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Students' metacognition growth in reading: the effectiveness of flipped metacognitive strategy

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ABSTRACT

Metacognitive functions as a means to regulate cognitive abilities, such as reading. The greater a person's awareness of their metacognitive processes during reading, the more effectively they will comprehend the material. This research aims to assess the effectiveness of a flipped metacognitive strategy (FMS) as a learning approach that incorporates metacognitive skills with a focus on technology in education. A random selection method was employed to choose 28 participants for the study. The findings indicated a notable difference in the average scores of students' metacognitive awareness before and after the implementation of the FMS. Specifically, metacognitive awareness in reading improved from a score of 56.42, categorized as "good enough", to 80.79, classified as "very good". The effectiveness assessment revealed that the N-Gain percent value for students' metacognitive awareness stands at 54.81%, placing it in the less effective category. Therefore, the FMS can be utilized to enhance metacognitive awareness in reading. Nonetheless, this strategy requires ongoing implementation to be optimally effective in tracking the advancement of students' metacognitive awareness, particularly in reading. As long as learning strategies are in place, educators must elevate the quality of instructional materials and pay greater attention to the learning needs of students. To enhance reading comprehension, teachers should foster students' metacognitive awareness, which encompasses understanding various reading strategies, recognizing problem-solving techniques during reading, and being aware of the factors that contribute to reading comprehension.

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1. INTRODUCTION

The utilization of technology as the primary medium for executing educational practices has emerged as a contemporary phenomenon. In fact, e-learning serves as a comprehensive solution that facilitates a seamless learning experience, enabling students to study from any location and at any time [1]–[3] and simplifying the burden on teachers and students [4], [5]. E-learning offers numerous features that facilitate access to educational content for both students and educators, thereby enhancing the efficiency and flexibility of the learning process. By utilizing the diverse functionalities provided by e-learning, universities are able to adopt flipped classroom models, as e-learning serves as a fundamental element for delivering online education [6]. In its development, the flipped classroom emerged as an approach that increases the

retention and transfer of learning more efficiently [7] and in accordance with the competencies required by the knowledge society [8].

Several studies on flipped classrooms state that flipped classrooms provide various advantages for improving the quality of learning. A flipped classroom can provide students with positive feelings about learning [9]. A flipped classroom can increase students' motivation and independent learning skills [10]. A flipped classroom can boost academic performance [11]. A flipped classroom can meet learning needs and increase interest in language learning [12]. A flipped classroom can promote the development of motivation, academic achievement, and problem-solving skills [13]. A flipped classroom can develop the mathematical thinking of prospective math teachers [14]. Furthermore, a flipped classroom helps reduce students' anxiety levels about learning the language [15], [16].

The flipped classroom is implemented alongside various learning strategies and techniques, such as active learning and blended learning [17]. The findings of the research indicate that the integration of the flipped classroom model with inquiry-based learning enhances the quality of education [18]. Flipped classrooms combined with gamification increase motivation and competition in the classroom [19]. Flipped classrooms combined with adaptive algorithm-based learning can improve learning efficiency [20]. A flipped classroom combined with a pedagogical approach can help develop creativity and dialogic learning [8]. Flipped classrooms combined with multimedia-assisted learning can explore creativity in an independent learning atmosphere [21]. Flipped classrooms combined with project-based learning can improve students' cognitive and metacognitive abilities [22]. Flipped classrooms with the help of digital textbooks can develop students' soft skills and academic achievement [23]. Flipped classrooms combined with deep learning-based tiered learning can increase student participation in class [24]. Furthermore, the flipped classroom serves as a method for learning writing with respect to both genre and gender [16].

However, based on these studies, there has been no research on flipped classrooms combined with metacognitive strategies. In fact, metacognition itself is a learning control tool, becomes the foundation of education, and promotes holistic learning [25]. Metacognitive strategies used in learning can improve the ability to understand problems, design and implement plans, and evaluate learning outcomes [26] so that students have problem-solving skills. Students need to have metacognitive awareness in language learning because metacognitive awareness is a factor that influences the quality of learning outcomes [27]. The implementation of metacognitive strategies aims to assist students in enhancing their metacognitive awareness. In this study, the flipped classroom was combined with a metacognitive strategy, so it was named the "flipped metacognitive strategy (FMS)". This strategy needs to be tested in real-world conditions so that it can be seen how well it affects the development of metacognitive awareness, especially in developing reading skills. Consequently, it is essential to conduct research on the implementation of this FMS. Specifically, this study seeks to address two research questions:

i) What is the level of metacognitive awareness among students prior to and following the application of the FMS?
ii) How effective are flipped metacognitive strategies in assessing students' metacognitive awareness in reading?

2. RESEARCH METHOD

This study is a quantitative investigation employing pre-experimental techniques to assess the effectiveness of the FMS on enhancing metacognitive awareness in reading. The pre-experimental framework utilized was a one-group pretest-posttest design. This design was implemented within a single group by administering treatment following the assessment of the students' initial capabilities via a pretest. The initial ability in question in this case is metacognitive awareness in reading, which is then treated with a FMS. This study's population consisted of students who took creative writing classes. By using a simple random sampling technique, 28 students in one of the creative writing classes were selected to be the research subjects. The weakness of this research lies in the limited sample. This research is a population study, namely 28 students who took creative writing classes. If the sample is less than 100 then all of them are taken so that the research is population research. The selected sample (n=28) adheres to the conventions for exploratory/paired designs and is justifiable when supported by suitable assumption checks and effect-size reporting.

Pilot or exploratory studies frequently utilize small samples (for instance, approximately 12 per group) in situations where prior estimates are not available [28]. In the context of paired-samples analyses, the validity of the t-test is primarily contingent upon the distribution of the paired differences, rather than adhering to an arbitrary $n \geq 30$ guideline; consequently, we assessed the normality of the difference scores (Shapiro–Wilk) and present effect sizes (Cohen's d) along with 95% confidence intervals to enable readers to evaluate practical significance. When deemed appropriate, we also performed the nonparametric Wilcoxon

signed-rank test for validation. Lastly, considerations regarding sample size and the interpretation of findings are examined in relation to statistical power and precision [29], [30]. This means that the research sample of 28 people is still suitable for research.

There are three instruments used in this study, namely semester learning plans, e-learning and reflective journal, and self-report questionnaires. Semester lesson plans serve as indicators for implementing educational activities throughout a semester. The self-report questionnaire utilized is the metacognitive awareness of reading strategy inventory (MARSI) [31] to measure students' metacognitive awareness in reading. Reflective journals include guiding questions to assess students' comprehension of learning material. The data collection procedure was carried out in three stages. First, give the MARSI self-report questionnaire to students to find out their metacognitive awareness before being given treatment. Second, implement creative writing learning using a FMS. Third, giving a MARSI self-report questionnaire to find out the development of metacognitive awareness in reading after being given treatment. Learning activities with flipped metacognitive strategies are carried out by following the flipped classroom learning steps [32] and metacognitive strategy steps [33], so that they are named "FMS". These steps are presented in Table 1.

Table 1. Learning activities using a FMS

Learning activities	Teacher and students activities	
	Teacher	Students
At home	Planning 1. The teacher prepares a semester lesson plan and the media used in learning. 2. The teacher prepares teaching materials according to learning outcomes and upload it in e-learning. 3. The teacher provides an assignment sheet to understand the learning material. 4. The teacher provides a reflective journal as a tool for monitoring assignment work.	Planning 1. Students prepare themselves to attend lectures. 2. Students visit e-learning and download learning material according to learning outcomes. 3. Students learn the learning materials provided in an e-learning
	Monitoring 1. The teacher offers students the chance to review lecture content and document their learning experiences at home by means of a reflective journal. 2. The teacher gives students the opportunity to ask questions through the chat feature in e-learning.	Monitoring 1. Students understand the learning material provided through e-learning. 2. Students monitor their reading activity using a reflective journal. 3. Students answer the questions provided on the assignment sheet.
At class	Evaluation 1. The teacher starts learning by doing apperception about the learning that has been done at home. 2. The teacher asks students to discuss the learning material that has been studied and gives quizzes to measure students' understanding of the learning material.	Evaluation 1. Students provide feedback and convey their learning experiences at home in accordance with learning outcomes. 2. Students engage in discussions and collaborate on quizzes assigned by the instructor to assess their comprehension of the educational content.

Data analysis was conducted utilizing the N-Gain score test, which is a descriptive statistical test, along with a paired sample t-test. The purpose of the N-Gain score test is to assess the effectiveness of the FMS. This assessment is executed by calculating the difference between the posttest and pretest scores, divided by the difference between the total score and the pretest score. The classification for determining the gain score is divided into three categories: if the N-Gain score exceeds 0.7, it is categorized as high; if it falls between 0.3 and 0.7, it is considered medium; and if it is below 0.3, it is classified as low. Additionally, the N-Gain percent is calculated by multiplying the Gain score by 100. The interpretation of effectiveness is categorized into four groups: if the N-Gain percent is below 40%, it indicates ineffectiveness; if it is between 40 and 55%, it suggests low effectiveness; if it ranges from 56 to 75%, it is regarded as quite effective; and if it exceeds 76%, it is deemed effective. Descriptive statistical tests were employed to illustrate the average understanding of the N-Gain score in reading before and after the treatment was administered. Following the assessment of normality and homogeneity of the data, and confirming that the data is normally distributed and homogeneous, an independent sample t-test was conducted to evaluate the differences in the effectiveness of the FMS. The data analysis was carried out using the SPSS application.

3. RESULTS AND DISCUSSION

In this section, the answers to the problem formulation will be explained, namely: measuring students' metacognitive awareness before and after using the FMS and the effectiveness of the FMS on the growth of metacognitive awareness in reading.

3.1. Students' metacognitive awareness before and after using the flipped metacognitive strategy

Metacognitive awareness in reading is assessed through three key indicators: global reading strategies, problem-solving strategies, and support reading strategies. The data for this assessment was gathered via a questionnaire. The analysis of the data was performed using a percentage formula. The results of the measurement are displayed in Table 2.

Table 2. Results of measuring metacognitive awareness in reading

No	Indicator	Pretest		Posttest	
		Percentage (%)	Category	Percentage (%)	Category
1	Global reading strategies	49.72	Good enough	78.27	Good
2	Problem-solving strategies	68.45	Good	88.39	Very good
3	Support reading strategies	51.07	Good enough	75.71	Good
	Average	56.42	Good enough	80.79	Very good

Based on Table 2, the average score shows the growth of students' metacognitive awareness from good enough to very good after using the FMS. First, global reading strategies in terms of global reading strategies, metacognitive awareness in reading progresses from the good enough category to a good category. The activities that students engage in while reading generally include the following: when reading, students typically have a specific objective in mind; they relate their prior knowledge to aid in comprehending the material; they preview the text to familiarize themselves with its content before delving into it; they consider how well the text aligns with their intended goals; they initially skim the text without focusing on its length or structure; students select their reading materials prior to beginning; students infrequently utilize tables and illustrations within the text to enhance their comprehension; students follow particular strategies to facilitate their understanding of the reading; students seldom employ tools to highlight significant information from the texts; students critically assess and evaluate the key information presented; students verify their understanding when they encounter information that conflicts with their existing knowledge; students attempt to infer the meaning of the text they are reading; and students review their comprehension of the material.

Second, problem-solving strategies. Metacognitive awareness in reading, particularly regarding problem-solving strategies, evolves from a satisfactory level to an excellent one. The actions that students undertake while reading, especially in addressing reading-related problems, include: students reflecting on their prior knowledge to aid in comprehending the material; when confronted with complex texts, students read aloud and multiple times to grasp the content; students take their time to ensure they fully understand the reading material; students revisit the text from the start if they lose focus; students modify their reading pace according to the nature of the text; when engaging with advanced reading materials, students strive to maintain focus and enhance their concentration; they pause at intervals to contemplate the information they have read; they endeavor to visualize or imagine the information to aid in retention; they verify their comprehension when they encounter information that conflicts with their existing knowledge; they make predictions about the text's content while reading; when faced with challenging reading, students read the text multiple times to deepen their understanding; and they infer the meanings of unfamiliar words or phrases within the text.

Third, support reading strategies. Metacognitive awareness that aids reading strategies evolves from a satisfactory level to a commendable level. Students take notes during their reading to enhance their comprehension of the material; when engaging with complex texts, students read aloud to facilitate their understanding of the content; students compose summaries to contemplate the main concepts presented in the reading; students engage in discussions about the reading material with others to verify their comprehension; students highlight important information.

The growth of students' metacognitive awareness after using flipped metacognitive strategies proves that metacognitive strategies are very important because are sequential processes that control cognitive activity to ensure that cognitive goals are achieved, especially in learning language [34]. In reading, metacognitive strategies encourage understanding of the reading and are very necessary to understand the hidden meanings in the text [35]. By using metacognitive strategies in reading, students can develop metacognitive awareness in reading. This awareness includes awareness of using various strategies in reading, awareness of efforts to solve problems in reading, and awareness of supporting factors in reading. Students who have metacognitive awareness will have more information than students who lack metacognitive awareness [35]. By understanding their metacognitive skills, students are able to prepare and organize effective reading, identify when to apply suitable reading strategies, comprehend how to oversee the implementation of these strategies, and assess the effectiveness of the strategies employed [36]. Therefore, students must always increase their metacognitive awareness and the teacher uses a variety of problem-solving strategies to develop students' metacognitive awareness.

3.2. The effectiveness of the flipped metacognitive strategy for measuring metacognition growth in reading

The N-Gain test was employed to assess the efficacy of the FMS in evaluating the growth of metacognition in reading. Prior to the N-Gain test, a descriptive statistical analysis and a paired sample t-test were conducted. The results of the descriptive test, along with the paired sample statistics for both pretest and posttest data, are illustrated in Table 3.

Table 3. Paired samples statistics

Condition		Mean	N	Std. Deviation	Std. Error mean
Pair	Pretest	56.4164	28	7.71366	1.45774
	Posttest	80.7926	28	9.48602	1.79269

From the output table of paired sample statistics, it can be observed that the average pretest score is 56.42, whereas the average posttest score is 80.79. A total of 28 students participated as respondents. The standard deviation for the pretest was 7.71, while the standard deviation for the posttest was 9.48. The mean standard error for the pretest is calculated to be 1.46, and for the posttest, it is 1.79. The average score of the posttest surpasses that of the pretest, indicating that there is a notable difference between the two sets of scores on average. Additionally, to assess whether the difference in scores between the pretest and posttest is statistically significant, an interpretation of the paired sample t-test results is conducted, as shown in Table 4.

Table 4. Paired samples test

Condition		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error mean	95% confidence interval of the difference Lower	Upper			
Pair	Pretest-posttest	-24.38	11.89	2.247	-28.99	-19.77	-10.85	27	.000

To determine the significance value of the difference in the average value, the basis of consideration for the comparison of the Sig values is used. (2-tailed) with a probability of 0.05. If the value of Sig. (2-tailed) smaller than 0.05 means that there is a difference in the average value of metacognitive awareness before and after using the FMS. If the value of Sig. (2-tailed) greater than 0.05 means that there is no difference in the average value of metacognitive awareness before and after using the FMS. From the output table of paired samples correlations, the value of Sig. (2-tailed) is 0.000. This value is smaller than 0.05. This means that there is a significant difference in the average value before and after using the FMS. In addition, in the output table, information is also obtained that the mean pair differences are -10.85 because the pretest average value is lower than the posttest average value. Furthermore, after the paired sample t-test, the N-Gain test was carried out for measuring metacognition growth in reading. The N-Gain test is differentiated into N-Gain score and N-Gain percent. The N-Gain score statistical results are presented in Table 5.

Table 5. Descriptives statistics N-Gain percent

Description statistics			Statistic	Std. Error
N-Gain percent	Mean		54.8138	4.56262
	95% Confidence	Lower bound	45.4521	
	interval for mean	Upper bound	64.1755	
	5% Trimmed mean		55.1591	
	Median		51.8839	
	Variance		582.891	
	Std. Deviation		24.14313	
	Minimum		6.39	
	Maximum		94.69	
	Range		88.30	
	Interquartile range		28.93	
	Skewness		0.190	0.441
	Kurtosis		-0.480	0.858

According to the output table of the N-Gain percent descriptive statistics, the mean value of the N-Gain percent is 54.81%. The effectiveness interpretation for this value is that the FMS is proven to be less effective for increasing metacognitive awareness in reading because it is in the range of 40-55%. However, this flipped metacognitive has the potential to increase metacognitive growth in reading if it is applied

continuously and an evaluation of the implementation of the strategy is carried out. FMS is a form of learning strategy that combines metacognitive strategies with flipped classrooms. This effort was made as a way to vary the use of e-learning in learning. This initiative also encompasses innovative methods and approaches aimed at enhancing students' metacognitive skills. Innovations carried out in learning also train students in solving problems [25] and metacognitive processes are key factors in problem-solving skills training [37]. Students also need to build a learning atmosphere that is conducive to learning because a positive mood can increase cognitive flexibility [38]. In addition, metacognitive development is also very dependent on the learning experiences of students [39].

In this study, it appears that students who experience metacognitive growth depend heavily on their experiences. Students who like to read and who do not like to read have different levels of metacognitive awareness. Students have different experiences in using reading strategies and have different problem solving efforts in dealing with problems in reading comprehension. Students possessing a high degree of metacognitive awareness have a greater understanding of the elements that enhance reading comprehension and are more capable of reducing factors that hinder reading. The growth of students' metacognitive awareness in reading also seems to have increased after implementing the FMS. Flexible learning activities created both at home and in educational institutions offer students the chance to discover their own reading strategies.

Additionally, the implementation of reflective journals as a means to track the progress of student learning contributes to enhancing metacognitive awareness. As is known, reflective journals record learning experiences and record problem-solving efforts in completing cognitive tasks [40], especially reading. Through reflective journals, in general, teachers can find learning experiences and independence in using strategies and efforts to solve problems. Students' metacognitive growth in reading takes time and the teacher plays an active role in helping students develop their metacognitive from time to time. In addition to using metacognitive strategies, teachers can also use a variety of media, variations, and feedback according to students' learning needs to optimize learning outcomes. Professional teachers are those who can cultivate the full potential of their students by employing a range of strategies and innovative approaches in the learning process.

4. CONCLUSION

The FMS has the potential to increase students' metacognitive awareness in reading. Students can study independently and use a variety of reading strategies to understand learning content. The integration of metacognitive strategies with the flipped classroom approach provides students with a more flexible opportunity to enhance their metacognitive awareness. Through independent learning, students acquire the appropriate strategies for reading, understand how to address reading challenges, and recognize the elements that can enhance their reading abilities. In its application in language learning, the teacher plays a very important role. Teachers must often introduce students to various learning strategies that can be used in reading and always expose students to problem solving efforts to train their metacognitive skills. In this instance, metacognition is regarded not as the conclusion of learning objectives but as a chance to impart knowledge and beliefs that empower students to oversee their learning autonomously. Students are not only expected to be able to know about strategies, when and how to use strategies but also know various problem-solving efforts and factors that can support their academic success, especially in reading. To increase students' metacognitive awareness in reading, a teacher must better understand students' thinking processes in an effort to understand the text. Always increasing students' metacognitive awareness in reading is the main thing that must be done by the teacher. Students must always use metacognitive strategies because the development of metacognitive skills is very dependent on individual efforts.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

This article was written with the mutual agreement of all authors and there is no conflict of interest in publishing this article.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available in the referenced articles and are all included in the reference list.

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