Environmental literacy research trends in education: A systematic literature review

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ABSTRACT

Environmental literacy is a key concept in promoting individual attitudes towards conscious lifestyle changes towards environmental challenges in a sustainable manner. This research is a systematic literature review by analyzing articles from 2018-April 2023 with environmental literacy in education as the main focus. This study aims to collect information related to various studies on environmental literacy in education in Indonesia. The results showed an increase in publication trends, the dominant research was quantitative research, besides that grade 7 and 10 students became the most subjects. Tests and percentage analysis are instruments and methods of data analysis used successively, and the most treatment is in the form of environmental literacy tests. The recommendations proposed for the next research are increasing the diversity of research types, research subjects, as well as the selection of appropriate instruments and data analysis.

INTRODUCTION

Environmental issues are often a hot topic that is interesting to discuss. Various environmental problems often occur as the population increases and its various activities (Wiedmann et al., 2020). Many environmental problems occur in life, such as pollution (Arwini, 2019), soil erosion (Yudhistira et al., 2011), garbage, forest fires (Anggraini & Trisakti, 2011), and global warming (Elleuch et al., 2018). Of course, environmental problems that occur have a negative impact on human life such as health problems (Hidayatullah & Mulasari, 2020), natural disasters and reduced aesthetics of an environment (Sutrisnawati & Purwahita, 2018).

Environmental awareness is needed as an effort to overcome environmental problems that occur around. Environmental awareness is an individual effort in cultivating, developing, and fostering awareness in preserving the environment which refers to environmental values through peaceful living with nature (Paramita & Yasa, 2015). Environmental awareness refers to environmental ethics which guides how to think, behave, and act in accordance with positive values to maintain and preserve the environment (Faizah, 2020). Environmental problems that occur today are caused by low environmental awareness of the community. Concrete behaviors that show low environmental awareness include people who often throw garbage into rivers under the pretext of being more practical and the absence of adequate facilities and infrastructure (Wijaya & Muchtar, 2019), the use of motorized vehicles and industrial smoke activities that pollute the air (Sugiarto & Gabriella, 2020), and the use of single-use plastics that can pollute the soil because they cannot be decomposed by bacteria (Setyowati & Mulasari, 2013). Behavior that does not support the environment is caused by low levels of environmental literacy.

Environmental literacy is a key concept in promoting individual attitudes towards conscious lifestyle changes towards environmental challenges in a sustainable manner (Bissinger &; Bogner, 2018). Environmental literacy should be instilled from an early age, for example implemented in the world of education (Saribas, 2015). The ability of environmental literacy in individuals can be measured through 4 aspects, namely: (a) environmental knowledge, including basic environmental knowledge; (b) Attitudes towards the environment, including sensitivity and feelings towards the environment; (c) Cognitive skills, including identification, analysis, and implementation of planning on environmental problems; and (d) behavior or concrete actions towards the environment (Kusumaningrum, 2018).

Environmental literacy should be applied through education because there will be interaction between teachers and students in cultivating their potential (Mutia et al., 2017). This self-potential can be in the form of environmental literacy. Education plays an important role in achieving environmental literacy, countries that have high knowledge are able to achieve better results in environmental literacy tests (Yanniris & Huang, 2018). Not only knowledge, education is also a means of forming individual character. Environmental literacy in education plays a role in shaping the character of individuals to care for the environment so that these individuals know and are able to do what to do in the environment (Hollweg et al., 2011). Environmental literacy will shape responsible behavior through knowledge, skills, awareness, and attitudes towards environmental issues (Suryawati et al., 2020).

In Indonesia, research on environmental literacy has been widely studied, especially in the field of education. Some of these studies discuss the development of teaching tools that are integrated with environmental literacy (Hekmah et al., 2019; Kahar & Fadhilah, 2019), the influence of learning models on environmental literacy (Anggraini et al., 2022) and differences in environmental literacy of adiwiyata schools with non-adiwiyata schools (Herlina et al., 2021). However, among the entire study, no one has reviewed the information that has been reported in the study.

This study is different from previous research that focused on environmental literacy. The thing that distinguishes it from the first previous study is that all articles studied have been published in the range of 2018-2023 which have been accredited by the *Science and Technology*

Index (SINTA) ranked 1 to 3. Second, the study was devoted to investigating all articles discussing environmental literacy in education. Third, the use of various aspects as a reference in article content analysis.

This study aims to collect information related to various studies on environmental literacy in education in Indonesia. The details of the research objectives include trends in the number of environmental literacy research in education from year to year, variations in research designs used in the implementation of research on environmental literacy, topics used in investigating environmental literacy, treatment given in investigations of environmental literacy, instruments used to measure environmental literacy, technical data analysis used in analyzing environmental literacy, and an overview of the results of research that has been conducted by researchers in investigating environmental literacy.

METHODS

This research design uses Systematic Literature Review (SLR). Systematic Literature Review is a research method that identifies, assesses, and interprets findings on research topics to answer predetermined research questions (Asmi et al., 2022). Systematic Literature Review in this study refers to the Systematic Review and Meta-Analysis (PRISMA) model. The PRISMA model has four stages, namely identification, screening, eligibility, and inclusion (Zhong et al., 2022). The results of the PRISMA model in this study can be seen in Figure 1.
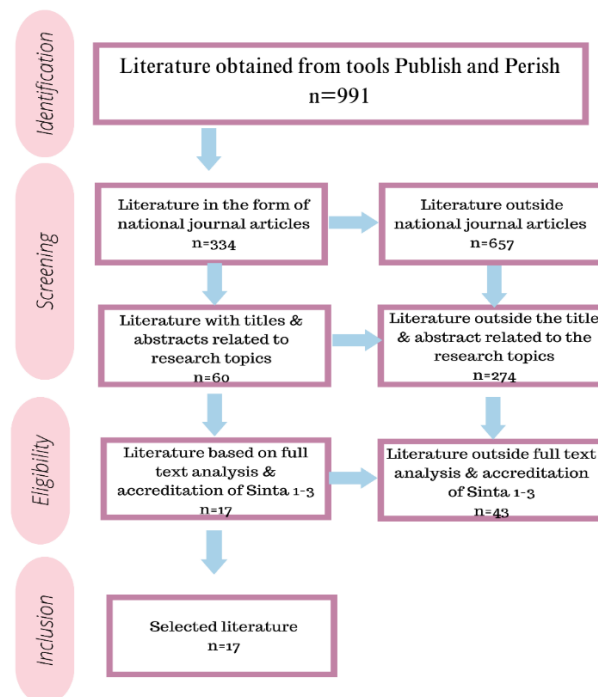

Figure 1. PRISMA model SLR flowchart

Identification is an early stage in the PRISMA model that refers to searching literature from databases. The database used is Google Schoolar with the help of Publish and Perish tools. Literature searches using Publish and Perish were sorted from 2018 to April 2023 and used the keywords "environmental literacy", "environment", "education".

The next stage is screening in the form of literature selection that refers to the established inclusion criteria. The inclusion criteria set include literature in the form of journal articles so that literature such as books and proceedings will be eliminated, journal articles with topics according to research criteria by reading titles and abstracts.

Eligibility is the stage of sorting accredited articles Sinta 1 to Sinta 3 to be analyzed in depth by analyzing full text so that analysis results relevant to the research topic are obtained. Sinta 1 to Sinta 3 were chosen because the journal articles in this category were of high quality in accordance with the assessment of the accreditation assessor which refers to Permenristekdikti number 9 of 2018 and the Director General of Research and Technology number 19 of 2018. Sinta 1 has an accreditation score of $85 \le n \le 100$, Sinta 2 has a score of $70 \le n < 85$, and Sinta 3 has a score of $60 \le n < 70$. Sinta 1 to Sinta 3 have certainly gone through a long review process with a series of validation by reviewers who are experts in their fields. The next stage is inclusion which is the final stage in the PRISMA model so that a final article that meets the criteria for this research is obtained.

The instrument used in this study is a modification of the instrument developed by Susetyarini & Fauzi (2020) which contains analytical guidelines related to the observed aspects (Table 1). These aspects include (1) the number of publications per year, (2) types of research, (3) research subjects, (4) data collection instruments, (5) data analysis methods, (6) and treatment. Aspects (1) and (6) are not determined at the beginning because there has been no previous research that is a reference to be included in the category. While aspects (2), (3), (4), and (5) are determined before data collection. The aspect (2) is divided into 3 sub-aspects including general research types (2a), quantitative research design (2b), and qualitative research design (2C). The aspect and categories that used as an analysis in research are presented in Table 1.

Table 1. Aspects and categories used as analysis in research

Aspects	Category	
Type of Research (2a)	A.1-Research & Development (R&D)	A.3-Quantitative Research
	A.2-Classroom Action Research (CAR)	A.4-Qualitative Research
Types of Quantitative Research (2b)	B.1-Observational Studies (OS)	B.5-True Experiment Design (TED)
	B.2-Correlational Research (CR)	B.6-Quasi-Experimental Design (QED)
	B.3-Survey Research (SR)	B.7-Ex Post Facto Design (EPFD)
	B.4-Pre-experiment Design (PED)	B.8-Quantitative Descriptive Design (QDD)
Types of Qualitative Research (2c)	C.1-Ethnography (E)	C.4-Natural Observation (NO)
	C.2-Case Studies (CS)	C.5-Interview (I)
	C.3-Document Studies (DS)	C.6-Phenomenology (P)
Subject	D.1-Early Childhood	D.10-Junior High School Grade 9
	D.2-Elementary School Grade 1	D.11-High School Grade 10
	D.3-Elementary School Grade 2	D.12-Senior High School Grade 11
	D.4-Elementary School Grade 3	D.13-High School Grade 12
	D.5-Elementary SchoolGrade 4	D.14-Undergraduate Students
	D.6-Elementary School Grade 5	D.15-Graduate Students
	D.7-Elementary School Grade 6	D.16-Elementary School Teacher
	D.8-Junior High School Grade 7	D.17-Junior High Teacher
	D.9-Junior High School Grade 8	D.18-Senior High School Teacher
		D.19-Headmaster
		D.20-Unidentified
Data Collection Instruments	E.1-Questionnaire Sheet	E.4-Interview Sheet
	E.2-Observation Sheet	E.5-Expert Validation Sheet
	E.3-Test Sheet	E.6- Unidentified
Data Analysis Methods	F.1-Mean	F.6-ANCOVA
	F.2-Percentage	F.7-Correlation
	F.3-N-gain	F.8-Undefined
	F.4-T-Test	F.9-Triangulation
	F.5-ANOVA	F.10-Other

Data analysis is carried out by classifying each article into certain categories according to predetermined aspects and criteria. The collected data is presented visually using a bar chart.

RESULTS AND DISCUSSION

Number of Publications

The number of publications indicates how much research was carried out in a given period of time. The total number of publications in the type of research articles is 17 articles (Figure 2). A sample of 17 articles is enough because it has passed the inclusion stage. There is a difference between a systematic literature review and an empirical study where the researcher will not know the number of samples before conducting the screening process according to the set criteria (Hadi et al., 2020). The number of environmental literacy research publications in Education has increased since 2018. However, until April 2023, there has been no research on environmental literacy in education. The increase in this trend indicates that researchers have sincerity in researching environmental literacy. Figure 2 below presented the trend of of increasing number of environmental literacy research publications in education.
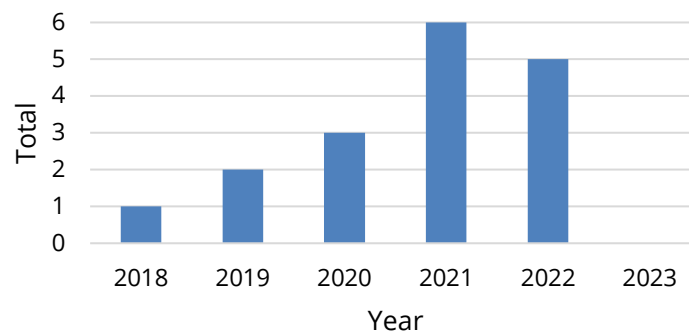

Figure 2. Trend of increasing number of environmental literacy research publications in education

The majority of research conducted by researchers is motivated by the issues that occur around them. One of them is the existence of environmental issues that are increasingly concerning for the life of living things on earth. Environmental issues are an important topic to be studied because of the low public knowledge to protect and preserve the environment (Waskito & Harsono, 2012). Therefore, a more in-depth and holistic study is needed so that the community has knowledge and awareness in responding to environmental issues that occur by taking various preventive and curative actions.

The more research on environmental literacy in education, it will have a positive influence on the development of education in Indonesia to form environmentally literate individuals. Various studies that have been conducted have the main objective to improve the capacity of the education system in terms of educational practices (Coburn & Penuel, 2016). In addition, research will affect educational practices for the following reasons: (1) research results can be a reference as credible information for teachers to implement, (2) findings in research can be a reference in determining education policies at the school, regional, and national levels, and (3) findings in research can affect teacher mindsets (Susetyarini & Fauzi, 2020).

Types of Research

The type of research can determine the focus of research. The categories of research is presented in Figure 3. Based on Figure 3, quantitative research dominates on the trend of environmental literacy research in education. The higher number of quantitative studies compared to other types of research is in accordance with previous studies that reported that researchers use more

quantitative research types in research in education than qualitative research types (Uzunboylu & Aşıksoy, 2014). This type of quantitative research is often used because it is easier to test statistics and can compare with previous research data (Haviz & Ridho, 2019). Quantitative research is more chosen because it is accurate because it is in the form of numbers, clear relationships between variables, and is able to simplify complex problems (Waruwu, 2023).

In addition, qualitative research is considered a new thing in educational research (Sharma, 2013), but there is an increasing trend in the use of qualitative approaches in the field of social science, including in the field of education (Mohajan, 2018). The phenomenon of low use of qualitative research can be an opportunity for further research related to environmental literacy in the field of education because data collection is carried out more in-depth based on data collected directly, participants who are directly involved in the object of research, rich and detailed information, and are able to explore different views (Waruwu, 2023). Figure 3 below illustrates some types of research.
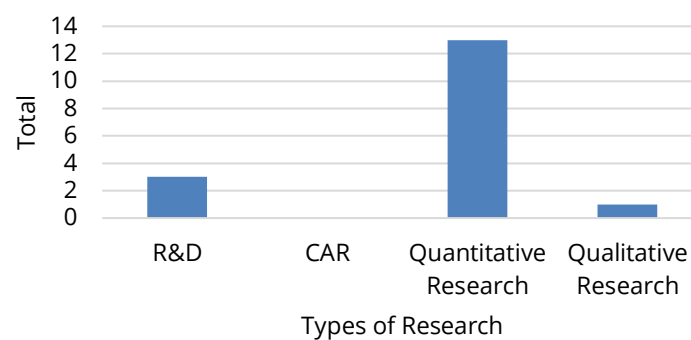

Figure 3. Types of research

This study found the existence of R&D research. Of course, R&D research has a lower frequency than quantitative research. However, R&D research is often used in the field of education. The R&D research in the article in the Systematic Literature Review produced products in the form of Web-worksheets, local potential-based biology learning tools, and PjBL-STEAM-based learning tools. The results of research conducted by (Rahardjanto & Husamah, 2022), show that there are 56 publications from JPBI journals, JPB Biosphere, and Bioedukatics that use R&D research. R&D is research used to produce products and test the validity and effectiveness of products (Astutik et al., 2023). R&D is a productive, innovative, and meaningful form of research that is oriented to produce innovative work that is valid and practical and useful for their respective educational institutions (Borg et al., 2003; Haviz, 2016). Products produced in R&D research include teaching modules, teaching materials (Puspita, 2019) and learning media (Elci et al., 2021). However, R&D research conducted by researchers in Indonesia on environmental literacy is still rarely carried out so that it can be an opportunity to improve R&D research related to environmental literacy in education. Figure 4 shows the distribution of quantitative research and Figure 5 shows the distribution of qualitative research.

This study also reveals the distribution of quantitative research types and qualitative research (Figures 4 and 5). In the distribution of quantitative research types, quantitative descriptive research is widely used in environmental literacy research trends in education. The types of correlational, survey, quasi-experiment, and ex post facto research are rarely used in environmental literacy research trends in education with a frequency of 1 to 3 publications. The types of quantitative research observational studies, pre-experimental research, and true experiments are not used in this research trend.
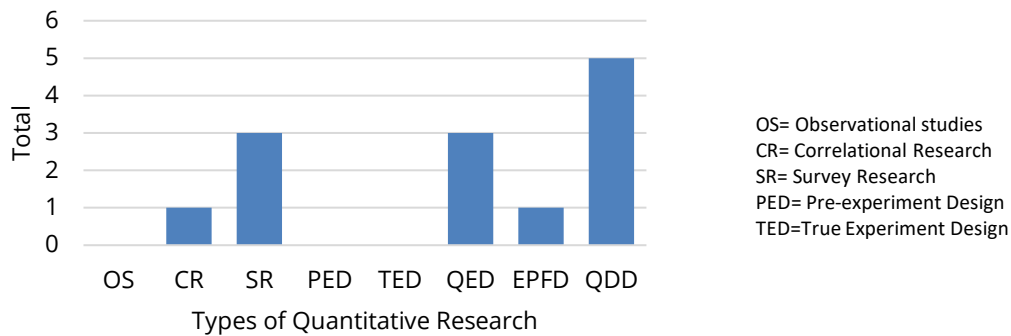
OS= Observational studies
CR= Correlational Research
SR= Survey Research
PED= Pre-experiment Design
TED=True Experiment Design

Figure 4. Distribution of quantitative research types

E   = Ethnography
CS = Case Study
DS = Document Studies
NO = Natural Observation
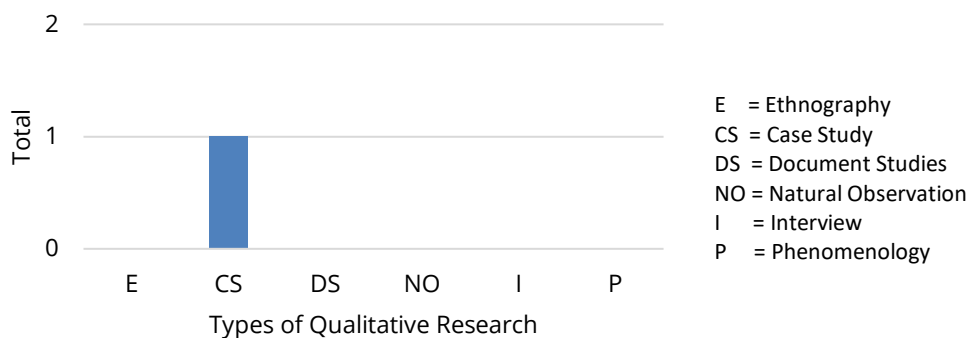I   = Interview
P   = Phenomenology

Figure 5. Distribution of qualitative research types

Quantitative descriptive research is able to provide an overview of observed phenomena based on numbers, besides that through quantitative descriptive research a study can explain data (numbers) without intending to test a particular hypothesis (Sulistyawati et al., 2022). In addition to quantitative descriptive research, this research trend is the use of quasi experiments. In quasi-experimental research, researchers compare which treatments are most effective for empowering environmental literacy. A prominent feature of quasi-experiment research is involving groups of students in class as controls and involving students in other classes as experimental groups with different treatments (Susetyarini & Fauzi, 2020). Quantitative research is often used to determine students' environmental literacy, this is in accordance with research conducted by (Santoso et al., 2021) environmental literacy in students is carried out through a test that refers to the Middle School Environmental Literacy Survey (MSELS) by scoring each question item and then analyzing it using percentages.

Survey research is also used on this trend. Survey is a method by collecting data through interviews and questionnaires from samples in the form of people where the data is able to represent certain populations in accordance with the research objectives (Aithal & Aithal, 2020). Survey research has advantages in the form of time efficiency, relatively low costs, and can collect data related to different variables in the same period of time (Rofiudlofir et al., 2024). Survey research is also used to determine environmental literacy, this is done by providing an environmental literacy questionnaire whose scoring uses the Likert scale and then percentage analysis is carried out and environmental literacy criteria ranging from less to very good are determined (Nugraha et al., 2021). This research trend also uses correlational and ex post facto research. Correlational research is research that shows the relationship between two or more variables without manipulating variables and providing treatment of variables (El Hasbi et al., 2023). Correlational research on environmental literacy has been conducted by Khalwaty et al. (2023) which shows a correlation coefficient value of 0.714 so that the results of the study are known that there is a relationship between the level of environmental literacy and the

conservation efforts of the Pute River by adolescents in Rammang-rammang Hamlet, Maros Regency. While ex post facto research is research that searches for and analyzes an event to find out what affects the event, in this study no treatment was carried out on the object under study (Rahmadana & Khawani, 2023).

The distribution of qualitative research types on environmental literacy research trends in education only uses case studies. Case studies are an empirical method in conducting in-depth investigations of phenomena or cases to gain an understanding of interesting problems or phenomena in real-life contexts naturally and deeply so that researchers gain holistic knowledge (Nurahma & Hendriani, 2021). One of the qualitative environmental literacy research is in grade VI students of Sukabumi school which shows that environmental literacy is still lacking because of frequent violations caused by several factors such as environmental conditions, infrastructure, availability of funds, lack of examples given by educators, and lack of reprimands or sanctions. Based on the description of the type of research on environmental literacy research trends, other research methods that have never been done before can be carried out.

Research Subjects

Environmental literacy can be applied to all educational levels. The categories of research subject is presented in Table 2. Based on Table 2, the environmental literacy research trend studied, the research subjects are dominated by school-age students. The highest distribution was found in grade 7 and grade 10 students, the number of subjects from grade 7 and 10 students because researchers adjusted to the lessons of Natural Sciences (Science) and biology on environmental change material taken in grades 7 and 10 (Siddiq et al., 2020). In addition, based on the graph, it is known that the higher the student's grade level, the less often it is chosen to be used as a research subject. This phenomenon is in line with the tendency of the school to give permission to researchers for grade 12 students due to the tight exam schedule at school (Susetyarini & Fauzi, 2020).

Environmental literacy should be trained from an early age so that individuals can live a lifestyle that is aware of environmental challenges in a sustainable manner (Bissinger &; Bogner, 2018). Environmental literacy needs to be implemented in the world of education, because education is a key factor in developing knowledge and concern for environmental problems (Esa, 2010). Therefore, the next research needs to choose subjects from other levels ranging from elementary to tertiary levels, it is even necessary to choose educator subjects so that environmental literacy is embedded in educators so that they can foster environmental literacy in their students shown in Table 2.

Table 2. Distribution of research subjects

Subject	Number of Article	Article Code
Early Childhood	1	B
3 ES; 4 ES; 5 ES; 6 ES	1	D
6 ES	1	L
7 JHS	3	A, C, Q
7 JHS; 8 JHS; 9 JHS	1	E
8 JHS	1	J
10 SHS	4	F, H, K, P
11 SHS	2	N, O
Undergraduated	3	G, I, M

Note: ES= Elementary School; JHS= Junior High School; SHS= Senior High School

Data Collection Instruments

Data collection instruments are related to the type of research both quantitative, qualitative, and research *and development*. Quantitative research instruments include questionnaire sheets, observation sheets, measurement instruments in experiments in the form of tools or methods,

survey questionnaire sheets, and test sheets (Jailani, 2023). In the trend of environmental literacy research in education, the data collection instruments used were questionnaire sheets, observation sheets, and test sheets (Figure 7). The questionnaire sheet contains a list of questions asked to respondents, both in the form of closed questions with predetermined answer choices and open-ended questions that give respondents the freedom to answer them (Creswell & Creswell, 2017). Observation sheets in quantitative research can be structured observation checklist sheets containing predetermined items to record and measure variables during the observation process (Creswell & Creswell, 2017). The test sheet contains a set of question items, each of which represents the variable being measured, the test can measure the knowledge, talents, skills, and abilities of research subjects.

Qualitative research instruments that are commonly used include interview sheets, observation sheets, documentation study guidesheets, case study plans, and group focus guide sheets (Jailani, 2023). In research on environmental literacy trends in education (Figure 7), the instruments used were observation sheets and interview sheets. Observation sheets are used to record and pay attention to important aspects during the observation process so that researchers will be helped to collect and organize data on the phenomenon under study (Creswell & Creswell, 2017). While the interview sheet contains a list of questions to be discussed in a qualitative interview, the interview sheet can help researchers provide a framework to ask respondents (Jailani, 2023).

Expert validation sheet instruments are generally used in *research and development* (R&D). Products developed in development research (R&D) must go through expert validation to determine the validity and feasibility of the product. The validation sheet contains questions in the form of questionnaires measured by the Likert Scale, each aspect is translated into indicators and then determined whether the product developed is included in the categories of very lacking, lacking, sufficient, good, and very good (Pribowo, 2018). In addition to questionnaires, expert validation sheets are also equipped with small notes in the form of improvement suggestions. Based on the description above, the trend of environmental literacy research in education has used research instruments that are in accordance with the type of research shows in Table 3 below.

Table 3. Research instruments

Research Instrument	Number of Article	Article Code
Test Sheet	6	A, F, I, M, O, Q
Questionnaire Sheet	3	B, D
Interview Sheet; Test Sheet	1	C
Observation Sheet; Test Sheet	1	J
Observation Sheet; Interview Sheet	1	L
Test Sheet; Questionnaire Sheet	5	E, G, K, N, P
Interview Sheet; Questionnaire Sheet; Test Sheet	1	H

Data Analysis Methods

The selection of data analysis methods can determine the validity of a study. Based on Figure 6, there are 6 articles that use the data analysis method in the form of percentages. Analysis in the form of percentages is related to the use of descriptive research (Figure 4). Percentage analysis is data processing by calculating the frequency multiplied by 100 then divided by the total number of respondents (Sutopo, 2021). Data analysis using t test there are as many as 5 articles. The t test is often used by researchers to compare two groups or classes. According to Susetyarini & Fauzi (2020), there are two trends in the use of t-tests. First, researchers only take the results of the post test and then test with the t-test. Second, researchers pay attention to pre-test and post-test data before calculating N-gain, then N-gain obtained from both classes is analyzed using t-test. Therefore, ANCOVA analysis is needed, especially in quasi-experiment research where researchers cannot select students one by one as research subjects. The use of ANCOVA will help researchers

control external variables that can affect independent variables and dependent variables (Fauzi &; Pradipta, 2018). Therefore, ANCOVA is suitable for data analysis in quasi-experimental research which contains pre-test and post-test results. The distribution of data analysis methods used is shown in Figure 6.
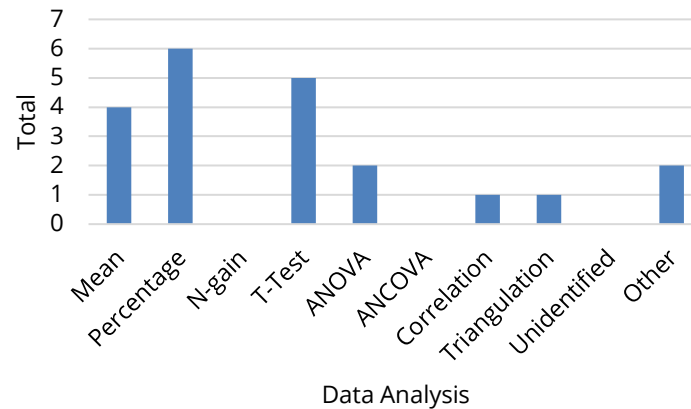

Figure 6. Data analysis methods

Treatments

Treatment is a procedure applied to research subjects (Hamilton et al., 2021). The provision of treatment has the purpose of testing hypotheses or testing how significant certain conditions are to the parameters tested. The treatment that is often used in environmental literacy research trends is 9 environmental literacy tests. Researchers often use tests to determine environmental literacy in the subjects studied. The use of tests is necessary because through tests can measure the environmental literacy of individuals who are research subjects. To see more clearly the distribution of research treatments can be seen in Figure 7.
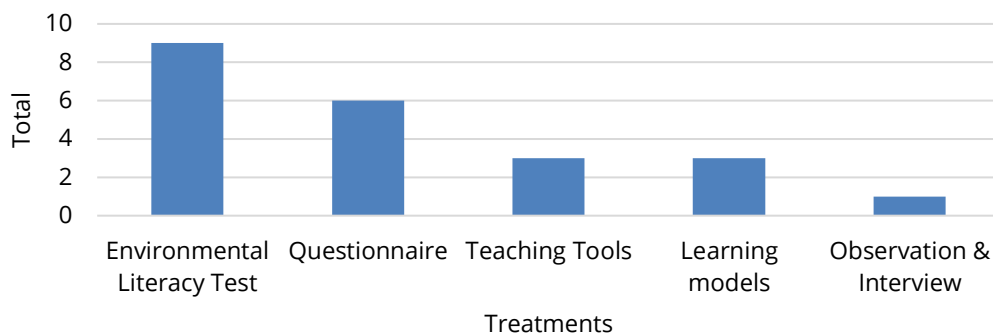

Figure 7. Treatments

CONCLUSION

In this study, articles on environmental literacy in education (sinta 1-3) from 2018-April 2023 have been reviewed. It was found that there was a trend of increasing the number of publications from year to year. Among the articles reviewed, most were quantitative research. In addition, students at the 7th grade and 10th grade levels became the largest research subjects due to adjustments to environmental materials. Environmental literacy tests are the most widely used treatment with the use of test instruments. In addition, data analysis that is often used is percentages. Based on the review, there are several recommendations that can be considered by future researchers. First, an increase in the number of qualitative research on environmental literacy research trends.

Second, the selection of research subjects should be able to start from low levels and educators. Third, the next researcher should clearly inform the research instrument clearly. Finally, it is advisable for the researcher to choose the appropriate data analysis for his hypothesis and research design.

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