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Enhancing Scientific Literacy Through Guided Discovery with SELWAN Application in Science Learning

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Abstract. Scientific literacy is one of the crucial skills in digitalization era. Scientific literacy is one of parameters in International Student Assessment Program (PISA). Indonesia was still far from the average PISA assessment. Pupils' scientific literacy abilities are now judged to be at a poor level. The major goal of this study is to know the effectiveness of using the guided discovery with the SELWAN app in improving pupils' scientific literacy. This research used a non-equivalent control group design and was a quasi-experiment. During the school year 2022-2023, this inquiry was carried out at Nazhatut Thullab Middle School. All seventh-grade pupils from Nazhatut Thullab Middle School are included in the study. The experimental group consists of 25 pupils from class VII E, and the control group consists of 23 pupils from class VII F. For data analysis, the independent sample t-test is used to examine pupils' scientific literacy abilities. The findings show that deploying the guided discovery in conjunction with the SELWAN application has a detectable influence on pupils' scientific literacy. The SELWAN app's guided discovery learning received a resoundingly favorable reaction from pupils, with 81.06% falling into the ideal category.
Keywords: Guided discovery, scientific literacy, APK

Introduction

Scientific literacy is one of the ability that every learner should develop. The International Student Assessment Program (PISA) includes scientific literacy as one of its characteristics. Scientific literacy encompasses an understanding of science as well as science-based technology, each of which has distinct aims, procedures, and outcomes. Technology is concerned with solving human issues, whereas scientific knowledge is focused on finding answers to particular questions about nature (OECD, 2019). Pupils can be taught logical thinking skills through the cultivation of scientific literacy. Scientific literacy is defined as pupils' ability to comprehend scientific processes and apply scientific information in real-world circumstances (Coppy et al., 2023). Scientists believe that scientific knowledge is critical to addressing present and future difficulties, especially educational issues (Aruta, 2023).

Scientific literacy is linked to the understanding of natural phenomena through the process of scientific investigation. Scientific literacy refers to the ability to understand scientific ideas in a meaningful manner, to provide explanations for phenomena based on scientific facts, and to apply this understanding in practical situations (Fausan et al., 2021). Scientific literacy abilities assessed in the Programme for International Student Assessment (PISA) 2018 encompass the ability to accurately describe scientific phenomena, devise scientific research plans, and critically analyze data and evidence using scientific methods (OECD, 2019). These three competencies emphasize that scientific literacy requires more than simply comprehension of scientific concepts and theories; it also includes familiarity with broad scientific methodologies and practices. Consequently, the cultivation of scientific literacy is seen as an essential skill that should be imparted to children.

According to the PISA study findings (2018), Indonesia was rated 74th out of 79 nations, with a scientific literacy score of 396. The score obtained by Indonesia was still far from the average PISA assessment, with an average score of 489. This score also decreased from the PISA assessment (2015). This is one of the factors that causes Indonesia to be in the lowest ranking in the PISA assessment. Empirical evidence indicates that children at Nazhatut Thullab Middle School continue to require classification as scientifically literate with respect to occurrences in their environment. This information was derived from interviews conducted with both junior high school teachers and pupils at the institution. The results of the preliminary assessment on scientific literacy queries, which showed that the level of classical comprehensiveness was at 25%, support this assertion. Pupils' competence in

scientific literacy skills remains relatively low. Pupils' competence in scientific literacy skills remains at a suboptimal level (Hartono et al., 2023).

Based on an interview with the principal of Nazhatut Thullab Middle School and a science teacher, it was found that the lack of scientific literacy skills may be due to the fact that the teaching methods aren't good enough and don't give pupils enough practice answering scientific literacy questions. Pupils are more focused on learning that trains communication skills rather than working on complex thinking skills, including scientific literacy. Knowing that it is still conventional is one of the causes of low scientific literacy in Indonesia (Purnomo et al., 2023). This condition demands changes in science learning to create more effective learning. Educators should practice a learning process focusing on developing complete scientific literacy (Yuliati et al., 2021). One meaningful learning alternative that can be applied to develop pupils' scientific literacy skills is the guided discovery learning model.

Guided discovery learning consistently aligns with prevailing educational trends, signifying its suitability for contemporary educational settings (Gosztonyi & Varga, 2023). Guided discovery learning represents an innovative pedagogical model that can be effectively employed in the modern education landscape. It entails the active involvement of all pupils in a systematic, critical, and logical exploration aimed at uncovering their understanding, attitudes, and competencies, fostering behavioral transformation (Muhali & Sukaisih, 2023). In essence, guided discovery learning denotes a form of discovery-based learning in which pupils take the lead with the guidance of their instructor.

Guided discovery learning may be accomplished through studies or demonstrations that are guided by observations, data, or inquiries offered by the instructor (Muhali & Sukaisih, 2023). This technique seeks to make it easier for pupils to identify concepts and compare them to theories from textbooks. Guided discovery learning technique comprises several fundamental parts, including motivation, issue formulation, data collection, data processing, verification, and closure (Yerimadesi et al., 2023). According to Bruner's paradigm, guided discovery learning encompasses five key stages: 1) Stimulation: The instructor encourages pupils to thoroughly analyze visuals in learning materials and to engage in critical thinking. This first phase enables pupils to extend their viewpoints and experiment with different problem-solving methodologies. 2) Problem Statement: Pupils are asked to identify and articulate difficulties connected to the subject content. This technique encourages pupils to form hypotheses. 3) Data Collection: Pupils do investigative activities or make observations to test the validity of their hypothesis. 4) Data Processing and Verification: The instructor evaluates pupils' replies by asking questions and evaluating their answers, allowing pupils to get a better understanding of the topics they've discovered. 5) Generalizations and Conclusions: Pupils create conclusions based on the facts and information obtained in response to the specified challenges. It is worth emphasizing that guided discovery learning has the potential to improve pupils' academic performance on a variety of topics (Ariani et al., 2022).

Increasing scientific literacy in the age of globalization requires the use of interactive media to motivate pupils to participate in a variety of learning activities. In the digital 4.0 age, interactive media employs current elements (Putra & Salsabila, 2021). Science learning can benefit from the use of Android-based application media. Pupils may swiftly obtain information by displaying content as a combination of text, photos, videos, and interesting animations in application media.

This study presents a novel learning paradigm for enhancing scientific literacy that is supported by Android-based software. Previous research has found that the discovery learning paradigm has a significant impact on scientific literacy abilities when ecological material is used (Utami et al., 2019). Using interactive media with the help of spring has a significant influence on pupils' high-level thinking abilities (Suresman et al., 2023). Pupils must be able to demonstrate scientific literacy as one of their higher-level thinking abilities. The guided discovery technique is used in this study to allow pupils to actively examine science topics via an interactive Android application. This learning seeks to provide a more interesting learning experience by combining scientific theory with practical applications in everyday life by utilizing technologies commonly used by today's young population. It is intended that this learning will considerably increase pupils' scientific literacy, allowing them to be better equipped to meet future scientific and technological issues. GDL *(Guided Discovery Learning)* will be investigated utilizing Android-based application media on life organization systems materials by researchers. Interactive medical visualization is required to accompany abstract scientific content.

This study goal to determine the effect of guided discovery with SELWAN which is an application based android about animal cell in science learning to enhance student’s scientific literacy and describe studen’s response about learning use guided discovery with SELWAN application. By GDL with SELWAN application during learning process, it is expected to enhance student’s scientific literacy and get student’s response about GDL with SELWAN application.

Methods

The research was conducted at Nazhatut Thullab Middle School for the 2022/2023 academic year. The time for conducting the research starts from February 2022 to March 2022. This research uses a quasi-experiment with a non-equivalent control group design.

The experimental group received treatment in the form of scientific learning utilizing the GDL paradigm using the SELWAN app, whereas the control group received conventional science learning treatment. The research design is depicted in Table 1.

Table 1. Non-equivalent Control Group Design Schme

	Pretest	Treatment	Posttest
TO	O_1	X	O_2
KP	O_1	-	O_2

(Sugiyono, 2020)

Noted:
TO: ClassExperiment
KP: ClassControl
X: The treatment uses the GDL model and SELWAN applications
O_1: Scientific literacy test before treatment
O_2: Scientific literacy test after treatment

The sample approach employs a purposive sampling technique in which particular considerations are used. This study employed two classes of samples: class VII E as the experimental class and class VII F as the control class. SELWAN apk (application) in Life Organization content was prepared with Microsoft PowerPoint and I Spring Apk. Figure 1 shows the media display for the application.

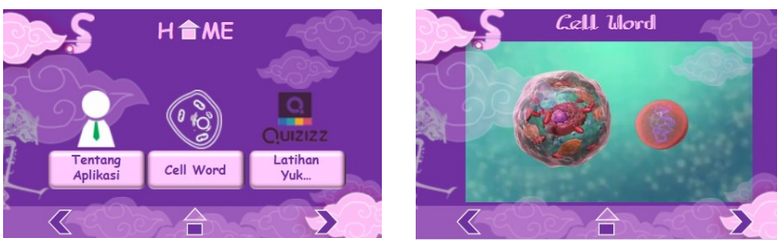

Figure 1. Media display of SELWAN apk

The data in this study consists of scientific literacy test data and student responses to Guided Discovery with the assistance of the SELWAN application. The research instruments include a written science literacy test encompassing knowledge and competencies, a science attitude questionnaire, and a student feedback sheet on guided discovery learning with the assistance of the SELWAN application. The instruments used in this study are science literacy tests and attitude scales to assess student responses. The student response questionnaire consists of statements regarding a specific object of response, which can be rated on a rating scale or checklist. The data collection techniques involve written tests and questionnaires.

The test items underwent consultation and validation by a qualified expert in the field of judgment. The examination questions were presented in the form of essays, evaluating many aspects of scientific literacy, including the ability to provide scientific explanations for occurrences, the capacity to design and appraise scientific research, and the skill to interpret data and evidence in a scientific manner.

The data collection procedure in this study is began with a pretest in the experimental class and the control class. Pretest is carried out to determine the initial ability of pupils before being given treatment. The next step is the implementation of GDL learning with SELWAN apk in experimental classes and conventional learning in control classes. The last step is the provision of science literacy tests and questionnaires after treatment. The tools utilized for facilitating the learning process in this study consist of instructional modules and LKPD (student worksheets). The data collection instrument used in this study was a scientific literacy assessment exam that was given to pupils to measure their knowledge of the subject.

Data analysis technique use independent sample t-test with SPSS version 20 software to know the effect GDL learning with SELWAN apk toward science literacy pupils. Prerequisite tests include normality tests and homogeneity tests. The Shapiro-Wilk test is used to determine data normality, whereas the Levene test is used to determine variance homogeneity. The recommendations in Table 2 are used to interpret the outcomes of the pupils' scientific literacy exams.

Table 2. Criteria of scientific literacy

Interval Value	Category
81-100	Very high
61-80	Tall
41-60	medium
21-40	low
0-20	Very low

(Jufrida et al., 2019)

The N-Gain test is intended to avoid errors in interpreting the N-Gain scores of each student. The formulas used are as follows:

$$<g> = \frac{(<sf>-<si>)}{(s_{max}-<si>)} \quad (1)$$

Note:
<g> : Score of N-gain
<sf>: Score of posttest:
<si> :Score of pre-test
s_{max}: Maximum score

Furthermore, the N-gain score was grouped into the following groups using a scholarly approach: 1) When the score exceeds 0.70, the level of improvement is considered substantial; 2) when the score is equal to or greater than 0.30 but less than 0.70, the level of progress is considered moderate; and 3) when the score is less than 0.30, the level of progress is considered minimal. (Ahied et al., 2020).

Data collection techniques for student responses through questionnaires with a Likert scale were given after implementing guided discovery learning using the SELWAN APK. The questionnaire is organized around indicators such as student interest in following the guided discovery learning process using SELWAN APK, student concentration on the guided discovery learning process using SELWAN APK, pupils' seriousness in learning, and pupils' responses after learning science using the guided discovery learning model using SELWAN APK. A questionnaire was used to collect data on student reactions to the guided discovery learning approach supported by the SELWAN APK, with the goal of improving pupils' scientific literacy. The questionnaire was methodically developed, with a Likert scale of 20 items divided evenly into 10 positive and 10 negative comments. Refer to Table 3 for more information on the scoring of student replies.

Table 3. Criteria of response studens

Response Scale (%)	Information
75.01 - 100	Very good
50.01 - 75	Good
25.01 - 50	Not good
0 - 25	Very not good

(Widoyoko, 2017)

Result and Discussion

The definition of scientific literacy is the capacity to participate in scientific procedures, comprehend scientific concepts and issues relevant to daily life, apply scientific knowledge and data, gather and evaluate evidence, explain scientific phenomena, and draw conclusions based on evidence while keeping in mind the goals and constraints of science in order to make decisions concerning the natural world (Stylos et al., 2023). According to the next generation science standards and the national research council report, scientific literacy is defined as pupils' capacity to grasp scientific facts and concepts logically so that they may be applied in the actual world (Elhai, 2023). Table 4 contains a description of the results on the experimental and control class pupils' scientific literacy abilities (SLA).

Table 4. Descriptive statistic of scientific literacy pupils

Class	N	Mean	Maximum	Minimum	SD
Experiment	25	79.24	96	61	11.009
Control	23	38.30	65	14	12.629

Table 4 shows that the average value of pupils' scientific literacy abilities who use GDL with the SELWAN apk is greater than that of pupils who utilize traditional learning. Normality and homogeneity tests are performed prior to hypothesis testing. Table 5 displays the normality, homogeneity, and hypothesis outcomes.

Table 5. Analysis Test

Test	Class	Sig	Criteria
Normality	Eksperimen	0.123	Normal
	Control	0.882	Normal
Homogeneity		0.662	Homogenous
Hypothesis		0.000	Effective

Table 5 shows the significant values obtained from the scientific literacy normalcy test conducted on the pupils in the experimental and control classes. The results show that the significance levels for the experimental and control groups of pupils are 0.123 and 0.882, respectively. Given that the significance level is greater than 0.005, it is reasonable to assume that the data has a normal distribution. The statistical significance of the pupils' scientific literacy exam results was 0.662, according to the Levene test. The data has a homogeneous distribution because the observed significance level is greater than 0.005. The calculated significance value for the hypothesis test performed on the experimental and control groups was 0.000. According to the statistical analysis, the observed significance level is less than 0.005, showing a statistically significant association between the adoption of the guided discovery paradigm via the SELWAN APK and pupils' scientific literacy. Guided discovery learning using an android aplication had an effect on pupils' scientific literacy skills (Khasanah et al., 2016; Anggriani et al., 2020; Atiyah et al., 2020; Karimah et al., 2023; Rubini et al., 2018). Interactive media has been proven to be effective in improving pupils' scientific literacy (Widodo et al., 2020). Figure 2 depicts the posttest results on the scientific literacy of pupils in the experimental and control classrooms, as indicated by the N-gain formula.

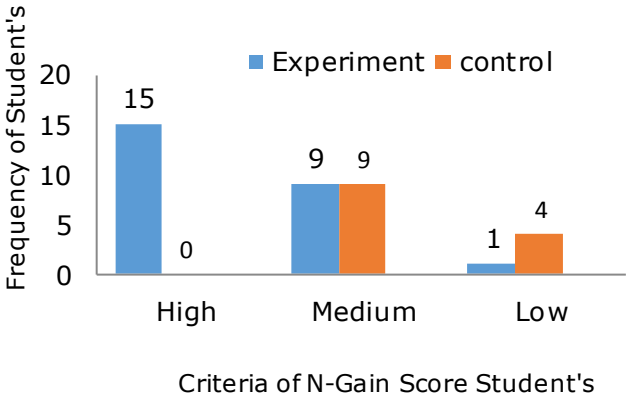

Figure 2. The result of the N-Gain Score

Data X explain about criteria of N-Gain scientific literacy pupils that are high, medium and low. Data Y explain about frequency of student's each criteria. Figure 3 shows that pupils who were treated in an experimental class with a guided discovery model using SELWAN APK experienced an increase in scientific literacy skills in the high category by 15 pupils, the moderate category by nine pupils, and the low category by one. Eight of the pupils in the control group who did not get therapy reported an increase in the moderate category, while 15 experienced an increase in the low category. The

average N-Gain calculation in the experimental and control classes is 0.74 in the high category and 0.25 in the low category. With the help of the SELWAN APK, the guided discovery method may help pupils learn more about science, since what they learn in the experimental class can be used to improve their science literacy, as shown in Table 6.

Table 6. Sintax Guided discovery with SELWAN apk learning toward science literacy

Syntax Model	Phase	Learning Activities	Science Literacy Competency
Guided Discovery	Phase 1 *(stimulation)*	The teacher guides the pupils' focus to the visual depictions presented in the worksheet, stressing the importance of thorough observation of these visuals. Additionally, the teacher presents thought-provoking questions to encourage the development of pupils' analytical and evaluative skills.	explaining scientifically
	Phase 2 *(Problem Statement)*	The teacher provides pupils with the opportunity to recognize a wide array of challenges that are relevant to the subject under study.	explaining scientifically
	Phase 3 *Data Collection*	Pupils utilize the SELWAN Apk as a tool to conduct experiments or observations in order to validate their hypotheses.	designing and evaluating scientific investigations
	Phase 4 *Data Processing and Verification*	The pupils process the collected data, while the teacher allocates assessment questions to each group and guides a collaborative verification process. This method is designed to improve the pupils' understanding of the fundamental concepts within the material.	interpreting data and evidence scientifically
	Phase 5 *Generalization/ making conclusions*	Pupils form assessments of the designated issues by relying on the facts and information they have gathered throughout their investigative journey.	interpreting data and evidence scientifically

(Muhali & Sukaisih, 2023).

The scientific literacy competencies of pupils in the experimental and control classes, according to Table 1, can be seen in Figure 3.

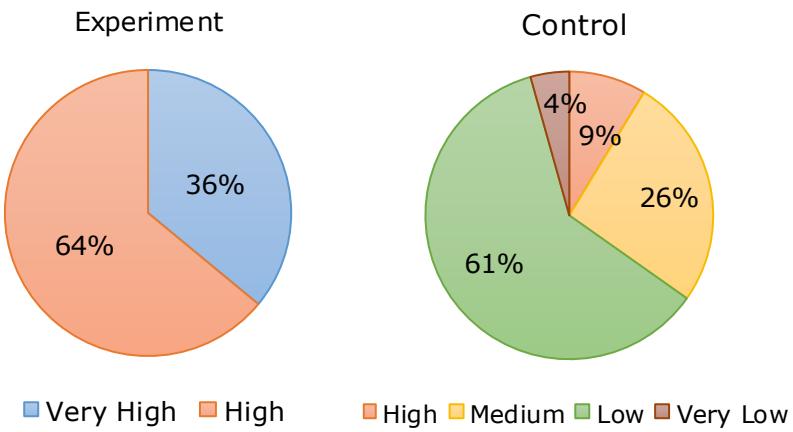

Figure 3. Criteria of Scientific Literacy skill's Pupils

According to the data shown in Figure 4, the experimental group's scientific literacy standards demonstrate that 64% pupils come into the high category, while 36% pupils fall into the very high category. In contrast, the control group's kids exhibit a range of scientific literacy levels. Thre are 4% student is classed as deficient, 61% pupils are classified as low, 26% pupils are classified as medium, and 9% pupils are labeled as high. Figure 4 depicts the graphical depiction of pupils' scientific literacy for each indicator.

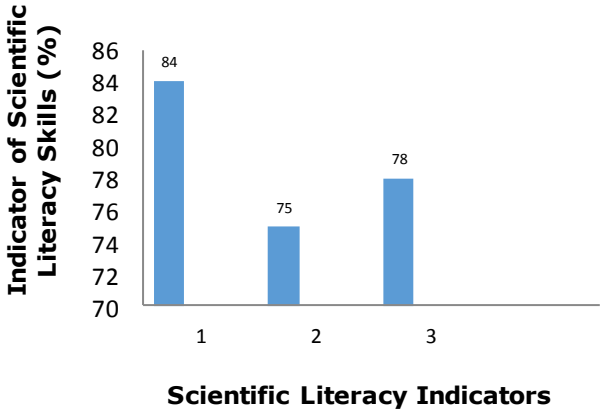

Figure 4. Student's scientific literacy skills in each indicator

Noted:
1. Explaining phenomenal scientifically,
2. Designing and evaluating scientific investigations,
3. Interpreting data and evidence scientifically.

Figure 4 shows that pupils' scientific literacy competency after implementing guided discovery learning with SELWAN apk in explaining phenomena scientifically was obtained at 84.3% with very high criteria, student competency in designing and evaluating scientific investigations was obtained at 74,5% with high criteria, student competency in interpreting data and scientific evidence obtained was 77,5% with high criteria. The indicator with the lowest percentage is pupils' ability to design and evaluate investigations. Pupils still need help finding solutions to prove the truth of a concept. Scientific literacy aspect demonstrating the lowest level of proficiency among pupils pertains to their ability to articulate and evaluate methods for ensuring data accuracy and

validity (Rusmansyah et al., 2023). On the contrary, pupils exhibit the highest proficiency when it comes to interpreting scientific phenomena. To optimize educational outcomes, it is recommended to incorporate the guided discovery model at the problem statement phase, as it stimulates pupils to identify relevant issues within the subject matter they are studying.

The results of this investigation substantiate that the use of the SELWAN app in conjunction with guided discovery learning effectively enhances pupils' scientific literacy skills. Table 7 presents the results of the analysis conducted on student response questionnaires in the context of science disciplines utilizing the guided discovery learning model in combination with the SELWAN app.

Table 7. Response Pupils using guided discovery learning with SELWAN apk

No	Questionnaire Indicator	Student's Response (%)	Average Response (%)	Criteria
1.	Student interest in following the learning process	85.63	81.06	Very good
2.	Student concentration on the learning process	81.67		
3.	Pupils' seriousness in learning	82.50		
4.	Student responses after learning science using the learning model	74.44		

According to the data presented in Table 5, the analysis reveals that the overall percentage of pupils who reply to science topics when utilizing the guided discovery learning model in conjunction with the SELWAN app amounts to 81.06%. It is important to note that this figure corresponds to the requirements for perfect responses.

Guided discovery learning with SELWAN apk positively responds to practice in science learning. The discovery learning model makes active changes to discover concepts and principles carried out through scientific activities (Hadi et al., 2020). Teachers design activities that require mental activity processes such as observing, classifying, measuring, and analyzing (Riandari et al., 2018). Learning using interactive media can make learning more practical and effective in increasing pupils' scientific literacy (Nursalamah et al., 2021). The discovery-based learning model with the SELWAN apk was chosen because, through this learning, pupils learn independently through simple experiments and constructive questions and answers in the concept discovery process.

Conclusion

The finding of this study show that guided discovery learning with assisteance of SELWAN apk effective to enhance pupils' scientific literacy. The increase in pupils' scientific literacy abilities after the guided discovery model learning treatment with the help of the SELWAN apk was 0.74 in the high category. Positive feedback is also seen from the questionnaire to determine student responses during learning. Student response to guided discovery model learning with the help of the SELWAN apk was 81.06% with very good category.

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