single study uses the Comprehensive Meta-Analysis (CMA) program. Effect size categories are based on the classification of Cohen et al. (2018), as shown in Table 2.

Table 2. Interpretation of Effect Size

Range of Effect Size	Effect Size Classification
ES < 0.20	negligible effect
0.20 ≤ ES < 0,50	small effect
0.50 ≤ ES < 0,80	moderate effect
0.80 ≤ ES < 1.30	large effect
ES ≥ 1.30	excellent effect

C. RESULT AND DISCUSSION
1. Results

After collecting the data, it was analyzed using the help of SPSS version 22 and CMA programs. The results of data processing to provide a descriptive statistical picture related to the overall MCA of students from both classes are presented in table 3 below:

Table 3. Descriptive Statistics of Student MCA Score

No	Class	N	$\bar{x}$	s_d
1	Experiment	40	87	9.11
2	Control	40	74	11.81

Ideal score is 100

Table 3 shows the comparison of students' MCA results after treatment. When table 3 is observed, it can be seen that descriptively students who are taught using the help of Cabri_Express get an average MCA of students higher than students in the conventional group. Furthermore, Table 4 shows the results of the normality test using the Shapiro-Wilk test. Table 5 is the result of the homogeneity test using the Levene Statistic. At the same time, Table 6 shows the result of the t-test at a significant level of 0.05. as shown in Table 4.

Table 4. Student MCA Data Normality Test

No	Class	Shaprio-Wilk		Interpretation
		Df	**Sig**	
1	Experiment	40	0.65	Normal distribution
2	Control	40	0.42	Normal distribution

When Table 4 is examined, it appears that the sig value of both classes is more than 0.05. This indicates that the two classes are normally distributed. This procedure provides an opportunity to use parametric statistics where the parameter used to estimate the population is the mean. But before that, it was continued with the homogeneity test of the variance of the two classes, as shown in Table 5.

Table 5. Homogeneity of Student MCA Test Data

Levene Statistic	Sig
2,79	0,67

When Table 5 is observed, the value of sig appears. =0.67 > 0.05. This means accepting the hypothesis that the two classes' variance is homogeneous. In other words, the data from both classes are homogeneous. These results warrant the use of the t-test. Furthermore, to compare the difference in the MCA mean of the two classes, a parametric test was performed using a t-test. With the research hypothesis: the average MCA of students in the class that received learning with the help of Cabri-Express was significantly higher than the conventional class, as shown in Table 6.

Table 6. Student MCA Difference Test

t	df	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	**Upper**
-4.74	78	.000	-.28472	-.17619

From the Test Statistics table using the t-test, the Sig value is obtained. = 0.000. because of the value of Sig. = (1/2). 0.000 < = 0.05 then the research hypothesis is accepted at the significance level = 0.05. In other words, the analysis results show that the average MCA of students in the class that received learning with the help of Cabri-Express was significantly higher than the conventional class. Further analysis was conducted to investigate the effect of the Cabri-Express-assisted learning model on students' MCA. The following are the results of the analysis using the CMA program, as shown in Table 7.

Table 7. Student MCA Effect Size

Model	Hedges	Standard error	Variance	Lower limit	Upper limit
Fixed-effect	1.232	0.244	0.059	0.754	1.710

Based on the data presented in Table 5, the effect size of students' MCA is 1,232. Values are determined using the Hedges equation, which is based on a fixed effects model. The effect size of 1,232 was categorized as a large effect when compared with Table 3. In other words, it was clear that Cabri-Expres' use significantly impacted students' MCA.

2. Discussion

The results of this study explain that the MCA of students on flat-plane geometry material is higher than students who receive conventional learning models. These results are consistent with the findings of previous researchers (e.g., Apriatna et al., 2020; Juandi et al., 2021; Nurjanah et al., 2020; Tamur et al., 2021; Tamur et al., 2020; Yuliardi et al., 2021). Although previous studies analyzed the effect of CABRI on different target states, they gave almost similar results. This shows an overall trend of learning utilizing CABRI. This is because in learning Cabri is used as a thinking tool (Tamur, Kusumah, Juandi, Kurnila et al., 2021) which allows students to build their frame of mind with the help of features available in Cabri. The role of students in using Cabri as mindtools is that students explore their geometric concepts using these various features so as to improve the representation and interpretation of data as an important part of MCA.

Although the CABRI superiority trend is almost the same as previous studies (e.g., Glassmeyer et al., 2022; Gülburnu, 2022; Kepceoğlu, 2018; Nurjanah et al., 2020) the magnitude of the effect of treatment is still moderate (Jaya & Suparman, 2021). From the results of the analysis of the effect size of the use of CABRI Express in this study, it was 1,232 (very strong). This is because Cabri Express as a further development of CABRI Equipped with features agile calculators (scientific, graphic, and 3D), equation editor, and dynamic geometry. Figure 1 shows the features in Cabri Ekspress, as shown in Figure 1.
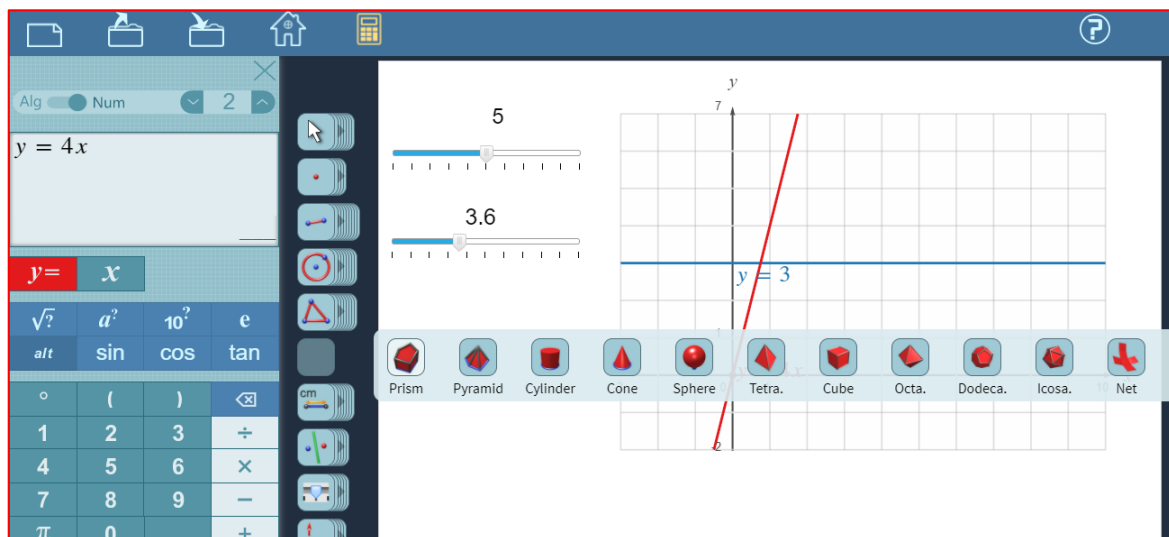

Figure 1. Cabri Express screen

Learning that is presented interactively by Cabri Ekspres requires students to respond to the materials provided. As mindtools, Cabri is not only a teacher who explains a material but also as an intellectual "partner", helping students construct their knowledge, supporting students' exploration abilities on a particular topic, and helping them understand the interrelationships between concepts (Tamur, Kusumah, Juandi, Kurnila et al., 2021).

An overview of the advantages of using Cabri Ekspres on students' MCA can be seen from the effect size classification of Cohen et al. (2018). The effect size of 1,232 which is accepted as a very large effect shows that students who are ranked 13th in the experimental class are equivalent to students who are ranked 4th in the control class. For comparison, Nurjanah et al. (2020) have examined the effect of Cabri and found an effect size of 0.66 which means that on

average the students who were ranked 13th in the experimental group were equivalent to students who were ranked 9th in the control group. This comparison illustrates that the use of Cabri Ekspres has a greater effect on students. However, this finding needs to be verified again because there have not been many studies involving the integration of the Express Cabri. This is reinforced by the results of the analysis in Table 5 which presents the research standard error of 0.244. The standard error explains that the effect size used to estimate the population is still unstable. So further research is needed involving a large sample.

D. CONCLUSION AND SUGGESTIONS

This study was conducted to analyze the effect of Cabri Ekspres on students' MCA. Based on the results of the analysis, it can be concluded that the use of Cabri EKspres has a very large influence on students' MCA. By clarifying the effect of Cabri-Express on students' MCA, this study recommends the need to use Cabri-Express in mathematics classes. The results of the analysis can also help researchers explore other materials in a relatable context. However, from the standard error value, it shows that further research is needed regarding the effect of Cabri Express by involving more traffic.

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