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# Instructional Models and Affective Factors in Statistical Literacy: A Systematic Literature Review

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***ABSTRAK***

*Statistical literacy is an important skill in understanding, interpreting, and evaluating data-based information. However, students' statistical literacy levels remain relatively low. Variations influence them in learning models and affective factors, yet studies systematically mapping trends in these areas and their relationships remain limited. This study aims to identify trends in learning models in the development of statistical literacy, examine the affective factors studied, and analyze the relationship between statistical literacy and affective factors. The method used was a Systematic Literature Review (SLR) using the PRISMA framework, comprising 16 articles published between 2016 and 2026, obtained from the ERIC, Google Scholar, and Scopus databases. The results of the study show that Problem-Based Learning, Project-Based Learning, and Contextual Teaching and Learning are the most dominant learning models and are reported to be effective in improving statistical literacy. The most frequently studied affective factors included statistical anxiety, attitudes toward statistics, curiosity, self-efficacy, and self-confidence. In addition, the literature showed a positive relationship between statistical literacy and positive affective factors, as well as a negative relationship with statistical anxiety.*

***Keywords***: *Statistical literacy*, *Instructional models*, *Affective factors*, *Systematic literature review*

## 1. INTRODUCTION

Statistical literacy is an individual's ability to read, interpret, critically evaluate, and communicate statistical information encountered in everyday life and in various media reports (Budgett & Rose, 2021; Schield, 2021). Gal (2002) describes statistical literacy as the ability to access, understand, interpret, critically evaluate, and, where relevant, express opinions on statistical messages and data-based arguments. In this framework, statistical literacy encompasses not only an understanding of statistical terms, symbols, and representations, but also of data variation, uncertainty, and differences between groups, enabling individuals to make informed decisions across contexts (Cansiz et al., 2021; Denis, 2021).

Statistical literacy skills play a strategic role because they are closely related to accountability, quality control, and future planning in various fields, including the education sector (Watson & Callingham, 2020). Education policymakers, for example, are required to understand and use national and international statistical reports in decision-making related to resource allocation, program evaluation, and curriculum development (Bargagliotti et al., 2021). Gal (2002) emphasizes that statistically literate behavior is supported by a combination of five knowledge bases (literacy, statistics, mathematics, context, and critical thinking) that interact with a set of supporting dispositions and beliefs, so that both cognitive and affective aspects play a role in statistical literacy.

However, quantitative and statistical literacy in Indonesia remains a significant challenge, as reflected in Indonesian students' mathematics scores in international assessments, which consistently fall below the OECD average (OECD, 2023; Tohir, 2019). This position indicates that students have limited ability to understand and use quantitative and statistical information in problem-solving and decision-making contexts (Prahmana et al., 2021; Wardono et al., 2020). Low statistical literacy can have adverse effects across various fields, including education, the workplace, and public decision-making (Frischemeier et al., 2021). At the same time, within the educational environment, the use of data to inform learning decisions and school policy is often suboptimal, partly due to psychological factors such as statistical anxiety, which can hinder the understanding and interpretation of statistical information (Cui & Tuo, 2021; Fathunnisa & Wahyudin, 2024).

Efforts to improve students' statistical literacy are carried out, among other things, by applying appropriate learning models oriented toward conceptual understanding and statistical reasoning. Various learning models have been developed and used in statistics education, including inquiry-based, project-based, and contextual problem-solving, as well as the use of technology to support data investigation (Fitriani et al., 2021). However, their effectiveness depends heavily on these models' ability to facilitate students' understanding of statistical concepts through authentic, real-life problems. Hafiyani et al. (2020) emphasize the importance of learning designs that provide opportunities for students to explore data, discuss findings, and reflect on their reasoning, thereby enabling meaningful development of their ability to interpret data, reason from data, and make evidence-based decisions.

In addition to learning models, affective factors also play an important role in the development of statistical literacy. Factors such as attitudes toward statistics, interest in learning, self-confidence, and statistical anxiety have been shown to influence how students process and interpret statistical information, with anxiety and negative attitudes being

associated with avoidance of statistical tasks and lower learning outcomes, while positive attitudes and high self-efficacy support active engagement and persistence in solving statistical problems (Setiawan et al., 2021). Gal (2002) emphasizes that individual dispositions toward statistical information, including beliefs, critical attitudes, and a tendency to question data-based arguments, are integral to statistical literacy. Therefore, statistical literacy is understood as the result of the interaction between statistical knowledge, contextual understanding, and affective factors.

Although various studies have investigated the effectiveness of instructional models in improving students' statistical literacy, while others have explored the influence of affective factors such as attitudes, motivation, self-efficacy, and anxiety, these findings remain fragmented across different contexts and educational levels (Maryati & Priatna, 2022). Existing studies generally examine instructional models and affective factors separately, making it difficult to obtain a comprehensive understanding of how both aspects jointly contribute to the development of statistical literacy. Furthermore, previous review studies have not systematically mapped the instructional models used, the range of affective factors investigated, and the empirical relationships between these variables across educational levels (Yusny & Maryam, 2023). Therefore, a systematic literature review is needed to synthesize existing evidence, identify research trends and gaps, and provide a comprehensive overview of instructional models and affective factors associated with statistical literacy. The findings are expected to serve as a reference for future research and support the development of more effective statistics instruction.

The following research questions guided this study. RQ1: What are the research trends in instructional models used to develop statistical literacy in recent years? RQ2: What affective factors have been studied in studies on statistics learning? RQ3: What relationships between statistical literacy and affective factors are reported in the literature?

## 2. METHOD

### 2.1. Research Design

This study used the systematic literature review (SLR) method to synthesize empirical and conceptual research on statistical literacy in Indonesia. According to Moher et al. (2009), SLR addresses clearly formulated questions and systematically identifies, selects, and analyzes relevant studies. The review process, guided by Petticrew & Roberts (2020) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, included defining research questions, searching databases, applying inclusion/exclusion criteria, selecting studies, extracting and analyzing data, and summarizing findings. The process is illustrated in Figure 1.

*Identification*

The literature search was conducted in the ERIC, Google Scholar, and Scopus databases to identify studies relevant to statistical literacy, instructional models, and affective factors in statistical learning research. These databases were selected because they provide access to a variety of reliable, peer-reviewed journals, ensuring the quality and relevance of the articles obtained. The research identification process was carried out through a focused search using

key terms such as "statistical literacy," "instructional models," and "affective factors" to facilitate the researcher's ability to find relevant articles in each database. A total of 318 articles were obtained from the ERIC, Google Scholar, and Scopus databases using the previously described key terms.

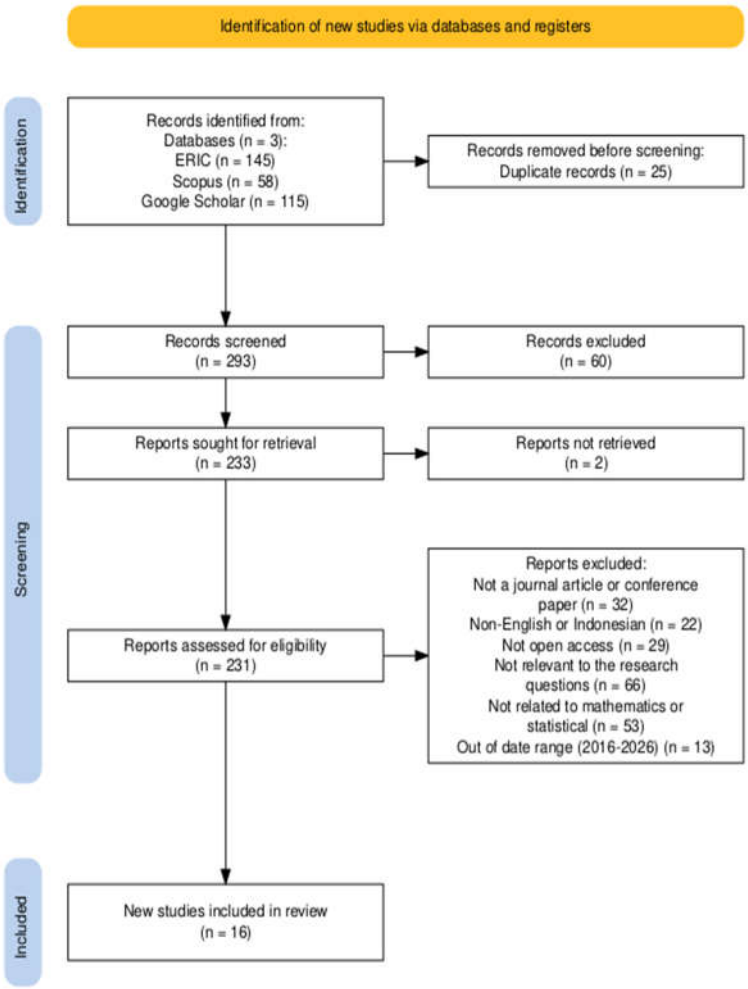



Figure 1. PRISMA Flowchart (Source: Authors' own elaboration)

*Screening*

The articles obtained were selected to ensure their suitability and relevance to the research objectives. Inclusion and exclusion criteria were systematically established based on the research objectives and scope of the topic under review. The screening stage was carried out through the review and selection of articles, taking into account the following criteria: (1) articles indexed in the Scopus, ERIC, or Google Scholar databases,
(2) published in scientific journals with peer review to ensure that the selected articles go through high-quality reviews,
(3) written in English or Indonesian,
(4) not duplicates of the search results in the three databases, and
(5) full-text accessibility of the articles.

At this stage, 25 duplicate articles in the three databases were removed, and 145 articles were excluded because they failed to meet the inclusion criteria, such as a lack of empirical

focus, not written in English or Indonesian, not available in full text (open access), or publication types other than journal articles.

*Eligibility*

The eligibility verification stage is the third stage of the systematic search strategy and assesses the articles remaining after the screening process. At this stage, the titles and abstracts of the remaining articles were examined to determine their relevance to instructional models, affective factors, and statistical literacy. Articles that met the inclusion criteria were then assessed through a full-text review to evaluate their methodological quality, relevance to the research objectives, and completeness of the reported findings. Only studies that satisfied all predefined eligibility and quality assessment criteria were included in the final review. Next, articles were evaluated based on the following criteria:

(1) articles published in the last ten years, namely 2016–2026;
(2) relevance of articles to the research questions; and
(3) suitability of articles to the field of statistical education.

At this stage, 132 articles were excluded for failing to meet the specified criteria. Of these, 13 articles were outside the 2016–2026 time frame, 66 articles were not relevant to the research question, and 53 articles were not related to the field of mathematics education or statistical literacy. Consequently, a total of 16 articles were selected for the final review and further analysis to answer the research questions.

*Included*

The systematic screening process through PRISMA yielded a final selection of 16 articles that met all predefined inclusion criteria.

## 3. RESULT AND DISCUSSION

### 3.1. Results

This section presents the results of an analysis of 16 articles that met the inclusion criteria and were obtained from the ERIC, Google Scholar, and Scopus databases through the application of a Systematic Literature Review framework. This analysis aims to answer three research questions, namely: (1) What are the research trends in instructional models used to develop statistical literacy in recent years? (2) What affective factors have been studied in studies on statistics learning? (3) What relationships between statistical literacy and affective factors are reported in the literature?

*RQ1: What are the research trends in instructional models used to develop statistical literacy in recent years?*

To answer RQ1, the analysis focused on mapping trends in learning models used in statistical literacy development research at various levels of education. Articles that met the inclusion criteria were analyzed according to the type of learning model, the characteristics of the learning approach, and the learning orientation applied. This analysis aimed to identify dominant patterns and trends in the use of learning models in statistical literacy research over

the past few years. To clarify these trends, Table 1 summarizes the learning models used in the selected articles.

Table 1. Results of Statistical Literacy Learning Model Topic Analysis

| No | Author | Journal | Research Results |
|---|---|---|---|
| 1 | Setiani & Suyitno (2021) | Qalamuna -Jurnal Pendidikan, Sosial, dan Agama | The results showed that the Problem-Based Learning model was effective in improving students' statistical literacy, as evidenced by achieving a classical mastery rate above 75% and a higher average statistical literacy score than in the direct learning model. |
| 2 | Domu et al., (2023) | Journal of Education and e-Learning Research | The results of this study indicate that integrating the Problem-Based Learning model has a significant positive impact on students' statistical literacy. |
| 3 | Sitompul et al., (2023) | Journal PEKA | The results of the study indicate that Problem-Based Learning (PBL) is a dominant and effective instructional model for improving students' statistical literacy through student-centered learning grounded in real-world problems. |
| 4 | Faridah et al., (2022) | Journal BASICEDU | The results of the study indicate that the Project-Based Learning (PjBL) model has a positive impact on the statistical and digital literacy of elementary school students through active project-based learning and real-world experiences. |
| 5 | Srikoon et al., (2024) | Malaysian Journal of Learning and Instruction | Research trends show that statistical literacy is developed through Problem-Based Learning (PBL), Project-Based Learning (PBL), and Contextual Teaching and Learning (CTL). These approaches are more effective because they are student-centered and relate learning to real-world contexts. |
| 6 | Fery et al., (2017) | Educational Research and Reviews | Research shows that statistical literacy is develops through technology-based Contextual Teaching and Learning, which links material to real-world contexts and improves student learning outcomes. |
| 7 | Boonsot & Chookhampaeng, (2024) | Journal of Education and Learning | Research trends indicate the use of flipped classrooms and Realistic Mathematics Education, grounded in contextual learning and technology, to develop statistical literacy. |

Based on a literature review, trends in statistical literacy development research are dominated by active and student-centered learning models, such as Problem-Based Learning, Project-Based Learning, and Contextual Teaching and Learning, which effectively link statistical concepts to real-world contexts. In addition, the integration of technology through flipped classrooms and interactive digital media is becoming increasingly popular, making constructivist and technology-based learning models the main trends in statistical literacy.

*RQ2: What affective factors have been studied in studies on statistics learning?*

To answer RQ2, this study focuses its analysis on mapping the affective factors examined in statistical learning research. Six articles that met the inclusion criteria were analyzed according to the types of affective factors examined and their contributions to the statistical

learning process and outcomes. This analysis aims to reveal the affective factors that receive the most attention in statistical learning research. Table 2 presents a summary of the six articles along with the affective factors studied.

Table 2. Results of Affective Factor Topic Analysis in Statistical Learning Studies

| No | Author | Journal | Research Results |
|---|---|---|---|
| 1 | Jalal et al., (2023) | Malaysian Online Journal of Educational Sciences | This study examines attitudes toward statistics and statistical anxiety among education policymakers. The results show that statistical anxiety contributes significantly to statistical literacy, whereas attitudes do not. |
| 2 | Setiani et al. (2024) | AlphaMath: Journal of Mathematics Education | The results show that curiosity has a positive and significant effect on the statistical literacy of vocational high school students. Students with high levels of curiosity demonstrate better data interpretation skills, while low curiosity hinders their ability to calculate, present, and conclude data. |
| 3 | Jamaluddin et al.,(2025) | Jurnal Psikologi Karakter | The results show that the affective factors examined in statistical learninf research include self-efficacy and self-regulation. |
| 4 | Widya & Sukoriyanto, (2023) | Indiktika : Jurnal Inovasi Pendidikan Matematika | The results show that the affective factors in statistics learning include curiosity, self-confidence, and mathematical self-esteem. |
| 5 | Saija (2018) | Jurnal Padegogik | The results showed that students' learning independence in statistics was in the fair-to-good range. |
| 6 | Ningsih et al., (2017) | Al-Jabar: Jurnal Pendidikan Matematika | The results of the study indicate that the affective factor examined in the study of statistics learning is learning independence, which affects students' ability to understand and learn statistics material independently. |

Based on a literature review, the analysis shows that the most frequently studied affective factors in statistics learning include attitudes toward statistics, statistics anxiety, curiosity, self-efficacy, self-regulation, self-confidence, mathematical self-esteem, and learning independence. Overall, these articles conclude that affective factors play an important role in statistics learning: positive affective factors support understanding and learning engagement, while negative affective factors, such as statistics anxiety, can hinder learning outcomes.

*RQ3: What relationships between statistical literacy and affective factors are reported in the literature?*

To answer RQ3, the analysis focused on examining the relationship between statistical literacy and affective factors as reported in previous studies. Articles that met the inclusion criteria were analyzed according to the type of affective factors examined and the direction and form of the relationships found with statistical literacy. This analysis aims to provide an overview of the pattern of relationships between statistical literacy and affective factors reported in the literature. Table 3 summarizes articles examining these relationships.

Table 3. Results of Relationship Analysis between Statistical Literacy and Affective Factors

| No | Author | Journal | Research Results |
|---|---|---|---|
| 1 | Liyanti et al., (2025) | Journal Of Mathematics Learning Innovation (JMLI) | The results show that the relationship between statistical literacy and affective factors indicates a significant positive correlation between students' mental resilience and curiosity and their statistical literacy skills. |
| 2 | Amidi et al., (2025) | Educational Process: International Journal | The study's results show a positive relationship between affective factors, particularly student self-confidence, and statistical literacy. Students with high self-confidence tend to be more active in problem-solving, calmer when facing challenges, and better able to communicate statistical ideas. |
| 3 | Korolkiewicz et al., (2025) | Teaching Statistics | The results of the study indicate a positive relationship between statistical literacy and affective factors: low statistical anxiety, positive attitudes, and self-efficacy are associated with improved statistical literacy. |

Based on the literature analysis, there is a significant positive relationship between statistical literacy and students' affective factors. Factors such as self-confidence, curiosity, mental toughness, and self-efficacy play an important role in improving students' ability to understand, communicate, and apply statistical concepts. In addition, low statistical anxiety and positive attitudes toward statistics are reported to correlate with increased statistical literacy, as they enable students to face cognitive challenges in a calmer, more reflective manner. Overall, the literature confirms that positive affective factors are key supporters in the development of statistical literacy, so that affective aspects need to receive equal attention to cognitive aspects in statistics learning.

### 3.2. Discussion

The results of the study show that the literature consistently reports a significant positive relationship between statistical literacy and students' affective factors. Among the reviewed studies, self-efficacy emerged as the most frequently investigated affective factor and was consistently associated with higher levels of statistical literacy**.** Factors such as self-confidence, curiosity, mental toughness, and self-efficacy have been shown to contribute to students' ability to understand, communicate, and apply statistical concepts. In addition, low statistical anxiety and positive attitudes toward statistics were associated with better statistical literacy outcomes. Although the reviewed studies generally reported positive relationships, the strength of evidence varied across affective factors, with self-efficacy receiving greater empirical attention than other factors such as curiosity and mental toughness.

These findings reinforce the view that affective factors play an important mediating role in the development of statistical literacy. Low statistical anxiety allows students to process information more calmly and reflectively, thereby supporting statistical reasoning and data-based decision making. This aligns with previous research indicating that statistical anxiety can hinder students' conceptual understanding and learning performance (Cui & Tuo, 2021; Maryati & Priatna, 2022). Conversely, curiosity and mental toughness encourage students to persevere in the face of cognitive challenges, especially when dealing with uncertain data and complex contextual problems, as reported by Liyanti et al. (2025) and Setiani et al. (2024).

Theoretically, the results of this study align with the statistical literacy framework proposed by Gal (2002), which posits that statistical literacy arises from the interaction between an individual's cognitive knowledge and affective disposition. Self-confidence and self-efficacy reinforce student engagement in statistical learning, making students better prepared to critically interpret, evaluate, and communicate statistical information (Amidi et al., 2025; Setiawan et al., 2021). Thus, these findings confirm that efforts to develop statistical literacy cannot focus solely on cognitive aspects; they must simultaneously integrate learning strategies that strengthen students' affective factors, enabling statistical literacy to develop optimally and sustainably.

## 4. CONCLUSION

This Systematic Literature Review (SLR) shows that the development of statistical literacy in recent years has been dominated by active, student-centered learning models, such as Problem-Based Learning, Project-Based Learning, and Contextual Teaching and Learning integrated with technology. These models are effective at improving statistical literacy through contextual learning and data-based problem-solving. In addition, this study found that affective factors, such as statistical anxiety, attitudes toward statistics, self-efficacy, self-confidence, and curiosity, play an important role in supporting statistical learning. This review also indicates that curiosity and learning independence are the most frequently investigated affective factors. Statistical anxiety consistently shows a negative relationship with statistical literacy, and no contradictory findings regarding the direction of these relationships were identified in the reviewed studies. Therefore, further research is recommended to examine in more depth the relationship between learning models and affective factors in the development of statistical literacy.

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