

The Critical Role of Instrument Design in Achieving Research Objectives: an in-depth Review

Oria Lasmana^{1*}, Festiyed Festiyed², Abdul Razak³, Muhyiatul Fadilah⁴

¹Universitas Negeri Padang, Indonesia; *Oriallasmana78@gmail.com

²Universitas Negeri Padang, Indonesia; festiyedf@gmail.com

³Universitas Negeri Padang, Indonesia; arazakunp@yahoo.com,

⁴Universitas Negeri Padang, Indonesia; Muhyifadilah@fmipa.unp.ac.id

Abstract: Instrument is a term commonly used by researchers to refer to measurement tools, such as questionnaires or checklists. The process of selecting research instruments is a very important step in the research process because this instrument is used to measure research variables. The type of research instrument to be used is determined based on data requirements analysis. It is important for research instruments to be able to capture each variable according to its conceptual or theoretical definition. In this research, articles about education registered in international journals were analyzed, focusing on research methods and instruments. Based on research results and reviews examining articles about education, it was noted that the USA, Indonesia and China were the countries with the largest number of articles. The findings show that the number of articles about education. This is also shown in the percentage distribution of research methods in the journals reviewed, the quantitative number is 46%. Test instruments can be used as measurements or assessments for research needs and in this study there were 25 studies with test instruments.

Keywords: *Instrument design, Alignment, Research objectives*

1. INTRODUCTION

Scientific research not only produces findings, but also in-depth discoveries, proof of existing phenomena, and scientific development that is more scientifically accountable (Adib, 2015). Research tools are an important component in it, because they play a role in collecting, analyzing and examining the problem being researched. An instrument can be considered as a tool used in the research process, which aims to detect relevant phenomena in the context of investigations to prove or reject certain hypotheses (Rachman et al., 2024). The quality of data obtained in research is largely determined by the validity of the instruments used, in addition to the data collection methods chosen. This understanding can be explained simply, where the instrument functions to convert facts into data. Therefore, if the instrument used has adequate validity and is reliable, then the data obtained will reflect the facts or situations observed during the data collection and analysis process. Research instruments function as tools to reveal phenomena that occur in investigations in order to prove or reject certain hypotheses (Rahardjo, 2018). An instrument that is considered good must have high validity and reliability. To obtain a quality instrument, apart from careful testing, it is also important to pay attention to validity and trustworthiness in compiling the instrument (Hardani et al., 2020). Therefore, it is important to ensure that research instruments have good validity and reliability. Testing, validity and trustworthiness must be considered in providing research instruments to ensure the quality of the data obtained and the overall success of the research.

Research design refers to all the stages required in planning and carrying out a study, which helps in the process of collecting and analyzing data (Sekaran, 2006). The role of a researcher, both in the context of qualitative and quantitative research, is very complex. A researcher acts as a planner, executor of data collection, data analyst, data interpreter, and ultimately as author of a report on the results of his research. The definition of research instruments or tools here is very important because they are an integral part of the entire research process. However, in this context, research instruments refer to data collection tools or techniques (Moleong, 2013).

Instrument is a term commonly used by researchers to refer to measurement tools, such as questionnaires or checklists. The process of selecting research instruments is a very important step in the research process because this instrument is used to measure research variables. The type of research instrument to be used is determined based on data requirements analysis. It is important for research instruments to be able to capture each variable according to its conceptual or theoretical definition (Polit & Beck, 2012). Conducting a comprehensive literature search can help researchers identify appropriate instruments to use, such as through an in-depth literature review. In some cases, a literature review may be the best methodological approach to answer some research questions, such as evaluating theory or evidence in a particular field, or to test the validity or accuracy of a theory (Tranfield et al., 2003). This approach can be specific and focused, for example in investigating the relationship between two particular variables, or it can be broader, such as in exploring collective evidence in a particular research area (Snyder, 2019).

Building research and connecting it with existing knowledge is the core of every academic research activity. Currently, although knowledge production is growing rapidly, it is still fragmented and interdisciplinary. This creates challenges in keeping research current, becoming a leader in a particular field, and evaluating the collective evidence in a specific research area. Therefore, in-depth literature review as a research method is more important than ever. This method is considered an in-depth way of collecting and synthesizing previous research (Baumeister & Leary, 1997; Tranfield, Denyer, & Smart, 2003). A literature review carried out effectively and skillfully can form a strong basis for the advancement of knowledge and facilitate theory development. By integrating findings and perspectives from multiple empirical studies, in-depth literature reviews can provide answers to research questions with power that individual studies do not have (Webster & Watson, 2002).

The Review Method has become a significant research method in academia, and there are various guidelines that direct researchers to implement it with various approaches. Some common types of literature reviews include narrative or integrative reviews (Baumeister & Leary, 1997; Wong, Greenhalgh, Westhorp, Buckingham, & Pawson, 2013), which allow researchers to descriptively outline findings from previous studies in a narrative that coherent. There are also in-depth reviews, which are more structured and based on a clear methodology for identifying, evaluating, and synthesizing relevant research; and meta-analysis, which uses a statistical approach to quantitatively combine findings from various studies (Davis, Mengersen, Bennett, & Mazerolle, 2014; Liberati et al., 2009; Moher, Liberati, Tetzlaff, & Altman, 2009). Apart from that, there are also integrative reviews (Torraco, 2005), which combine and synthesize various concepts or theories from various research fields into one more comprehensive and integrated framework. Each type of review has its own use in understanding and synthesizing existing knowledge.

2. LITERATURE REVIEW

Instruments in a research context are tools used to do something, such as collecting data needed in research or investigation activities. Data collection instruments are tools chosen and used by researchers to collect data in an in-depth way and facilitate the work process. According to Arikunto (2021), data collection instruments help make research activities more structured and make research easier. Raco (2010) states that instruments are measuring tools used to obtain objective quantitative research results on various characteristics of change. Meanwhile, Hardani et al. (2020) explained that research instruments are usually used quantitatively to record the state and function of psychological characteristics, which can be divided into cognitive and non-cognitive characteristics. Cognitive characteristics are represented by questions, while non-cognitive characteristics are represented by statements (Nuriyati et al., 2022).

Based on the descriptions of several experts above, it can be concluded that data collection methods and tools are techniques and tools used in research to collect various data, both quantitative and qualitative. The use of data collection instruments helps make the research process more structured, in-depth, and makes it easier for researchers to obtain the necessary data. Therefore, the selection and use of appropriate data collection instruments is very important in conducting quality research.

In terms of qualitative research instruments, Lincoln and Guba revealed that the instrument of choice in naturalistic inquiry is humans. We will see that other forms of instrumentation may be used in later stages of investigation, but humans are primary and ongoing. But if human instruments have been used extensively in the early stages of investigation, then instruments can be built that are based on the data that human instruments have on the product (Sugiyono, 2017). According to Azwar (1999), forms of data collection instruments in social and psychological research include interviews, questionnaires, tests, psychological scales, and so on. Whatever form of data collection instrument is used, the issue of accuracy of purpose and use of the instrument (validity) and the reliability of the measurement results (reliability) are two non-negotiable characteristics, in addition to the demands for objectivity, efficiency and economy. Meanwhile, the forms of instruments used in research (Gulo, 2000) are detailed as follows:

a. Test Instrument

Tests can be in the form of a series of questions, worksheets, or the like that can be used to measure the knowledge, skills, talents and abilities of research subjects. There are several types of this test depending on the target and object being studied, such as a personality test; Talent test or aptitude test; Intelligence test or intelligence test; Attitude test or attitude test; Interest tests or measures of interest; Achievement test or achievement test.

b. Interview Instrument

A form of dialogue carried out by researchers to obtain information from respondents is called an interview. The instrument is called an interview guide or interviewguide. The types of interviews can be divided into Unstructured interviews; Semi-structured interviews; Structured or standardized interviews; Group interviews; Procedural/structural factors; Contextual factors.

c. Observation Instrument

Observation in research is defined as focusing attention on an object by involving all the senses to obtain data. Observation is direct observation using sight, smell, hearing, touch, or if necessary, taste.

d. Documentation Instrument

There are two types of documentation instruments, namely documentation guidelines which contain outlines or categories for which data will be sought, and check-lists which contain a list of variables for which data will be collected. The difference between these two forms of instrument lies in the intensity of the symptoms studied (Cooper et al., 2002).

Instrument Implementation is the process of preparing an assessment tool, because the assessment provides information about the object to be investigated. Therefore, providing instruments is an important step in the investigation process that cannot be ignored. This is done so that the data collected with test subjects remains sustainable as part of hypothesis testing (Darmalaksana, 2020). Instruments have a key role in determining the quality of an investigation, due to the validity or collection of data in a study. We can use existing instruments or create our own instruments (Purba et al., 2021). Existing instruments are generally considered standard for data collection. If an expert instrument is available to collect modified data in a study, we can use it directly, provided the underlying theory matches the theory in our study. Additionally, the modification of the construct measured by the instrument must be the same as the modification of the construct in the study. However, if there is no suitable instrument, we need to create an instrument to collect the modified data ourselves (Yusup, 2018).

Carrying out research is like putting together a puzzle according to the stated investigative objectives. Therefore, the objectives must be clear and specific in order to guide researchers through an unexpected journey of exploration. Research objectives are usually expressed in the infinitive form and are aimed at achieving certain results. Some authors, such as (de Barrera et al., 2005), express that research objectives pass through several levels: the perceptual level at which the researcher explores and describes; the level of Understanding at which they analyze and compare; the Comprehensive level at which explanations, predictions, and proposals are made; and the Integrative level where modification, confirmation, and evaluation are carried out. In other words, research objectives direct researchers through an in-depth and gradual research process to achieve a deep understanding of the subject under study (de Barrera et al., 2005; Trigueros, 2019).

3. METHODS

This research is an in-depth review using various previous studies as study material. This method is carried out by identifying, reviewing, evaluating, and interpreting all available research. Researchers reviewed articles that were appropriate to the topic of the research question. The review process is carried out in depth, structured and in-depth in each process by following predetermined stages (Triandini et al., 2019). To ensure optimal writing results, this research is based on Research Questions (RQ). The purpose of this Research Question is designed to provide more focus on the literature review as well as assist researchers in finding relevant data.

Table 1. Research Question

RQ	Motivation
How does instrument design play a critical role in achieving research objectives?	By understanding how well-designed instruments can aid in gathering valid and relevant data, this study is expected to offer valuable insights for researchers in designing their studies more effectively.
What are the important implications in supporting the effective attainment of research goals?	This research can serve as a solid foundation for the development of better research methodologies in the future.

The articles used in this literature review were obtained through searches using databases such as Google Scholar, Science Direct, Scopus, Springer Link, WOS (Web of Science), Sprott and others. A search for research literature appropriate to the research topic was carried out using the keyword "educational research instruments". The literature search process was carried out in March-April 2024 and the articles were then sorted based on research topics. A total of 30 research articles were collected and are considered to represent all research articles discussing research instruments within the scope of educational science. The articles used are articles that have been published in the last ten years.

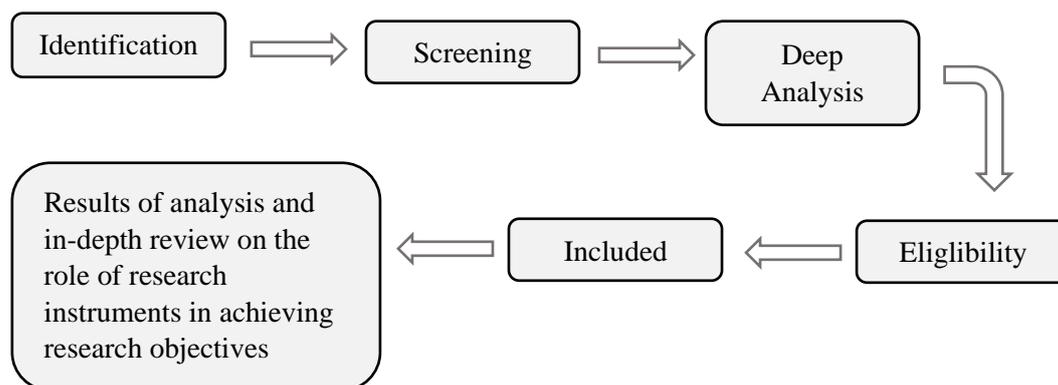
The selection of articles used in writing this literature requires the application of inclusion and exclusion criteria which are the main focus of the research. The results of the data search using these criteria were then used to conduct an article review. Thus, this process ensures that only articles that are relevant and fit certain criteria are used in this literature review.

Table 2. Inclusion and Exclusion Criteria

Inklusi	Eksklusi
<ul style="list-style-type: none"> Articles must relate to the role of instrument design in achieving research objectives. Articles can be empirical studies, literature reviews, or theoretical reviews relevant to the topic. Articles published from 2014 to 2024 Articles about students and teachers 	<ul style="list-style-type: none"> Articles that are not accessible or readable in full Articles in the form of final program research (thesis/dissertation)

The data analysis method used is the narrative method. The purpose of the narrative method is to explain how the role of research instruments is able to provide an achievement in the research objective. After going through the filtering stage, there were 387 articles remaining after removing duplicate and irrelevant articles, with more articles appearing outside the field of education. Then, at the eligibility stage, 30 articles were selected based on exclusion criteria. Then the article is studied in depth to obtain conclusions that support the research questions.

Picture 1. In-Depth Review Flowchart



4. FINDINGS AND DISCUSSION

The data findings describe the number of journals that support the study topic of "The Critical Role of Instrument Design in Achieving Research Objectives" in each year, from 2016 to 2024, along with the percentage of the total number of journals found in each year. The following is a graph of the distribution of journals in each year after going through the data screening and filtering process:

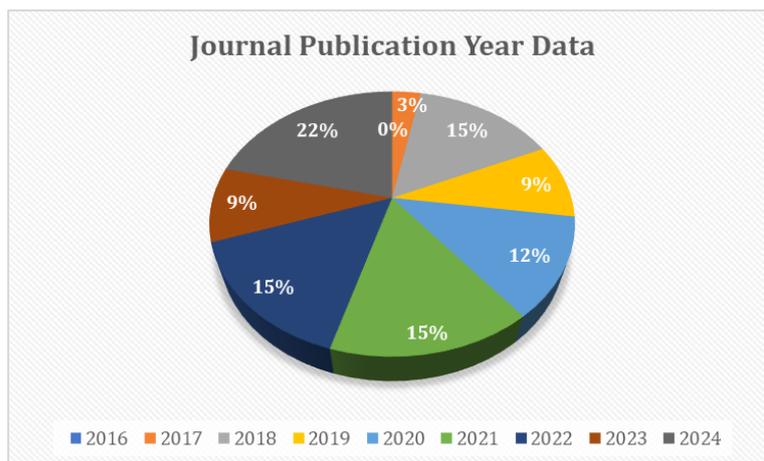


Figure 2. Distribution of articles by year

In 2016, there were no journals that supported the topic "The Critical Role of Instrument Design in Achieving Research Objectives" which was included in the review study, after a filtering process was carried out. So the percentage of journals in 2016 was only 0% of the total number of journals included in the criteria. Then there were two journals included in the criteria that supported the study topic in 2017, which constituted 7% of the total number of journals included in the review study. The number of journals in 2018 included in the review study was five journals or more than the previous year, contributing around 17% of the total number of journals included. In 2019 there were four journals included in the review study, which is equivalent to 13% of the total number of journals included. Then the number of journals included in the review study fell to just three journals in 2020, contributing around 10% of the total number of journals included. In 2021, there are again four journals that meet the criteria and are included in the review study, which is 13% of the total number of journals included. Furthermore, the number of journals included in the review study will be three in 2022, contributing around 10% of the total number of journals included. In 2023, there were five journals included in the review study, which constituted 17% of the total number of journals included. Finally, in 2024, there will be four journals that support and are included in the review study, which also accounts for 13% of the total number of journals included.

Then data on the use of instruments in journals has also been recorded, which includes the use of instruments for qualitative and quantitative studies which are divided into Test Instruments, Interview Instruments, Observation Instruments and Documentation Instruments, with a description as below:

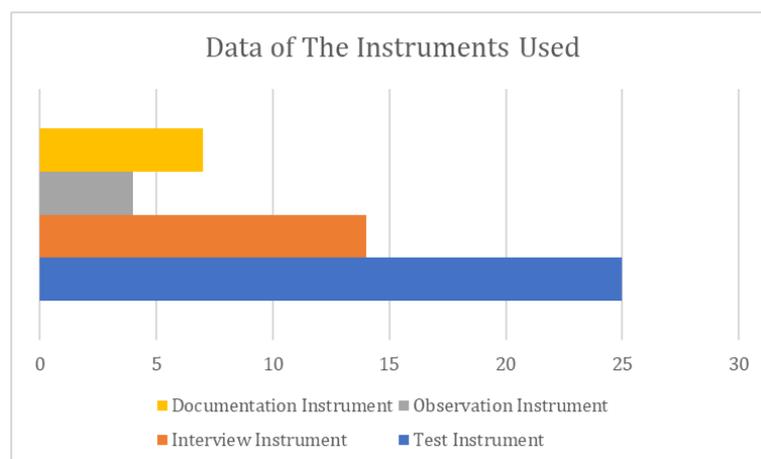


Figure 3. Distribution of articles based on research instruments

This data provides an overview of the distribution of types of research instruments used in journals. In detail, it can be explained that the distribution of data for the test instruments used in the 20 journals that have been analyzed. These test instruments may include a variety of evaluation tools, such as questionnaires, standardized tests, or other assessment tools. The use of test instruments shows a tendency to measure certain variables in

research, such as respondents' attitudes, knowledge or behavior. Then as many as 15 journals used interview instruments in their research. Interview instruments are used to obtain data directly from respondents through face-to-face or virtual interactions. These interviews can be structured, semi-structured, or unstructured, depending on the research approach used. The observation instruments were used in the 8 journals analyzed. This instrument allows researchers to observe and record directly observed behavior, situations, or phenomena. The use of observational instruments is often relevant in qualitative research where the researcher wishes to understand in depth a social context or interaction. Finally, there are 13 journals that use documentation instruments. Documentation instruments include collecting data from written or recorded sources, such as archives, official documents, text or voice transcripts, social media, or others. The use of documentation instruments can provide valuable insight into past events or recorded behavior.

From the explanation above, we can see that a variety of research instruments are used according to methodological needs and research objectives in the journals analyzed. These instruments each provide a different approach to data collection that supports achieving research objectives. The number of journals that use research instruments is more than 30 because there are a number of studies that use the same instruments in one study (Crowder et al., 2019; de Barrera et al., 2005; DeRosier & Thomas, 2018; Fuchs, 2022; Kilgus et al. ., 2020; Murano et al., 2021; Pancorbo et al., 2020; Williams et al., 2018), such as in mixed method studies, or qualitative research which usually uses more than instruments.

The distribution of journals reviewed in the research context based on research methods provides an overview of the methodological approaches most frequently used in research that supports research studies. The following is a graphic depiction of the distribution:

Data of The Method Used

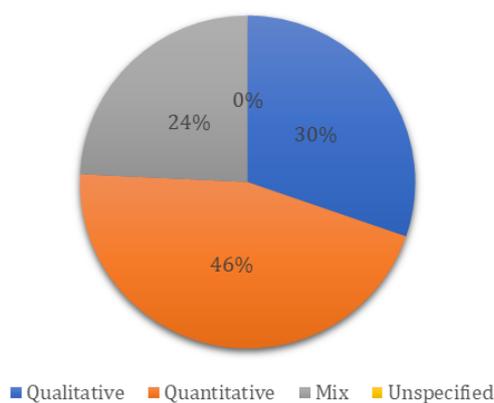


Figure 4. Distribution of articles based on research methods

Qualitative research methods were used in all 10 of the journals reviewed, emphasizing in-depth understanding of social phenomena and the complexity of context, often through narrative, interpretive, or phenomenological analysis. Furthermore, quantitative research methods are used in the 15 journals reviewed, which measure phenomena numerically, using data that can be measured objectively to produce generalizations and predictions. Finally, a mixed approach was used in the 8 journals reviewed where this approach combines elements of qualitative and quantitative methods to obtain a more complete understanding of the phenomenon under study. Of the total journals reviewed, there was no journal that did not specify the research methods used. The graph above shows that quantitative research methods are the most commonly used, followed by qualitative and mixed methods. Mixed approaches are increasingly popular because they can provide a more comprehensive understanding of the phenomenon under study by exploiting the strengths of each method.

The distribution of journals reviewed in the research context by country shows the diverse contributions of various countries in research on the topic. The following is an illustration of the distribution of articles reviewed in the context of this research by country:

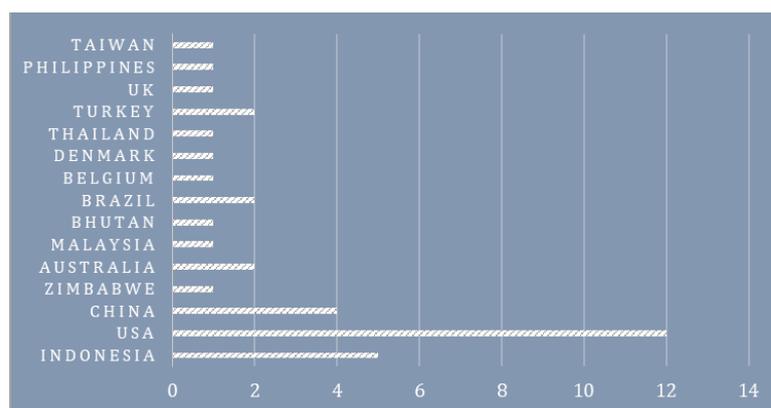


Figure 5. Distribution of articles by country

Among the countries above, the majority of research was conducted in the United States (USA), which dominated with 12 journals reviewed. This is not surprising considering its position as one of the world's leading research and education centers. Then Indonesia has a significant contribution with five journals reviewed and China also with four journals reviewed. This was followed by Australia, Brazil and Turkey who contributed two journals that were reviewed, and then the UK, Malaysia, Bhutan, Thailand, Denmark, Belgium, the Philippines, Taiwan and Zimbabwe each contributed one journal that was reviewed. The data above was taken based on the total journals collected and went through a filtering process according to research methods and based on inclusion and exclusion criteria. From this distribution, it can be seen that research on educational research and development involves various countries around the world, showing broad contributions from various cultural and academic contexts.

By utilizing in-depth review studies in the educational realm, the number of in-depth review studies that review how research instruments play a role in research objectives is still very minimal and therefore needs to be carried out. In-depth reviews play an important role in providing a comprehensive overview of the field under study. Through this approach, topics that require future attention, knowledge gaps, and deficiencies in the literature can be identified (Cinar, 2021). This research aims to make an in-depth review of articles about education found in various databases to then examine in depth the critical role of the research instruments. In this way, a profile of educational articles will be formed with identified methods and instruments.

When analyzed by country of origin, educational articles from the USA, Indonesia and China stand out, which may be due to the high interest in education in these three countries. Therefore, there are many educational initiatives in all three countries. Several studies on education with different study themes also show that the USA is the most prominent (Li et al., 2022; Sawangmek, 2019), but several others show differences (Ashraf et al., 2021; Talan, 2021). It is important to note that in some studies, the United States dominates (Marín-Marín et al., 2021; Thu et al., 2021; Yu et al., 2016). This is consistent with America's superiority in learning according to (Wilson et al., 2022). In other research, South Korea, the United States and Indonesia lead in productivity (Santi et al., 2021). These differences may be related to differences in keywords, search strategies, and databases used.

Finding articles about education included in the review as a whole tend to increase from 2016 to 2024, although there is a decrease in 2019 and 2023, this can occur due to various factors, both external and internal, such as social issues, accessibility to conduct studies, factors research inclusion, exclusion, limitations in data collection and other matters. Because the study focuses on the role of a research instrument, this data is only a report on the distribution of reviewed articles by year. It was noted that the number of articles from 2017 continued to increase (Muchson et al., 2024). Results related to increasing articles have also been reported in a number of studies (Vincent-Lancrin & Jacotin, 2023; Wang et al., 2023).

Research in this scope generally uses quantitative research methods. Quantitative research is research that is based on facts or reality and uses lots of numbers (Ali et al., 2022). (Irwanto et al., 2022) found that quantitative methods are more commonly used, besides that quantitative research can examine various aspects of education (Karimuddin et al., 2021). Qualitative research in the field of education aims to understand and explore in depth and empathy the processes, activities, patterns, models, procedures, culture, approaches, methods, strategies, assessment and evaluation in the realm of education. This means that qualitative research when used in education is useful for finding solutions or new theories in the world of education (Sidiq & Choiri, 2019). The study findings

also show the use of mixed methods to support research objectives. The combination of quantitative and qualitative methods in a mixed approach is carried out to correct errors that occur in research, where the emphasis is on application and solutions to problems rather than having to focus on one method (Indrawan & Jalilah, 2021).

This instrument is the instrument most widely used in this research and is also the most commonly used (Indrawan & Jalilah, 2021). This form of instrument can be used, one of the ways, in evaluating the ability of students' learning outcomes in elementary schools, of course by paying attention to fundamental aspects such as abilities in knowledge, attitudes and skills possessed either after completing one particular material or all the material that has been presented (Thalha et al. ., 2019). In the review, we found a number of studies on student psychology, which examine how students can feel belonging to a number of inherent components and aspects, such as valued group involvement, intrapersonal factors, meaningful personal relationships, environmental factors, social aspects of belonging, identification with a group, safety. needs, and so on (Slaten et al., 2018; Williams et al., 2018). Of course, a number of these studies use test instruments to support research objectives.

Interview instruments, especially unstructured and semi-structured interviews, are often used in qualitative research, where in this study they are the second most popular instrument. This instrument is used in qualitative research because it can reveal information across time, namely relating to the past, present and future. And the data produced from interviews is open, comprehensive and unlimited, so that it is able to form complete and comprehensive information in revealing qualitative research (Ulfatin, 2014). Regarding this instrument, in an in-depth review of the data from this research, a number of studies were found that examined the experiences of teachers or teaching staff in teaching practice, forming teaching skills and professional identity (Dalimunthe et al., 2024; Lin et al., 2021; Marsofiyati et al. , 2024; Rosenberg et al., 2023) which of course requires an interview instrument that is able to accommodate information related to this information.

Humans need a strong foundation in carrying out systematic studies, in capturing the symptoms that reality visualizes (Prabandari, 2010). Observation in its implementation not only acts as the earliest and most basic technique in research, but is also the most frequently used technique, such as participant observation, experimental research design, and interviews. According to Johnson (1975) everyone can make observations, from simple forms to the most complex levels of observation. The observation methods used in each research activity vary, depending on the setting, needs and research objectives (Hasanah, 2016). In the context of this in-depth review, a number of studies were found that required information that required complete data visually through existing symptoms, both qualitative (Naturalistic) (Block et al., 2019; Fernandes et al., 2022; Fuchs, 2022; Victoriano & Ocbeña, 2024), quantitative (standardization and control) (Crowder et al., 2019; Gresham et al., 2020; Murano et al., 2021) and mixed methods (Chiang et al., 2022; Habig & Gupta, 2021; Rabgay, 2018). These findings certainly require observation to provide additional information and data through visual symptoms.

Documentation techniques are tracking and obtaining the required data through available data (Rukminingsih et al., 2020). (Sugiyono, 2017) said that documentation studies are a complement to the use of observation and interview methods in qualitative research. The use of documentation as a means of collecting data is based on various sources of information such as articles, places and people (Amri, 2018). In this research, a number of studies were found that reviewed the development of students (Tuhuteru et al., 2023), teachers (Rosenberg et al., 2023) and school staff (Ward et al., 2023), apart from that, this research also identified barriers to learning. (Victoriano & Ocbeña, 2024), teaching challenges (Fernandes et al., 2022) and the learning process and perspectives of students with disabilities (Block et al., 2019). These studies certainly require comprehensive documentation for detailed data during the process, developments and things that happened during the research.

5. CONCLUSION

Although there have been systematic reviews of education in various literatures, research that specifically explores the study of research instruments is still limited. Current research focuses on theories about research instruments. In this research, articles about education registered in international journals were analyzed, focusing on research methods and instruments. Based on research results and reviews examining articles about education, it was noted that the USA, Indonesia and China were the countries with the largest number of articles. The findings show that the number of articles about education continues to increase every year, with the majority of articles published in 2024. Test instruments are still a favorite in education articles, but it is important to note that some articles do not support the findings of this research. Groups of research subjects from various groups such as students, teaching staff and staff. The research instruments used are tests, interviews, documentation and

observation, while tests and interviews are the most widely used. This is also shown in the percentage distribution of research methods in the journals reviewed, the quantitative number is 46%. Test instruments can be used as measurements or assessments for research needs and in this study there were 25 studies with test instruments. Interview instruments can accommodate information across time and are more complex and in this research there were 14 studies with interview instruments. The observation instrument was used to collect data through visual symptoms and in this study there were 6 studies with observation instruments. Documentation is a means of collecting data based on various sources of information such as articles, places and people and in this research there were 7 studies with documentation instruments.

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