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Analysis of the Effectiveness of the Literacy-Orientation-Collaboration-Reflection (LOC-R) Learning Model in Science Learning Activities of Islamic Elementary School Students

Suhendra Iskandar

Ibtidaiyah Teacher Training Program, IAIN Sultan Amai Gorontalo, Gorontalo, Indonesia
E-mail: Suhendra_iskandar@iaingorontalo.ac.id

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Abstract: Unlike other learning models, the LOC-R learning model focuses on literacy in learning material so that no single learning objective is neglected. However, the learning concept still relies on student-centered learning (SCL). This research examined the effectiveness of the LOC-R learning model (literacy, orientation, collaboration, and reflection) in science learning activities for Madrasah Ibtidaiyah Teacher Education IAIN Sultan Amai Gorontalo students. The research used a learning model focusing only on lecturers' lectures and a learning model concentrating on students' independent presentations as a control group. Three learning materials were selected for the science learning activities, two for the control group (one-way lecture and presentation) and one for the test group, assessed as having the same difficulty level. The success of learning activities is evaluated in two aspects: learning outcomes and student interest in learning. To test the learning outcomes of each group, a pre-test was carried out at the beginning of each learning activity and a post-test at the end of each learning activity for the three groups. Then, the results were analyzed using the N-gain test technique. In addition, a semi-quantitative analysis of students' learning interests was also carried out through questionnaires. The results obtained were that the LOC-R learning model was proven to improve student learning outcomes as seen from the N-gain value of 87.4035%, which was much greater than the control group, where the one-way lecture method only produced an N-gain value of 39.5127% and the presentation method produced an N-gain value of 45.6645%. However, based on the questionnaire given to students who took the LOC-R learning model test, not all showed positive interest, with 50% of students rating it positively, 13.64% rating it neutral, and 36.36% rating it negatively. From this research, researchers can conclude that the LOC-R learning model has proven effective in improving student learning outcomes. However, there is still a need to think about ways to package the learning model innovatively so that it can be popular with all students.

Keywords: Learning Interests; Learning Outcomes; LOC-R; N-Gain Test; Science Learning.

Introduction

According to Law Nu. 20 of 2003, education is a conscious and planned effort to create a learning environment and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, as well as the skills needed by themselves, society, the nation, and the state [1]. Education is solely to cultivate and develop the talents and potential possessed by students through a series of learning activities. [2]. Determining the appropriate tools and methods for conducting the educational process is essential. Different tools and methods will significantly determine the effectiveness and efficiency of the educational process [3]. However, sometimes, a particular teaching method or model that is considered successful when applied to a specific group of students turns out to be unsuitable when applied to another group of students. [4]. Therefore, in this case, a teacher's sensitivity is required in choosing the correct teaching method or model to be applied in their classroom.

The jigsaw cooperative learning model effectively taught mathematics to Class VIII B students at SMP Negeri 1 Kota Sorong in 2019/2020. However, students still complained about the lack of time for the teacher to explain the material in detail, as this learning model was mainly used for guided practice [4]. The discovery learning model attempts to enhance the teacher's role as the key to students' knowledge, where the learning process is directed according to the student's interests [5]. Kristin (2016) conducted a study to test the effectiveness of the discovery learning model for science subjects among fourth-grade students at SD Negeri 1 Ngombak, SD Negeri 1 Kalipang, SD Negeri 3 Sungai Ambawang Kubu Raya, and fifth-grade students at SD Negeri 2 Karangharjo in the academic year of 2014/2015. The results were satisfactory [6]. However, this learning model strongly emphasizes the learners' prior learning experiences, so the more diverse these experiences are when learning begins regarding a topic to be discussed, the more difficult it will be for learners to achieve optimal results in their learning [6,7]. Djonomiarjo (2019) studied the effectiveness of the problem-based learning model in economics social studies for tenth-grade students at SMK Negeri 1 Patilanggio. The results showed that the problem-based learning model improved students' learning outcomes. The main reason is that high-achieving students inevitably help their lower-achieving peers within the same group to ensure group work success. This makes the learning activities more effective because lower-achieving students often experience

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a "reluctance to ask the teacher." With other sources of information from their higher-achieving classmates, who are more accessible, they can better understand the learning material. However, this also raises an issue when students' skill levels within a group are different. High-achieving students tend to feel burdened by their lower-achieving peers, making it more difficult to improve their abilities. [8]. Of course, this is not the essence of the problem-based learning model because problem-based learning is essentially a learning model designed to directly guide students in applying the theories they have acquired during learning activities to solve real-world problems. [9]. Unfortunately, this is often the case in practice, including in the class studied by the researcher.

It is very difficult to choose a suitable learning model for students. Trying to cover up a deficiency in a certain learning activity often creates another gap. There are many factors to consider when selecting an appropriate learning model, such as the characteristics of the students, the capabilities of the educator, accessible learning media, educational goals, learning material, the educational environment, and many others. [3]. The teacher's choice of an appropriate learning model is the most significant factor in determining learning success. This influences the learning environment and the student's readiness to receive the learning information [10].

Let's revisit the concept of learning activities. They are essentially just the process of delivering information, which is the learning material, from the teacher to the students. The learning model is a mechanism designed to facilitate this information delivery by selecting the most appropriate learning media [11]. It sounds easy, but delivering information that can be fully understood by all students is a very challenging achievement. There are various causes of learning difficulties in the classroom, including intelligence, interest, talent, personality, and many others [12]. LOC-R is one of the learning models that provide students with the opportunity to explore various knowledge through literacy activities, stimulates students to think critically by presenting various problems or prompting questions, facilitates students in discussing and solving problems based on prior knowledge and the results of the literacy stage, and conducts learning reflections guided by the lecturer [13]. Literacy can be defined as the skill of understanding gained through reading, which helps develop abilities that are beneficial for life [14]. The skills of reading and writing information obtained from reading represent the most basic level of literacy [15].

Unlike other learning models, the LOC-R learning model emphasizes the comprehensive literacy of learning materials so that no learning objective is overlooked, as the lecturer provides all reading materials for the students to read. However, the learning concept still relies on student-centred learning (SCL). By doing this, it is hoped that students will be able to understand the learning objectives more thoroughly and in detail and apply them to real-world problems. This study will examine the effectiveness of the LOC-R learning model (literacy, orientation, collaboration, and reflection) in the science learning activities of students in the Madrasah Ibtidaiyah Teacher Education program at IAIN Sultan Amai Gorontalo.

Research Methods

This study falls into the category of a quasi-experiment. Sugiyono (2014) states that a quasi-experiment is a development of the true experimental design. This design includes a control group but cannot fully control external variables that influence the execution of the experiment [16]. Several factors cause the difficulty in eliminating distortion when creating instruments in social research, whether they come from the sources, situational factors, measuring tools, or the internal factors of the instrument itself, such as ambiguity, respondents' difficulty in understanding the language, triggering emotional responses from the respondents, and many others [17].

Normality and homogeneity tests on the data must be performed to determine whether the analysis will be conducted using parametric or non-parametric methods. A Kolmogorov-Smirnov test assesses data normality [18], while a variance equality test evaluates data homogeneity [19]. The Kruskal-Wallis test is selected as a non-parametric test to determine whether there are significant differences among the data groups [20]. Here are the formulas:

$$D = \text{maks } |F_0(x) - S_n(x)| \quad [18]$$

$$F = \frac{S_B{}^2}{S_K{}^2} \quad [19]$$

$$H = \frac{12}{N(N+1)} \sum_{t=1}^{k} \frac{Rt^2}{n_t} - 3(N+1) \quad [20]$$

The study to test the effectiveness of the LOC-R learning model in science learning activities for the PGMI 4C class at IAIN Sultan Amai Gorontalo in the academic year of 2023/2024 was conducted using learning models that focus only on lecturer lectures and students' self-presentations as control groups. The steps of the learning activities in this study can be seen in Table 1.

Three learning materials were selected for the science learning activities to be applied, two for the control group (one-way lectures and presentations) and one for the test group (LOC-R learning model), which were assessed as having the same difficulty level. The learning materials were "Classification of Living Things" for the one-way lecture as control group 1, "Plants" for the student's self-presentation as control group 2, and "Animals" for the LOC-R learning model as a test group. It is summarized in Table 2.

The success of learning activities is assessed in two aspects: learning outcomes and students' interest in learning. To test students' learning outcomes for each treatment, a pre-test is conducted at the beginning of each learning activity and a post-test at the end for all three groups. The results are then analyzed using the N-gain test technique. Detailed criteria for categorization of N-gain effectiveness interpretation can be seen in Table 3 [21].

$$\text{N-gain score} = \frac{\text{N posttest} - \text{N pretest}}{\text{N maximum} - \text{N pretest}}$$

To assess students' interest in learning, each student is given a questionnaire to honestly express their opinions regarding the strengths and weaknesses of each learning activity format. They also rate their interest level numerically from 0 to 10, where 0 indicates very little interest, and 10 indicates very high interest.

Table 1. Steps of LOC-R Learning Activities

Steps	Action
Introduction	Students are given a pre-test and an advance organizer in the form of prompting questions.
Literacy	Students are given time to read the learning materials. The prompting questions asked at the beginning will be crucial in directing students to fully understand the learning objectives, which will be their focus in conducting literacy studies.
Orientation	The lecturer engages in a question-and-answer session related to the main ideas about the topic covered in the learning materials.
Collaboration	Students form small groups to exchange ideas about their understanding of the learning materials to deepen and broaden their knowledge of the subject matter.
Reflection	Students and the lecturer summarize the core knowledge gained in the learning activities, review the materials individually, and transform that knowledge into real-life contexts. Finally, a post-test is conducted.

Table 2. Research design

Group	Pre-Test	Post-Test
Experiment (LOC-R)	A1	B1
Control 1 (One-Way Lectures)	A2	B2
Control 2 (Students' Self-Presentation)	A3	B3

Table 3. Criteria for categorization of N-gain effectiveness interpretation

N-gain value (%)	Interpretation
<40	Ineffective
40-55	Less effective
56-75	Effective enough
>76	Effective

Results and Discussion

Learning models fundamentally rely on two major theories: behaviourism and constructivism. Behaviourism is concerned with various efforts to modify learners' behaviour, while constructivism is concerned with multiple efforts to change learners' thought patterns [22]. LOC-R itself falls within the realm of constructivist learning models. Instead of teaching specific habits, LOC-R focuses on habituating learners to a learning behaviour pattern.

The LOC-R learning model, which emerged in 2018, was initiated by Nuansa Bayu Segara based on social constructivism and Vygotsky's socio-cognitive theory. It was initially developed for geography subjects [23]. However, this learning model is now commonly applied to other subjects such as history, sociology, and economics [24], including article review activities in university research methodology classes [25]. This learning model includes the steps of literacy, orientation, collaboration, and reflection, making it highly effective in enhancing students' literacy skills. However, educators must understand their roles well and know when to act as mentors, collaborators, mediators, or facilitators during learning activities [26]. Effrisanti (2023) reported that this learning model was also successfully applied to students with medium to low literacy skills [27].

The foundation for every successful learning activity is when it enjoyably takes place [28]. That's why planning for each learning activity should be flexible according to the classroom atmosphere at that time while still adhering to formal frameworks in general terms [29]. The environment is deliberately built positively to relax students during the learning process. This is crucial to foster their critical thinking skills, which will thrive best in a comfortable atmosphere [30].

Students Learning Outcomes

To measure the effectiveness of the LOC-R learning model in science learning activities compared to two other control groups (one-way lecture and student self-presentation), a pre-test was conducted at the beginning and a post-test at the end of each learning activity for the experimental and control groups. The results obtained are shown in Table 4.

Table 4. Pre-test and post-test results of students in learning activities for each data group

Group	Pre-test		Post-test	
	Mean	D-max	Mean	D-max
One-way Lectures	24.3182	0.2285	53.5	0.1345
Students' Self-presentation	26.5	0.1131	59.7727	0.1980
LOC-R	27	0.2273	90.8182	0.1354

Conducting a normality test for each dataset is important to determine whether it is usually distributed. This is crucial because normally distributed data allows for valid conclusions to be drawn from statistical analyses. The researcher used the Kolmogorov-Smirnov test to compare the D max obtained from calculations against the critical D value (D table). If D max $\leq$ D table, the data is usually distributed. Conversely, if D max > D table, the data is not normally distributed. The critical D value (D table) for a sample size (n) of 22 with a significance level of 5% is 0.281 [18]. It is noted that none of the D max values from the six datasets exceeded the critical D value (D table), indicating that all six datasets are normally distributed and suitable for data analysis. Furthermore, it is important to

ensure that the pre-test data in both the LOC-R model experimental group and the one-way lecture and students' self-presentation control groups are homogeneous. This ensures that students were in nearly the same condition before the learning activities began despite the pre-tests in each group being conducted on different days. The variance equality test showed that F calculated = 3.2311 > F table = 2.685 [19]. This indicates that the assumption for conducting parametric tests is not met, thus requiring non-parametric tests. In this case, the researcher chose the Kruskal-Wallis method to test the homogeneity of the data [20]:

It is obtained by arranging all data from smallest to largest, then ranking them where the smallest gets rank one and the largest gets the last rank. Next, the sum of ranks for each group is squared, divided by the number of data points, and summed across groups. Finally, any remainder follows the formula where N is the total number of data points. From the manual calculation, the calculated H-value is 0.5398. This value is then compared with the critical H-value from the table. It's important to note that when the calculated H-value $\leq$ the critical H-value, it can be concluded that the data groups do not differ significantly.

Conversely, suppose the calculated H-value > the critical H-value indicates a significant difference between the data groups, for df=2 (df = degrees of freedom, equal to the number of data groups – 1 or variants – 1) and with an error rate of 5 %. In that case, the critical H-value is 5.991 [31]. Since the calculated H-value is less than the essential H-value, it can be concluded that the data groups do not differ significantly. It proves that students participated in all three learning activities (one-way lecture, student self-presentation, LOC-R) under somewhat similar conditions, thus it can be assumed that there was no data bias considering the students' conditions.

The time has come for us to measure the effectiveness of the LOC-R learning model in improving students' learning outcomes compared to lecture and presentation methods. Here, we will use the N-gain test technique. The n-gain test or normality gain test is a test that provides a general overview of the improvement in learning scores before and after a particular model is applied [21]. The n-gain test determines enhancement in students' learning outcomes after specific treatments. Usually, this improvement will be measured by comparing pre-test and post-test scores obtained by learners. As for N-gain is the comparison between the actual gain score and the maximum possible gain score [32]. The actual gain score is the exact difference between the post-test and pre-test scores, while the maximum possible gain is the maximum difference between post-test and pre-test scores, which learners can obtain when they can get a maximum score on the post-test [33, 34].

Now, it's time to analyze the learning outcomes in data collected from these three learning activity experiments. The average N-gain value can be determined by comparing the difference between the post-test scores and the pre-test scores to the difference between the maximum post-test scores and pre-test scores expressed in percentage terms. The results can be seen in Table 5.

Table 5. N-Gain Score Rate Results for Each Data Group

Group	N-Gain Score Rate (%)
One-way Lectures	39.5127
Students' Self-presentation	45.6645
LOC-R	87.4035

For the control group, where the lecturer conducted learning activities focused solely on lectures, the N-gain value is 39.5127%, which falls into the ineffective category based on the data in Table 4. Therefore, based on the learning outcomes, it can be concluded that teaching activities focused solely on lectures produce ineffective results.

For the other control group, where the learning activity involved students presenting independently with minimal explanation from the lecturer, the N-gain was 45.6645%. According to the data in Table 4, this interpretation falls into the less effective category. Therefore, it can be concluded that the learning activity where the lecturer only instructed students to present independently to discuss the learning material resulted in less effective outcomes.

Now, let's look at the learning model that is the focus of our discussion, LOC-R. According to Table 5, the N-gain value is recorded at 87.4035%. Based on the data in Table 4, this value falls within the range of practical interpretation. Therefore, the LOC-R learning model is proven effective in improving student learning outcomes.

Students' Interests in Learning

Good learning outcomes do not always reflect the success of a learning activity. It's crucial to ensure that these good outcomes do not result from excessive pressure on students, demanding them to perform perfectly. Consequently, such learning activities would be futile as the knowledge gained does not stem from their genuine desire to learn, making it only short-term memory for them, which they will quickly forget.

Although LOC-R is a literacy-based learning model, which might seem more suitable for subjects like social or language studies that require memorization, it doesn't mean that this model has never been applied to science-based subjects. Many studies have implemented it in subjects like mathematics, often considered the queen of sciences. One such study was by Anastasia et al. in 2024, which showed positive results [35]. In the context of science subjects, Tuasamu et al. (2024) applied the LOC-R learning model in their research on the topic of Photosynthesis, and it also showed positive results [36].

Table 6. The data on student interest levels rate and favoritism towards the three forms of learning activities, ranging from a scale of 0 (very uninterested) to 10 (very interested)

Group	Mean	Number of Students Favoring (%)
One-way Lectures	7.1364	13,64
Students' Self-presentation	7.9091	22,73
LOC-R	8.1364	50

Table 6 illustrates students' interest levels towards the three forms of learning activities, expressed on an interval scale. At a glance, based on the mean values, it is evident that the LOC-R learning model received the highest student interest with an average interest score of 8.1364 out of 10, followed by the presentation method with an average interest score of 7.9091 and lastly, the lecture method, which garnered the lowest average interest score of 7.1364.

However, let's test the data using the Kruskal-Wallis equation. The researcher skips the steps of normality and homogeneity tests here because, unlike the previous interval data assessed by the researcher alone, the current interval data comes from questionnaires filled out by several different individuals. Each individual's assessment is unique, making the data potentially have ordinal characteristics. Therefore, parametric analysis is not feasible, and non-parametric analysis is required. Based on manual calculations, the calculated H-value is 1.5178, less than the critical H-value of 5.991. This result indicates that there is no significant difference in student interest among the three learning activities tested.

Upon deeper personal investigation into each student, I found that not all of them perceive LOC-R learning as the best among the three tested learning activities despite LOC-R having the highest average interest rating. Only 50 % of students rated LOC-R as the best learning activity. As many as 13,64 % of students preferred one-way lectures, and 22,73 % preferred students' self-presentation, while the remaining students chose to remain neutral.

The researcher also attempted to understand why these few students did not choose LOC-R. Unfortunately, almost all students did not answer the question, so the researcher could only obtain two responses. One of the students mentioned that the LOC-R learning model was too mentally draining due to a sense of 'compulsion' to read the materials in class. Another student noted that it requires a high level of self-awareness to understand what is being read, as not everything can be easily comprehended. The researcher recalled a learning system in South Korea where students are 'forced' to engage in independent study once a week. Despite being called independent study, teachers supervise the students' learning, leaving the students with no choice but to study. The researcher feels the LOC-R learning model resembles this South Korean independent study system. While LOC-R has succeeded in improving student learning outcomes, many students in this experiment were questioned about their interest in this learning model. We must not ignore student interest and focus solely on learning outcomes, which could lead to more significant issues such as stress or mental pressure. The LOC-R learning model is effective, but we should not disregard the opinions of minority students who find the learning steps challenging, especially when it requires independent reading where not all students have strong memory retention abilities. However, some students support the LOC-R learning model, finding that it helps them focus more on the learning material because there is a basic reference material, and they can see the rest online or through discussions with fellow students.

For the other form of learning activity, namely the one-way lecture method, some students support it because the material is presented comprehensively with detailed explanations from the lecturer. However, some students dislike it due to the one-way communication causing boredom, and many tested students tend to be hesitant to ask questions directly to the lecturer.

As for the presentation method, supportive students argue that it helps them practice public speaking and encourages them to explore new knowledge. On the other hand, students who do not like it tend to find it difficult to understand the material because the lecturer does not explain it; the workload is highly demanding in various aspects, as most presentation methods require students to form groups where conflicts arise over task allocation due to the unique characteristics of group members; it becomes very challenging when dealing with lazy group members; interaction with the lecturer is reduced as they act only as facilitators, which affects the comprehensiveness of the material coverage.

Conclusion

Based on the research findings, the LOC-R learning model effectively improves student learning outcomes. However, innovations still need to be considered to make learning activities truly stimulating for students rather than imposing them as obligations. This could lead to even more significant adverse effects.

In this instance, researchers expressed the need for further exploration of the LOC-R learning model to discover universal methods for naturally making reading activities enjoyable, particularly in the Literacy phase of the LOC-R learning model.

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