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Fun Learning Science with the GIReSiMCo Model to Promote Students' Critical Thinking Skills

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ABSTRACT

The cultivation of thinking skills is paramount for students, as it equips them with the intellectual tools necessary to navigate and thrive in the complexities of life. The development of these competencies can be facilitated by implementing a learning model that aligns with the characteristics inherent to the scientific discipline. A one-semester study was conducted to determine the effect of the learning model GIReSiMCo (Guided Inquiry, Reading, Sharing, Mind Mapping, and Communication) on students' critical thinking skills. The quasi-experimental research design encompassed 126 eleventh-grade students and employed a nonequivalent pretest-posttest control group. The sample of 126 students was selected from a total population of 300 students. Two types of data were collected: first, students' critical thinking skills were evaluated using essay tests; and second, students' fun learning science (FLS) was assessed using questionnaires. The critical thinking skills data were analyzed using the ANCOVA test, while the FLS data were analyzed using the ANOVA test. The study's findings indicated two notable results. First, students in the GIReSiMCo course demonstrated higher levels of critical thinking skills compared to students in the other courses. Second, the present study identified a significant discrepancy in FLS scores between students in the GIReSiMCo group and students in the comparison group. Specifically, the GIReSiMCo group demonstrated higher scores compared with students in the traditional learning group. Consequently, it can be posited that the GIReSiMCo learning model enables students to think critically. Furthermore, the GIReSiMCo model fosters a positive attitude towards learning activities, contributing to an overall positive learning experience. It is recommended that this model be applied in science learning.

Keywords: critical thinking, fun learning, mind mapping, reading

INTRODUCTION

The main goal of the educational process in schools is to develop students' cognitive abilities, especially their capacity for critical thinking. Critical thinking is seen as a vital skill because it provides students with the tools to tackle modern issues effectively. Not only is critical thinking essential for problem-solving, but it is also key to planning future activities successfully. The many changes in 21st-century life make it necessary for students to sharpen their critical skills, allowing them to evaluate information from various sources and make better decisions [1]. In schools, consistently teaching critical thinking skills has been shown to promote independent learning. Furthermore, strengthening these skills positively impacts other areas of learning, such as cognitive outcomes [2], collaboration, communication [3], and creativity. Other researchers discovered that activities like discovery-based modules help optimize students' critical thinking abilities [4].

Students' ability to engage in critical thinking can be influenced by their enjoyment of learning [5]. Learning activities are designed to make students feel comfortable and enthusiastic. Previous studies have shown that breaks in learning, such as ice-breaking, positively impact learning outcomes [6]. When combined with the brain's capacity for enthusiasm and joy, the mind becomes more skilled at analysis and decision-making. The concept of "radiant thinking," as previously described [7] suggests that the brain can effectively connect diverse concepts radially and systematically when in a radiant state. This improved cognitive state has been shown to foster creativity in students, as evidenced by the findings of [8], and to generate numerous solutions to life's challenges.

However, extraneous factors may impede the development of intrinsic motivation. Examples of such inhibitors include peer bullying, minimum standard report card grades, and learning activities perceived as monotonous by the students [9]. Consequently, educators must meticulously craft engaging learning activities by employing learning models tailored to students' circumstances, thereby demonstrating a commitment to cultivating critical thinking skills. GIReSiMCo, a learning model designed for science instruction, exemplifies this commitment. This model has previously been shown to stimulate students' science process skills [10]. The present study has two

objectives: to ascertain the impact of implementing the GIReSiMCo learning model on the critical thinking skills of high school students, and to determine the response to the pleasure experienced by students with the learning model.

RESEARCH METHODS

This study is a quasi-experimental study of high school students with a nonequivalent pretest-posttest control group design. The participants involved consisted of 126 eleventh-grade students who had selected mathematics and natural science as their academic majors. The student study groups were randomly selected from two different schools, namely a public school and a private school. It is noteworthy that both schools possess equivalent accreditation predicates and are situated within the same district. The total number of groups from both schools was four, which were then divided into two large groups. The first group constituted an experimental class that followed biology learning with the GIReSiMCo model, while the second group served as a comparison class that followed learning with the model usually applied by the previous teacher (conventional model). The population of this study comprised 330 eleventh-grade students majoring in Mathematics and Natural Sciences from both schools. The sample comprised 126 students, selected using random sampling techniques. This process entailed selecting two classes from four classes at a public school and two classes from three classes at a private school.

The research instrument is divided into two distinct types of tests. The initial instrument employed is the Watson–Glaser Critical Thinking Appraisal (WGCTA) critical thinking skills test [11]. The instrument under consideration was developed in the form of a written test consisting of 30 questions, with details provided in Table 1. The thirty questions have been determined to be valid from the forty questions that were previously compiled. The validity of these questions was assessed by evaluating forty instrument items in other educational institutions, excluding research schools. The validity value of these questions was then subjected to analysis using the Pearson Product-Moment formula, a method that declares a question as valid if the significance value (2-tailed) is less than 0.05.

Table 1. Critical Thinking Instrument Grid

Aspect of Critical Thinking	Number of Items
Inference	5
Recognition of Assumptions	6
Deduction	6
Interpretation	5
Evaluation of Arguments	8
Total	30

Each question answered correctly by respondents was assigned a score of one, while a score of zero was assigned to questions answered incorrectly. To ascertain the value of students' critical thinking skills, the subsequent formula was employed for analysis.

$$\text{The value} = \left(\frac{\text{Total score}}{30}\right) \times 100$$

The solution to the initial research objective, which sought to ascertain the impact of the implementation of the GIReSiMCo learning model on critical thinking skills, was then analyzed using the ANCOVA test. The analysis was initiated with a prerequisite test in statistics, namely the normality and homogeneity test of data.

The second tool used is a Likert scale, which is employed to measure students' enjoyment levels related to their engagement in science learning. The tool includes 10 items based on the learning fun indicators presented [5]. These items are derived from six aspects of learning fun: delight, autonomy, immersion, challenge, stress, and the removal of social barriers in biology learning. The scale ranges from one to five, with one indicating the lowest and five the highest levels of engagement. Responses to the second research objective, which relates to students' enjoyment of the GIReSiMCo learning model, were analyzed by calculating the average score for each element of learning enjoyment.

RESULT AND DISCUSSION

The result of the descriptive analysis of the pre- and post-test data on critical thinking skills from two groups of different learning model applications is displayed in Table 2.

Table 2. The Result of Descriptive Analysis of Posttest

Models	Number of students	Min Score	Max Score	Mean	Standard Deviation
GIReSiMCo	65	5.67	90.00	75.33	9.22
Traditional	61	6.67	83.33	63.83	8.75

As illustrated in Table 2, the mean value of the GIReSiMCo group (75.33) exceeds that of the comparison learning group (63.83). In addition to conducting a descriptive analysis of the post-test data, the data distribution (i.e., data normality) and data homogeneity were also analyzed as prerequisites for further testing (ANCOVA). The findings from these analyses are summarized in Table 3.

Table 3. The Result of the Normality Test and Homogeneity of Variances

Posttest	Tests of Normality				Tests of Homogeneity of Variances			
	Kolmogorov-Smirnov				Based on Mean			
	Model	Statistic	df	Sig.	Levene Statistic	df1	df2	Sig.
	Traditional	0.113	61	0.073	0.571	1	124	0.451
	GIReSiMCo	0.112	65	0.044				

The results of the ANCOVA prerequisite test analysis indicated that the normality of the data from the two groups was not equivalent. Specifically, the classic learning group demonstrated a normal distribution, whereas the GIReSiMCo group exhibited a non-normal distribution.

The results of the analysis with ANCOVA, which was conducted to ascertain the impact of the GIReSiMCo learning model on critical thinking skills, are presented in Table 4.

Table 4. The Result of Ancova Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4355.554[a]	2	2177.777	27.198	.000
Intercept	31422.658	1	31422.658	392.441	.000
Pretest of Critical Thinking	188.097	1	188.097	2.349	.128
Model	4096.554	1	4096.554	51.162	.000
Error	9848.593	123	80.070		
Total	627411.290	126			
Corrected Total	14204.147	125			

At a confidence level of 95%, it is indicated that the model's significance value is 0.00. This value is less than the value of α = 0.05 that was utilized in the data analysis design. Hence, it can be concluded that the GIReSiMCo learning model has a significant impact on improving students' critical thinking skills in learning.

FLS data is displayed in a different way than critical ranking skills data. As illustrated in Figure 1, the data from the Likert scale is presented in a manner that describes the FLS conditions of the GIReSiMCo learning model group, and it is compared to other data sets. As demonstrated in Figure 1, the data reveal that students who utilized the GIReSiMCo learning model exhibited higher mean values in all six components of FLS when compared to the conventional learning model. In the GIReSiMCo group, all aspects exhibit an average scale value of 4, while in the traditional group, these values are three.

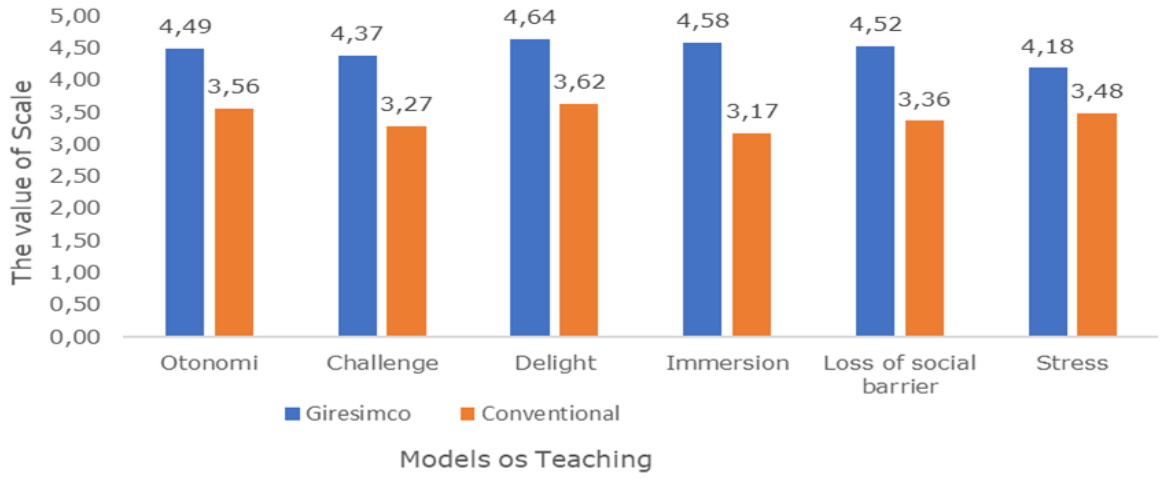

Figure 1. FLS Data for Both Learning Groups

The capacity for critical thinking is an attribute that students can develop throughout the learning process. The efficacy of their success in learning is determined by various factors, with the pedagogical model employed by the instructor being a salient one. The present study sought to examine the impact of GIReSiMCo on students' success, with a particular focus on critical thinking. A comparison of classic learning methods and those carried out by the students in the GIReSiMCo learning group reveals that the students in the GIReSiMCo learning group adhere to the learning process through a series of activities carried out in stages.

In addition to the learning model factor, the intrinsic motivation possessed by students has also been demonstrated to contribute to critical thinking skills. Conversely, other experts posit that students who are intrinsically motivated will transform learning into a fun activity, thereby increasing critical thinking scores [12]. The GIReSiMCo learning model, as implemented in this study, measures the fun of learning through six different elements: autonomy, immersion, challenge,

stress, loss of social barriers, and delight in the learning process. These elements are experienced by the students in the stages of learning the GIReSiMCo model. The model commences with the exploration of a phenomenon, followed by the formulation of questions and the initiation of an investigation. This investigation begins with planning, reading, and analyzing the data, and is followed by the sharing of findings. The sharing stage is preceded by mind mapping. The final stage is communicating new knowledge.

GiReSiMCo is an inquiry-based science learning model that integrates additional activities such as reading, mind mapping, and sharing. Its contribution to developing critical thinking skills relies on a series of mutually supportive strategies. The approach starts with exploring a phenomenon, where students use their five senses to gather information directly from the environment and observe objects. This information is then processed and compared to existing memories stored in the brain. If the new information aligns with old memories, it strengthens those memories. If it does not, cognitive conflict occurs, prompting students to question what they have observed. Asking questions is the second stage in this learning model. The act of posing questions in the GiReSiMCo model supports other research that shows asking questions can enhance students' critical thinking skills [13].

The subsequent phase involves conducting an investigation, which is initiated using planning. This step constitutes an activity that engages students as a collective. Conducting an investigation is the optimal stage for finding answers to questions. In line with cognitive learning theory [14], the information acquired during the learning process is more likely to be retained in long-term memory, particularly when it is obtained through direct experience. This process of transformation of information into a meaningful experience is a hallmark of effective learning. A substantial body of research has demonstrated that investigative activities play a pivotal role in the cultivation of critical thinking skills [15]. Conducting investigations for students enrolled in the GIReSiMCo class constitutes an activity that necessitates their encounter with challenges. They conducted investigations with delight, actively engaged in the activities, and became so absorbed that they lost track of time. This contrasts with the experiences of students in the conventional group.

The reading step in the GiReSiMCo learning model aligns with prior studies [16] that report the efficacy of reading in empowering critical thinking skills. Concurrently, students who exhibit proficient reading habits exhibit a positive and significant relationship with their academic learning outcomes in school [17]. The results of another study [18] revealed that when reading seriously, the mind focuses on the content of the reading, thereby diverting attention away from the stress and problems faced. The Giresimco learning model underscores the multifaceted role of reading in cultivating critical thinking skills and enhancing learning outcomes. It also fosters creative thinking skills, as exemplified by mind-mapping activities. In this regard, students are expected to comprehend and accurately identify the information derived from the referenced materials, subsequently determining the pertinent keywords in the reading material.

In the GiReSiMCo model, the sharing step takes place in small groups of four to five members who discuss the results of the investigation. The contribution of sharing activities to critical thinking in this study corroborates the findings of previous research [19], which presented that discussion in small groups is a process to strengthen critical thinking skills. In this context, students who encounter difficulties in comprehending independently can overcome these challenges by receiving feedback and input from their peers within the group. In terms of fostering a sense of fun learning, Figure 1's data indicates that group discussions can effectively mitigate social barriers in the classroom, thereby fostering a sense of ease and familiarity among students.

However, the retention time for all information obtained through investigation, reading, and discussion is limited. In the GIReSiMCo learning model, this problem is addressed by creating mind maps. Mind maps are visual representations that combine elements of critical thinking and the art of drawing, in which keywords from investigation, reading, and discussion activities are connected through lines or symbols [7]. In this context, mind maps function as a medium for note-taking and imaginative creative expression that utilizes lines, colors, and symbols to connect keywords. According to the principles of cognitive learning theory, visual media are more effective than written language for retaining information. Based on the data in Figure 1, students in the GIReSiMCo group had higher FLS scores than their comparison class. Students in this group received an exciting challenge because they were allowed to express themselves artistically by drawing, making biology learning a fun activity. Research conducted [20] revealed that drawing is an effective way to reduce depressive emotions

The culminating step in the GIReSiMCo educational process is communication. The objective of this stage is to present the results of group work. In this stage, students are trained to argue and develop ideas orally. The findings of this study corroborate other research, as reported [21], which indicated that presenting assignments and defending arguments can enhance critical thinking skills. The present study found that the critical thinking skills of GIReSiMCo class students exhibited an average score that surpassed that of conventional class students. Moreover, in terms of students' fun in learning science, communication can remove social barriers, challenging them to communicate arguments so that they can evaluate their thinking skills.

CONCLUSION

This study shows that implementing fun learning through the GIReSiMCo model significantly improves students' critical thinking skills in biology. These critical

thinking skills are supported by various aspects of Fun Learning in Science (including delight, autonomy, immersion, challenge, stress, and the removal of social barriers) experienced by students while learning with the GIReSiMCo model. The level of achievement of these aspects is proven to be higher compared to students who learn biology using conventional models. This indicates that the GIReSiMCo model, which integrates various learning activities oriented towards increasing the enjoyment of learning science, is effectively able to improve students' critical thinking skills.

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