The Effect of Ethnoscience-Themed Picture Books Embedded Within Context-Based Learning on Students' Scientific Literacy

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ARTICLE INFO	ABSTRACT
	Purpose: Scientific literacy plays an important role in catalyzing science learning in the 21st century. Unfortunately, previous evidence revealed that students' scientific literacy tends to be unsatisfactory. This study investigated the effect of ethnoscience-themed picture books embedded in context-based learning (EthCBL) on students' scientific literacy. **Methods:** In this quasi-experimental research, 58 (35 girls and 23 boys) fifth-grade students in a public elementary school in Indonesia were selected using purposive sampling. Twenty-nine students (19 girls and 10 boys) were assigned as an experimental group and 29 students (16 girls and 13 boys) were assigned as a control group.

The Scientific Literacy Test (SLT) was employed to measure students' scientific literacy in prior and subsequent interventions. Data were analyzed using independent and paired *t*-tests at the .05 significance level.

Findings: The results showed that EthCBL was more effective in promoting the scientific literacy of fifth-graders than traditional teaching. After treatment, the experimental group showed higher posttest scores in all sub-scales of scientific literacy compared to the control group.

Implications for Research and Practice: In this study, EthCBL was integrated with the surrounding culture that allows students to learn more and participate actively which made their scientific literacy increase. Therefore, it is recommended that teachers apply EthCBL to improve the scientific literacy of elementary school students to a satisfactory level.

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Introduction

Scientific literacy plays an important role in catalyzing science learning in the 21ˢᵗ century. Nowadays, students should be prepared to be scientifically-literate to be able to solve scientific problems. However, there is no consensus on the definition and meaning of this term. The Program for International Student Assessment (PISA) defines scientific literacy as the ability to apply science-related comprehension into real-life situations (OECD, 2016). Hurd (1998) defines scientific literacy as "a civic competency required for rational thinking about science in relation to personal, social, political, economic problems, and issues that one is likely to meet throughout life" (p. 410). In general, scientific literacy refers to "the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity" (OECD, 2004, p. 286). The framework for scientific literacy assessment according to PISA covers three competencies; identifying scientific issues, explaining certain phenomenon scientifically, and using scientific evidence (Bybee, McCrae, & Laurie, 2009). Therefore, in this study, we define scientific literacy as the ability to apply science-related understanding, identify questions, and draw evidence-based conclusions to real-life situations in order to make appropriate decisions.

Although scientific literacy has been set as the main objective of the science education curriculum, in 2015, PISA reported that many countries have weak scientific literacy, including Indonesia (Hwang, 2018). Recently, PISA (OECD, 2018) reported that Indonesia scored 396 and ranked the 70ᵗʰ among 78 countries in terms of scientific literacy. This finding is in line with the previous literature (e.g., Afriana, Permanasari, Fitriani, 2016; Kadaritna, Rosidin, Sari, Rakhmawati, 2020; Nisa, Rusilowati, & Wardani, 2019) which reported that the scientific literacy of Indonesian elementary school students was at a low level. In another context, Bellova, Melichercikova, and Tomcik (2018) found that Slovak students' scientific literacy was also low. Similarly, Mun, Shin, Lee, Kim, Choi, and Krajcik (2015) explored the scientific literacy of Korean secondary students and found that students did not develop interconnections with their environment, real-life, and confidence in making decisions. Supportively, Ozdem, Cavas, Cakiroglu, and Ertepinar (2010) examined the scientific literacy of elementary school students in Turkey and found that eighth-graders had difficulties with several items related to the nature of science.

Several major obstacles to students' literacy have been identified. Previous studies (e.g., Cajas, 1999; Goodson, 1994; Layton, 1973; Teo & Lim, 2014) found that teachers had difficulties in making a connection between science and daily life, and they generally prioritized completing teaching syllabi on time rather than applying appropriate teaching approaches. Similarly, Sarkar and Corrigan (2012) also found that some teachers had issues in applying appropriate teaching approaches to promote scientific literacy. Promoting scientific literacy requires students to be engaged in science practices (Dori, Avargil, Kohen, & Saar, 2018). On the other hand, most science textbooks emphasize basic knowledge only, instead of integrating science, technology, and society (Boujaoude, 2002; Mumba, Chabalengula, & Hunter, 2006). In addition, textbooks generally only contain summaries of topics and are rote in nature, so they do not develop students' problem-solving skills and scientific literacy (Taqiyyah, Subali, & Handayani). Thus, students' scientific literacy needs to be promoted by

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applying the principles of science in daily life (Teo & Lim, 2014). Aikenhead (2007) agreed that real-life science activities can engage students in the practices, improve academic achievement, and encourage their personal development. By constructing a meaningful connection between science and real-life, students are expected to develop better science comprehension.

There are many ways to improve science learning, one of them is through ethnoscience. The ethnoscientific teaching approach has been recommended by the Science for All Movement (UNESCO, 1991) in teaching science. Ethnoscience is an indigenous knowledge system integrated within the local culture, objects, and natural events which people can practice in their daily lives (Abonyi, 2002; Glick, 1964; Vlaardingerbroek, 1990). Similarly, Fasasi (2017) argued that ethnoscience refers to a person's knowledge that develops from particular norms and local beliefs that influence one's understanding of nature. In ethnoscience instruction, learning activities and materials are designed based on students' native culture and are designed to connect students with science concepts. In recent years, contextual instructional materials have been seen as an effective method to help students understand science concepts (Ultay & Ultay, 2014).

Context-based learning (CBL) is a student-centered approach that connects scientific concepts and real-world contexts to promote students' interest and understanding in science (King & Henderson, 2018; Pilot & Bulte, 2006), and to make science more relevant. Bennett, Lubben, and Hogarth (2007) explained that the purpose of CBL is to help students understand the importance of studying science and to develop a positive attitude towards science. In CBL, students are taught to grow a connection with the subject they study and take responsibility for their learning (de Putter-Smits, Taconis, & Jochems, 2013). CBL also facilitates students becoming more active and autonomous in developing their knowledge (Johnson, 2002). In the literature, Smith, DiSessa, and Roschelle (1994) highlighted that to encourage rapid growth, teachers can combine science with students' personal contexts into their daily lives. In essence, the contextual materials are expected to help students develop positive attitudes towards science and promote the transfer of knowledge from the class to real-life situations (Gilbert, Bulte, & Pilot, 2011; Herranen, Kousa, Fooladi, & Aksela, 2019; Rohaeti, Prodjosantoso, & Irwanto, 2020).

Some empirical studies have reported the efficacy of context-based learning materials in science learning. Hiwatig (2008) found that students taught using ethno-scientific teaching approach showed a higher attitude towards science than those taught in conventional classes. Similarly, Demircioglu, Dinc, and Calik, (2013) investigated the effect of storylines embedded in the context-based learning approach on sixth-grade students' comprehension of 'physical and chemical change' concepts. They found that this teaching method did not only offer more meaningful learning but also improved students' achievement. Also, Ultay (2015) investigated the effects of concept cartoons embedded in context-based learning approach on eighth-grade students' alternative conceptions of "chemical bonding". Results showed that concept cartoons were effective in remedying alternative concepts about chemical bonding. In another study, Fasasi (2017) also found that ethnoscience instruction successfully promoted junior secondary school students' attitudes toward science. Seraphin (2014) revealed that the inclusion of contextual materials such as local wisdom in science

learning can facilitate students' understanding of subjects that are often far from their experiences. In a study, Baptista and El-Hani (2009) studied prior knowledge brought to school by students who were local farmers. They then developed a didactic tool to compare the scientific and local names of plant structures and parts. This tool was also used to discuss the physiological and morphological changes in plants that students observe in their daily farming experiences. As a result, they reported that the use of didactic material connected students' ethnoscience knowledge and school science knowledge. This means that materials and instructions embedded within the context-based learning approach are effective in promoting student achievement (Irwanto, Saputro, Rohaeti, & Prodjosantoso, 2019; Saputro, Irwanto, Atun, & Wilujeng, 2019).

Unfortunately, limited studies are available regarding the use of ethnoscience-themed picture books in context-based learning environments (Azalia, Sudarmin, & Wisnuadadi, 2020; Fasasi, 2017), especially at the primary level. Thus, this study was conducted to examine the effects of ethnoscience-themed picture books embedded in context-based learning (EthCBL) on fifth-grade students' scientific literacy. The research questions (RQ) were proposed as follows;

1. Is there any significant difference in the pretest and posttest scores between students in the experimental and control groups?
2. Is there any significant change in the scientific literacy scores of students taught using EthCBL?

Method

Research Design

A quasi-experimental pretest and posttest control group design was utilized in this research. The pretest–posttest design was used to compare the scientific literacy of the experimental group exposed to treatment and the control group that did not receive the treatment (Dimitrov & Rumrill, 2003). The independent variable was ethnoscience-themed picture books embedded in context-based learning (EthCBL) and the dependent variable was students' scientific literacy. After six meetings, the mean score of students' posttest scores in the experimental group taught by EthCBL was compared to the ones of the control group who were taught using the chalk and talk method. The quasi-experimental pretest–posttest control group design used in this study is illustrated in Table 1 (Creswell, 2012).

Table 1
Nonequivalent Pretest and Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Experimental	SLT_1	Ethnoscience-themed picture books embedded within context-based learning	SLT_2
Control	SLT_1	Chalk and talk teaching method	SLT_2

Participants

Participants were 58 (35 girls and 23 boys) fifth-grade students at a public primary school in Surabaya, Indonesia. The experimental group consisted of 29 students (19

girls and 10 boys) and the control group consisted of 29 students (16 girls and 13 boys). One class was randomly assigned as an experimental group, while another class was assigned as the control group using purposive sampling with the consideration that both classes had the same number of samples, were taught by the same teacher, and had a similar gender distribution and socio-cultural status. The experimental group was taught using the ethnoscience-themed picture books embedded in context-based learning (EthCBL) and the control group was instructed using the traditional "chalk and talk" learning. All students were instructed by a female teacher with 20 years of teaching experience. Students' age ranged from 12-13 years. Students in both groups came from rural areas and lower-middle-income families and they had an equal educational background. The study was conducted from October to November 2019 in the odd semester of the 2018/2019 school year.

Instrument

The Scientific Literacy Test (SLT) of the PISA framework for the science assessment (OECD, 2019) was adapted and developed in this study. The SLT consisted of three scales; (a) explaining certain phenomena scientifically, (b) evaluating and designing scientific inquiry, and (c) interpreting data and evidence scientifically. The SLT consisted of 5 essay questions for each indicator, with a total of 15 questions (examples of questions are shown in Table 2). The minimum and maximum scores of each student ranged from 0 and 300 points respectively. After construction, the SLT was validated and empirically tested, and instrument reliability was then checked. All test items were face and content validated by 4 experts; 2 senior lecturers and 2 experienced science teachers. The Cronbach's alpha reliability coefficient for the entire scale was .73 and that of the sub-scales of explaining certain phenomena scientifically was .71, evaluating and designing scientific inquiry was .73, and interpreting data and evidence scientifically was .74. These values indicate that the SLT is a valid and reliable instrument to measure students' scientific literacy.

Table 2

Examples of Questions for the Sub-scales of (a) Explaining Certain Phenomena Scientifically, (b) Evaluating and Designing Scientific Inquiry, and (c) Interpreting Data and Evidence Scientifically

https://gresikkoe.blogspot.com/	**(a) "*Pudak*" Dough** To make *Pudak* dough, coconut milk, brown sugar, and rice flour are mixed. The dough is then put into *Ope* (banana leaves as the wrap). The dough is then steamed on **the** furnace and firewood. During the steaming, temporary and permanent changes in the substances occur. The steaming process solidifies the liquid *Pudak* dough. How can *Pudak* dough solidify?

Read the passage carefully: **"***To make Pudak dough, coconut milk, brown sugar, and rice flour are mixed.***",** After those ingredients are mixed, why does the dough **change its form to become liquid?**

"*During the steaming, temporary and permanent changes in the substances occur.***" What does this sentence mean?**

Table 2 Continue

(b) Illegal Logging

The Protection of Forest and Fauna Organization (PROFAUNA) emphasizes that the area of forests in Indonesia is currently only 82 million hectares. Garut Deputy Regent Helmi Budiman said that severe damage to the forest area bordering Girimukti Village, Cikelet District, could not be tolerated. He asked that people carrying out illegal logging activities in the area be stopped immediately.

The deputy district head explained that the community itself would bear the consequences of the destruction of this forest's function. Many disasters can occur if the forest is deforested because water reserves can be lost by the destruction of forests and the majority of people work in agriculture, agriculture needs water and water comes from the forests.

The deputy regent considered what happened to this forest as part of the destruction of human morals. In addition, various methods have been used by the government so that forests are not bare (https://profouna.net/).

"*Bearing the consequences of this destruction of forest function.*" **What does this sentence mean?**

(c) *Kupat Ketek*

Gresik has a variety of special foods, one of which is "*Kupat Ketek*" which is now almost extinct. The traditional food is made from glutinous rice and *ketek* water. Currently, "*Kupat Ketek*" can still be found at the house of Surachman and Inem, a married couple who live **i**n Jalan Dewi Sekardadu, Gresik. Surachman was assisted by his wife to make *kupat ketek* wrap from banana trees and siwalan trees. The uniqueness of making a *kupat ketek* indeed takes approximately 5 hours so that the ketchup produced feels chewy and not stiff when sold.

Kupat Ketek is indeed different from the usual *kupat*, because of the typical way of serving mixed with grated coconut and smeared with palm sugar then eaten. Whereas *kupat* is usually served with vegetables as side dishes, said Surachman. Now, the original special food of Gresik can only be found just before Ketupat. The process of making it takes quite a struggle to get *ketek* water. It is very steep, slippery, and rocky so that not everyone can do it. Besides, the diameter of the tug water well is only 1.5 meters in diameter with a depth of two fingers. (https://beritajatim.com/).

The right solution to overcome the above problems is …

Procedures

An ethical research permit was obtained from the Surabaya State University Review Board with 04/05/2018 date and 001760/UN38.8.1/LT/2018 number. Prior to the study, researchers obtained official permission from the principal and teachers. Informed consent forms were distributed to students and parents as well. In the beginning, the researcher explained the purpose of the study to all students. Since students participated voluntarily, they could withdraw themselves from the study at any time. Before starting the treatment, the SLT test was applied to both groups as a pretest. Then, all students participated in the learning for six meetings (6 x 35 min = 210 min). During the instruction, students in the experimental group were taught using EthCBL, while students in the control group were instructed using a traditional

teaching method. In the EthCBL environment, learning activities were conducted based on the five learning cycles of Crawford (2001); REACT (Relating, Experiencing, Applying, Cooperating, and Transferring). In this treatment, both groups are taught by one model teacher to avoid teacher bias. Learning activities in the experimental and control groups are summarized in Table 3.

Table 3

Interventions in the Experimental and Control Groups

Meet	Experimental Group	Control Group
1	At the beginning of the instruction, the teacher allowed the students to taste "*Pudak*", typical food from Gresik Regency, Indonesia made from rice flour, palm sugar, and coconut milk (see Figure 1a). Students were asked to observe, eat, and write down all the information they obtained in the worksheet. During the instruction, students got more information about "*Pudak*" from the ethnoscience-themed picture books (see Figure 1b-c).	At the beginning of learning, the teacher conveys the purpose of learning today.
2	Further, they could find a relation to the concepts of science (*Relating*). The concepts included the digestive organs, changes in the shape of objects, and natural resources. For the topic of natural resources, the teacher presented a plate of *Pudak* that they had consumed. Students observed its ingredients through a video.	The teacher shared the scientific concepts based on the traditional textbook.
3	The concepts included the digestive organs, changes in the shape of objects, and natural resources. For the topic of natural resources, the teacher presented a plate of *Pudak* that they had consumed. Students observed its ingredients through a video. Students then practiced making *Pudak* assisted by the teacher (*Experiencing*).	Students listened to a power-point presentation.
4	For the topic of changes of state, students observed the process of making *Pudak* and noticed the physical and chemical changes that occur. For the topic of the digestive organ, students were asked to answer some questions "how do human digestive organs work when we consume *Pudak*?" and "how can we keep our digestive organs healthy?". Moreover, students applied the knowledge they have acquired to solve other relevant problems (*Applying*).	Students were then asked to answer the questions in the textbook.
5	Students conducted small group discussions (4-5 students) about the digestion process that occurs when someone eats *Pudak* (*Collaborating*).	The teacher asks students if there is anything that was not understood about the material delivered today.

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Table 3 Continue

Meet	Experimental Group	Control Group
6	Finally, students wrote their report on the findings that they obtained from the experiment and explained the function of each digestive organ to be given feedback from their peers (*Transferring*).	At the end of the lesson, students were encouraged to ask questions about the difficulties they experienced.

(a) https://www.matakota.id/   (b)   (c)

Figure 1. *(a) Pudak and (b-c) Ethnoscience-Themed Picture Books*

In general, there were five main elements (Ministry of Education, 2017) and unique characteristics of ethnoscience-themed picture books embedded in context-based learning. First, the "*Let's find out!*" allowed students to read the information about Pudak that has been packaged concisely. Second, the "*Glossary*" facilitated students understanding of the key terms found in the book. Third, the "*Discussion forum*" contained problems about the surrounding environment, so students could exchange ideas and find solutions with other group members. Fourth, "*Let's complete!*", a concept map was used to find out the extent of student learning success on the material that has been presented. Finally, the "*Competency test*" was offered to evaluate students' performance.

Data Analysis

The normality of the data was checked (a Shapiro–Wilk test was performed; $p = .200$), data homogeneity was tested (a Levene's test was conducted; $p = .968$), and independent and paired *t*-tests were performed to analyze the data. Descriptive statistics including mean, standard deviation, maximum and minimum scores were computed to explain the findings in detail. An Independent *t*-test was done to compare the difference in the mean scores of students in the experimental and control groups

(RQ1). A paired *t*-test was then employed to investigate changes in students' scientific literacy scores in the experimental group prior to and subsequent to the intervention (RQ2). In addition, Cohen's *d* was used to measure the effect size; .20 < *d* < .50 represents a small effect, .50 < *d* < .80 a moderate effect, and *d* > .80 a large effect (Cohen, 1992). Inferential analysis was performed at the .05 significance level using the SPSS 17 program.

Results

Based on the pretest, students in the control group obtained mean scientific literacy scores slightly higher than the experimental group. To test whether there were significant differences in the scientific literacy scores between the two groups, an independent *t*-test was performed. Overall (see Table 4), there were no significant differences between students taught using EthCBL and conventional teaching approaches (*t*(56) = .259; *p* = .797). It can be concluded that all participants had equal scientific literacy before the treatment.

Table 4

The Gap of Pre-SLT Scores Between Students in the Experimental and Control Groups

Sub-scales	Groups	N	M	SD	t	p
Explain phenomena scientifically	Experimental	29	18.20	5.48	-1.513	.136
	Control	29	20.35	5.28		
Evaluate and design scientific inquiry	Experimental	29	30.27	8.93	.320	.750
	Control	29	29.45	10.66		
Interpret data and evidence scientifically	Experimental	29	21.03	5.28	.342	.734
	Control	29	20.58	4.68		
All sub-scales	Experimental	29	69.51	12.47	.259	.797
	Control	29	70.38	12.88		

After the intervention, students in the experimental group obtained higher posttest scores in all sub-scales of scientific literacy. As shown in Table 5, significant differences were found between the experimental and control groups after the learning (*t*(56) = 24.378; *p* = .0001). The gap is indicated by higher mean scores on each indicator of scientific literacy (*p* < .05). Thus, it can be concluded that students taught using EthCBL had higher scientific literacy skills compared to those in the control group.

Table 5

The Gap of Post-SLT Scores Between Students in the Experimental and Control Groups

Sub-scales	Groups	N	M	SD	t	df	p
Explain phenomena scientifically	Experimental	29	81.89	4.85	11.55	56	.0001
	Control	29	58.89	9.56			
Evaluate and design scientific inquiry	Experimental	29	85.14	3.36	18.82	56	.0001
	Control	29	59.41	6.55			
Interpret data and evidence scientifically	Experimental	29	88.17	2.00	22.03	56	.0001
	Control	29	63.52	5.68			
All sub-scales	Experimental	29	255.21	7.25	24.38	56	.0001
	Control	29	181.82	14.50			

To answer the second research question, a paired *t*-test was executed to see changes in students' scientific literacy scores in the experimental group prior and subsequent intervention.

Table 6

Changes in Mean SLT Scores of Students in the Experimental and Control Groups

Sub-scales	Paired Differences		t	df	p	Cohen's d
	M	SD				
Explain phenomena scientifically	63.69	6.62	-51.83	28	.0001	8.55
Evaluate and design scientific inquiry	54.86	9.64	-30.64	28	.0001	10.49
Interpret data and evidence scientifically	67.14	5.71	-63.30	28	.0001	15.38
All sub-scales	185.69	12.23	-81.78	28	.0001	17.79

Table 5 shows an increase in the mean pretest and posttest scores from 69.51 to 255.21 (an increase of 185.70 for the experimental group) and from 70.38 to 181.82 (an increase of 125.45 for the comparison group). This indicates that there is a significant increase in the mean scores for both groups in favor of the experimental group ($t(28)$ = –81.782; p = .0001). This significant increase was also found in all sub-scales of scientific literacy ($p < .05$). To obtain the practical sense of the differences in mean scores from pretest to posttest, Cohen's *d* was computed. Although both groups demonstrated a significant increase, the experimental group showed a higher change than the control group. Specifically for the experimental group, Cohen's *d* value was found to be large (d = 17.79), indicating that the increase was practically significant. It can be summarized that the improvement in the experimental group arose from the effect of treatment and had a practical significance. Therefore, ethnoscience-themed picture books embedded within context-based learning effectively improved the scientific literacy of elementary school students.

Discussion, Conclusion and Recommendations

In this study, the effectiveness of ethnoscience-themed picture books embedded in context-based learning (EthCBL) in developing students' scientific literacy is explored. Significant differences in posttest scores between the experimental and control groups were observed. The experimental group obtained a higher score than the control group. This increase might have occurred because the students in the experimental group had hands-on activities, connected daily problems into scientific concepts, and applied their schemata to solve new problems. With assistance from the teacher, students were required to conduct experiments, report findings, and draw conclusions. Literature suggests that performing experiments contributes positively to students' scientific literacy (Genc, 2015). Students with high scientific literacy can design experiments and make adequate conclusions based on evidence (Wen et al., 2020). Besides, the teacher's assistance during the inquiry process is also beneficial for students to develop permanent scientific literacy (Wen et al., 2020). In brief, Millar (2007) reported that courses offered based on scientific literacy stimulate students' interest and active involvement in science learning. This situation contradicts teacher-centered learning which prevents students from making effort to develop their scientific literacy (Solomon, 2001).

The improvement in the literacy of students in the experimental group relates to the use of ethnoscience-themed picture books in context-based learning environments. During the intervention, students learned the concepts of science in ethnoscience-themed picture books. In this learning settings, students completed contextual assignments, identified and applied science concepts in appropriate situations, and proposed evidence-based arguments. As stated by Balgopal, Wallace, and Dahlberg (2017) and OECD (2016), students' ability to make evidence-based arguments is an important factor in the development of their scientific literacy. In addition, Boujaoude (2002) explained that in addition to students' experience, the quality of the textbooks also affects the level of scientific literacy. In essence, proficiency in scientific literacy enables students to use knowledge critically in everyday life (OECD, 2016). In turn, students with an adequate understanding of science will become scientifically-literate individuals in the future (Roberts, 2007).

The results of the independent *t*-test showed that the intervention done to the experimental group had a significant effect on students' scientific literacy compared to the control group. In this case, EthCBL is more effective in increasing student scientific literacy than chalk and talk instruction. The EthCBL allows students to exchange experiences and give feedback on each other's ideas. Also, students can share their work in small groups, participate actively in problem-solving, and take on more responsibilities. As a result, they learn more, their confidence develops, and in turn their scientific literacy increases. Problem-solving and discussion in contextual learning environments affect students' interests and attitudes (Mbajiorgu & Ali, 2002), and in turn affect their scientific literacy. In a similar vein, NRC (1996) agreed that a learning environment that encourages students to think scientifically stimulates students to propose and evaluate various arguments that are useful for scientific literacy.

The paired *t*-test results showed EthCBL effectively increased students' scientific literacy to satisfactory levels. This may occur as students were encouraged to describe, explain, and predict scientific phenomena. During the treatment, students were encouraged to interpret findings, draw conclusions, make arguments based on evidence, and communicate their ideas and thoughts. When students write their arguments and communicate with other colleagues, they succeed in building scientific knowledge about authentic problems (Balgopal et al., 2017). Scientific literacy is strongly related to the context of the science being studied (Bybee, 2015). This is consistent with principles in the CBL environment, where students are encouraged to activate metacognitive skills and are required to be scientifically-literate (Bennett & Holman, 2002). In ethnoscience instruction involving "Pudak", students can indirectly understand several topics, namely changes in the form of substances, natural resources, and the digestive system. For example, the topic of changes in the form of substances is studied when students make "Pudak" dough and observe how substances change from liquid to solid. Additionally, the topic of natural resources is studied when students make use of them in their environment. In other words, students who are able to apply and integrate what they learn inside and outside of school will become scientifically literate citizens (Chen & Liun, 2018).

In this research, the EthCBL succeeded in improving "explaining phenomena scientifically" because experimental group students were familiarized with texts and videos related to phenomena that existed in their daily lives and they were encouraged to explain why the changes occurred. Furthermore, the EthCBL could also enhance "evaluation and design scientific questions". Due to this, learning was designed by providing scientific evidence of real-life phenomena and then students were stimulated to conduct scientific investigations in small groups. Moreover, the EthCBL promoted "interpretation and scientific evidence" because students were given scientific data about real-world applications, so they could support the data using their arguments. The results of this study support previous empirical evidence. For example, Turgut and Fer (2006) found that contextual learning was more effective in increasing student scientific literacy than traditional teaching. In addition, Yager and Akcay (2008) noted that students who were involved in contextual human experience teaching and learning successfully applied science concepts in new situations and developed more positive attitudes toward science than students who learned using the traditional textbook approach. In the Indonesian context, Sinaga, Kaniawati, and Setiawan (2017) developed and implemented a contextual science book and found that a well-designed science book significantly increased the scientific literacy of eighth and ninth-grade students.

Conclusion and Recommendations

In conclusion, there is a significant difference in the scientific literacy between students in the experimental group taught using EthCBL and those in the control group taught using conventional learning. At the end of the lesson, the experimental group students showed higher posttest scores in all sub-scales of scientific literacy compared to the control group. This proves that EthCBL is effective in increasing students' scientific literacy at the primary level. These results provide an alternative for teachers and curriculum developers to use ethnoscience-themed picture books embedded within context-based learning for a more effective learning process.

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Teachers should engage their students in inquiry activities to develop their scientific literacy in the 21st century. However, the characteristics of certain scientific concepts, learning environments, teaching materials, and active student participation should be taken into account to obtain an optimal impact on student achievement. Future researchers are encouraged to conduct more advanced studies to support current findings and adapt them to different cultures. In addition, we suggest researchers involve more participants and conduct their research within a longer period to compare the use of this method to other non-traditional methods to obtain more comprehensive results.

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