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Bridging Theory and Practice: A Literature Review on Learning Trajectories in Statistical Literacy Instruction

Rahma Siska Utari[1], Ratu Ilma Indra Putri[2*], Zulkardi[3], Hapizah[4]
[1,2*,3,4]Mathematics Education Study Program, Sriwijaya University, Palembang, Indonesia
[1]rahmasiskautari@fkip.unsri.ac.id; [2*]ratuilma@unsri.ac.id; [3]zulkardi@unsri.ac.id; [4]hapizah@fkip.unsri.ac.id

ABSTRAK

Literasi statistik merupakan keterampilan penting, terutama bagi calon guru yang akan mengajarkan konsep-konsep statistik kepada siswa. Namun, banyak calon guru yang kesulitan dalam memahami dan menerapkan konsep statistik secara efektif. Penelitian ini bertujuan mengkaji secara sistematis temuan-temuan terdahulu mengenai penggunaan *Learning Trajectory* (LT) dalam pembelajaran literasi statistik bagi calon guru, guna merancang kerangka pembelajaran yang lebih terstruktur dan aplikatif. Metode yang digunakan adalah *Systematic Literature Review* (SLR) berdasarkan model Xiao & Watson, yang mencakup tiga tahap: perencanaan, pelaksanaan, dan pelaporan tinjauan. Artikel diperoleh dari database *Education Resource Information Centre* (ERIC), melalui proses seleksi bertahap yang terdiri dari penyaringan kualitas, penyaringan kelayakan, dan penyaringan relevansi, hingga diperoleh 7 artikel akhir dari 31 artikel awal. Teknik analisis yang digunakan adalah *thematic coding* untuk mengidentifikasi pola dan kesenjangan dalam penelitian sebelumnya. Hasil menunjukkan bahwa *learning trajectory* berpotensi besar dalam meningkatkan pemahaman statistik calon guru dengan menyelaraskan pembelajaran secara progresif, meskipun integrasi konteks lokal dan fokus eksplisit pada calon guru masih jarang ditemukan. Kesimpulannya, *learning trajectory* yang dirancang secara kontekstual dapat menjadi jembatan antara teori dan praktik dalam pembelajaran literasi statistik untuk calon guru.

Kata Kunci: Literasi Statistik; *Learning Trajectory*, Pendidikan Calon Guru; Pembelajaran Statistik; S*ystematic Literature Review*

ABSTRACT

Statistical literacy is an essential skill, particularly for prospective teachers who will be responsible for teaching statistical concepts to students. However, many prospective teachers struggle to understand and effectively apply these concepts. This study aims to systematically examine previous findings on the use of Learning Trajectories (LT) in statistical literacy instruction for prospective teachers, to design a more structured and applicable instructional framework. The method employed is a Systematic Literature Review (SLR) based on the Xiao & Watson model, which consists of three stages: planning, conducting, and reporting the review. Articles were sourced from the Education Resource Information Centre (ERIC) database through a multi-step selection process involving quality screening, eligibility screening, and relevancy screening, resulting in a final sample of 7 articles out of an initial 31. Thematic coding was used to identify patterns and gaps in prior research. The results indicate that learning trajectories hold significant potential to enhance prospective teachers' statistical understanding by supporting progressive learning; however, the integration of local contexts and a specific focus on prospective teachers remain limited. In conclusion, contextually designed learning trajectories can serve as a bridge between theory and practice in statistical literacy instruction for prospective teachers.

Keywords: Statistical Literacy; Learning Trajectory; Prospective Teacher Education; Statistical Instruction; Systematic Literature Review

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1. INTRODUCTION

Statistical literacy has become an essensial skill in higher education (Ben-Zvi, 2020), emphasizing the importance of students' ability to comprehend, interpret, and critically assess statistical information in a world that is increasingly influenced by data (Gal, 2019). The key components of statistical literacy include comprehension of statistical concepts, proficiency in reading and interpreting data, and the ability to apply statistical information across various contexts (Sharma, 2017; Mutiakandi & Sari, 2024). As the volume of available data continues to grow, these skills are becoming increasingly essential, not only for academic success but also for informed citizenship and professional effectiveness (Ünal et al., 2023).

Despite its critical role in higher education, many students struggle to develop statistical literacy, which can hinder their ability to make data-informed decisions (Muñiz-Rodr í guez et al., 2020). These challenges came from difficulties in grasping complex concepts (Callingham & Watson, 2017), a lack of practical experience in applying statistical methods (Chance et al., 2023), and anxiety toward statistics courses (Meriyati et al., 2018). All of which serve as major barriers to effective learning (Watson & Smith, 2022). Moreover, traditional instructional approaches often focus on procedural computations rather than fostering conceptual understanding (Wallman, 1993), making it difficult for students to see the relevance of statistics beyond the classroom without meaningful connections to real-world applications, students may fail to develop the confidence and skills necessary to apply statistical reasoning in practical contexts (Tishkovskaya & Lancaster, 2010; Iqrima, Zulkarnain, & Kamaliyah, 2023).

Various studies have explored statistical literacy in education, both from theoretical and practical perspectives (Hassad, 2011; van Dijke-Droogers et al., 2022). Several frameworks, such as Gal' s (2002) Statistical Literacy Framework and the Guidelines for Assessment and Instruction in Statistics Education (GAISE) by Schield (2017), emphasize the importance of critical thinking in understanding statistical data and information. Additionally, inquiry-based, and problem-solving approaches have been implemented in statistical literacy instruction (Odom & Bell, 2017; Wahyuni, Suwarno, & Afdhila, 2024). However, while these studies contribute to understanding statistical literacy, limited research explicitly investigates how prospective teachers can progressively learn statistical literacy through structured learning trajectories.

Learning trajectories describe the conceptual and pedagogical progression that students follow when learning a topic, providing a structured approach to instruction (Gravemeijer & Cobb, 2006; Afriansyah & Arwadi, 2021). In the context of statistical literacy (Gal, 2019), a well-defined learning trajectory can help educators design more effective instructional strategies, ensuring that students develop statistical reasoning progressively(van Dijke-Droogers et al., 2022). Although various statistical literacy frameworks exist, they often lack explicit guidance on how learning should be sequenced to support students' development over time (Tarabant & Wozniak,

2023).

Despite the increasing recognition of learning trajectories in mathematics and science education, their application in statistical literacy instruction remains underexplored. Most research has focused on assessing students' statistical literacy levels rather than developing structured instructional strategies to enhance their understanding (Almašiová et al., 2021; Andriatna & Kurniawati, 2021). Furthermore, existing frameworks tend to be conceptual rather than providing clear implementation guidelines within higher education curricula (Tarabant & Wozniak, 2023). There is also limited research on how students comprehend and apply statistical concepts in teaching contexts, particularly in preparing prospective teachers to facilitate statistical learning effectively.

A review of the literature reveals a research gap in the field of statistical literacy instruction, particularly in the development of learning trajectories tailored for prospective teachers (Daro et al., 2011; Jayanti & Cesaria, 2024). Existing frameworks primarily address statistical literacy in general terms without offering a structured and progressive learning approach (Llinares, 2022). Moreover, limited research has examined how these approaches can be applied in teaching strategies to improve students' long-term comprehension (Borremans et al., 2024). Therefore, this study is important because it addresses a specific need in teacher education: developing structured, research-based instructional models that guide how statistical literacy should be taught progressively to prospective teachers.

This study offers novelty by shifting the focus from merely assessing statistical literacy levels to analyzing how learning trajectories have been utilized in previous research to support the systematic development of statistical understanding. Developing statistical literacy is crucial for prospective teachers in an increasingly data-driven world (Gal, 2019; Tiro, 2018; Utari et al., 2024). While previous research has primarily focused on assessing or measuring statistical literacy (Andriatna & Kurniawati, 2021; Bilgin, 2021), this study provides a new perspective by systematically reviewing how learning trajectories can serve as a practical and theoretical foundation for instruction. By reviewing existing literature, this study aims to bridge the gap between theoretical frameworks and instructional practices, providing insights into how statistical literacy can be systematically developed in teacher education.

The objective of this literature review is to identify key elements of learning trajectories that support statistical literacy instruction for prospective teachers. Specifically, this study investigates how structured learning progressions support students statistical reasoning and understanding. Given the significance of learning trajectories in shaping instructional design, an important question arises: How have learning trajectories in statistical literacy been developed in previous research, and how can these findings be applied to design a systematic and practical instructional model for prospective teachers?

2. METHODS

This study employs the Systematic Literature Review (SLR) method, following the model developed by Xiao & Watson (2019). This model consists of three stages: planning the review, conducting the review, and reporting the review, each encompassing a series of systematic activities in conducting a literature review. The research stages can be seen in Figure 1, the following research diagram.

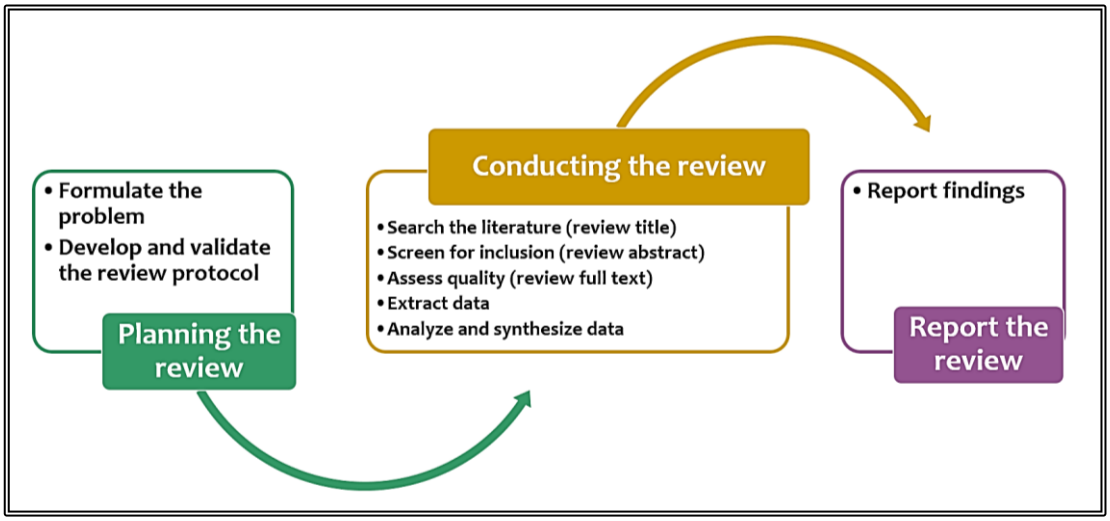


Figure 1. The stages of the systematic literature review

Figure 1 illustrates the stages of the Systematic Literature Review. The following is an explanation of each stage

a. Planning the review

In the planning stage, the research problem was formulated, and a review protocol was developed and validated. This protocol included the strategies for conducting the literature search, defining inclusion and exclusion criteria, and establishing the procedures for assessing the quality and relevance of the selected articles. This step ensured that the review process was systematic and aligned with the research objectives.

b. Conducting the review

The data collection process was initially conducted from January to June 2023. However, to ensure the inclusion of the most relevant and recent studies, a refinement of the selected articles was performed until early 2024. The literature search focused on academic articles obtained from the Education Resources Information Center (ERIC) database. The selection process involved several stages of screening:

- Quality screening, to evaluate the methodological soundness of the articles,
- Eligibility screening, to ensure that the content aligned with the research focus, and

- Relevancy screening, to determine the contribution of each article to the topic of learning trajectories in statistical literacy.

A total of 31 articles were identified in the initial search, of which 7 met all the criteria and were included in the final review. Data from these articles were then extracted and analyzed using thematic coding, a qualitative analysis technique used to identify patterns, themes, and gaps across the studies.

c. Reporting the review

The final stage of the Systematic Literature Review (SLR) process is reporting the findings. In this stage, the findings were synthesized and presented in a structured format. The analysis highlighted how learning trajectories have been conceptualized and applied in statistical literacy instruction, particularly in the context of preparing prospective teachers. This systematic review provides a theoretical foundation for developing structured instructional models that bridge statistical theory and teaching practice.

3. RESULT AND DISCUSSION

In result section presents the research findings based on the stages of the Systematic Literature Review developed by (Xiao & Watson, 2019). The findings are systematically organized to address the research questions. The following is a description of the findings at each stage.

a. Planning the review

This study begins by identifying the research question and establishing a structured approach for the literature review. The research question guiding this review is how learning trajectories, as conceptualized in existing theories, can be utilized to teach statistical literacy to prospective teachers. Following the problem formulation, the next step is developing and validating the review protocol. This protocol specifies the strategies for identifying relevant literature, the criteria for inclusion and exclusion, and the procedures for assessing the quality of selected studies. In this study, specific inclusion and exclusion criteria were established to ensure that only relevant literature was analyzed. Table 1 below presents the inclusion and exclusion criteria defined for this study.

Table 1. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Relevance to Topic	Studies discussing learning trajectories; context, model, and task in statistical literacy	Studies on statistical literacy that do not address the inclusion criteria
Type of Publication	Peer-reviewed academic sources: journal articles, conference proceedings, academic books	Non-academic publications: opinion pieces, blog posts, or sources without academic peer review

Criteria	Inclusion	Exclusion
Publication Period	Studies published within the last ten years to maintain relevance	Older studies that fall outside the selected time frame
Language	Studies published in English or Indonesian, accessible to the researcher	Studies in languages other than English and Indonesian that cannot be accurately translated
Completeness of Text	Full-text articles available for comprehensive analysis	Incomplete texts, such as abstracts only or missing critical sections

b. Conducting the review

At this stage, the researcher conducted a systematic search, screening, and analysis of relevant literature related to the research topic. The selection process began with an initial screening based on inclusion criteria, in which article titles and abstracts were reviewed to determine their relevance. Articles that met these criteria proceeded to a full-text review for a more quality assessment. These 7 articles were sourced from the ERIC database, having met the predefined inclusion criteria. A thorough and systematic analysis was conducted to extract key findings relevant to the research questions on learning trajectories for teaching statistical literacy. The learning trajectory in this context refers to the structured sequence of instructional steps or learning activities designed to support prospective teachers in developing their statistical literacy skills. Figure 2 presents the PRISMA selection process, illustrating the systematic approach undertaken in identifying, screening, and including relevant studies for this review.

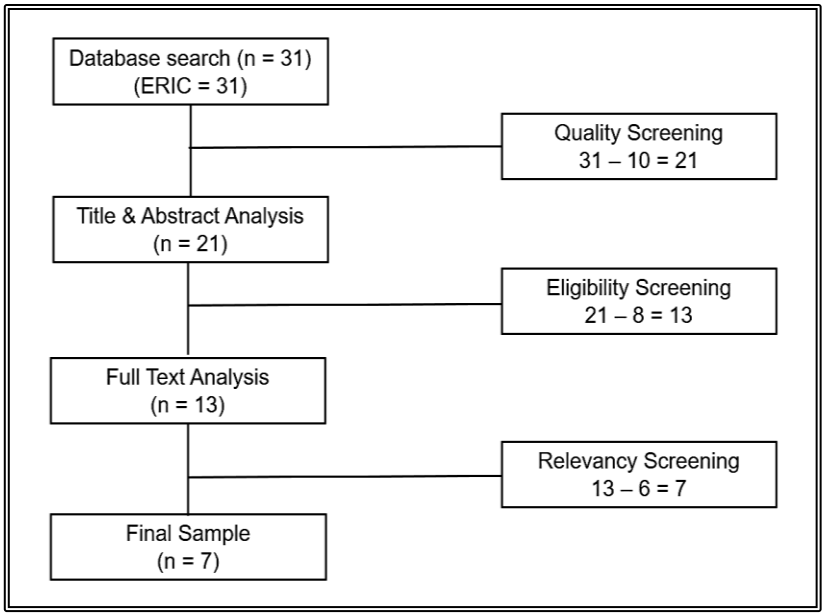


Figure 2. PRISMA selection process

Figure 2 illustrates the article selection process employed in this study using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The

process began with a database search in ERIC, yielding 31 articles that matched the search keywords. A Quality Screening was then conducted, eliminating 10 articles, leaving 21 articles for the title and abstract analysis stage. During the Eligibility Screening phase, 8 articles were excluded based on the inclusion and exclusion criteria, resulting in 13 articles proceeding to the Full-Text Analysis stage. Following this, a Relevancy Screening was performed, which further excluded 6 articles due to a lack of relevance to the research focus. The final selection comprised 7 articles that met all predefined criteria and were included in this systematic review.

c. Report the review

At report the review' s stage, the findings from the SLR are systematically analyzed and synthesized to provide a comprehensive understanding of learning trajectories in teaching statistical literacy. The reviewed studies offer valuable insights into how structured instructional sequences can support prospective teachers in developing statistical reasoning and literacy skills. By examining various learning trajectories, this study identifies key instructional steps and approaches that enhance statistical comprehension and application. The results serve as a theoretical framework for designing more effective and structured statistical literacy instruction for prospective teachers, ensuring a progressive and meaningful learning experience. Table 2 presents a summary of the reviewed literature, highlighting the learning trajectories in statistics or statistical literacy and their implications for instructional design.

Table 2. Learning trajectories and the implications for instructional design in statistical literacy

No	Authors & year	Learning trajectory	Implications for Instructional Design
1	Sharma (2017)	(1) Interpret graphs, explain responses, and ask critical questions; (2) Analyze data collection methods and contextual meaning; (3) Make data-driven decisions and justify choices; (4) Think statistically, evaluate statements, and communicate reasoning.	By applying these instructional design principles, prospective teachers can develop a strong foundation in statistical literacy, equipping them to effectively teach statistical concepts in their future classrooms.
2	Budgett & Rose (2017)	(1) Establishing Statistical Knowledge, students engage in a quick class poll to activate prior knowledge, discuss sampling concepts, and refine statistical vocabulary; (2) Introducing Margin of Error, A real-world article is used to explore the concept of margin of error and its relevance in statistical claims; (3) Developing Intuitive Understanding – Students build conceptual intuition for the margin of error through visual and interactive activities; (4)Conceptualizing Margin of Error for a Single Proportion, Students deepen their understanding by formally defining and	Instructional design should activate prior knowledge using real-world examples and authentic data. Interactive and visual learning supports intuitive reasoning and deeper conceptual understanding.

No	Authors & year	Learning trajectory	Implications for Instructional Design
		applying the margin of error to single proportion estimates; (5) Understanding the 95% Confidence Interval, Students learn to construct and interpret a 95% confidence interval for a single proportion; and (6) Applying the Rule of Thumb – Students are introduced to a simplified heuristic for estimating the margin of error in real-world statistical contexts.	
3	Arnold et al. (2018)	(1) Examine randomness, assumptions, and repeated actions with real objects; (2) Collect result of repeated actions in empirical distributions; (3) Use simulation of repeated samples, and empirical distributions to infer probability distribution; (4) Use physical and computer tools to simulate observational study with a single proportion; (5) Use physical and computer tools to simulate experimental study comparing two proportions; (6) Build generalizable model of using repeated sampling approach to inference.	These steps in the learning trajectory help students develop statistical literacy by gradually moving from concrete experiences to abstract statistical reasoning. By using real objects, simulations, and computational tools, students build an understanding of randomness, probability distributions, and inferential statistics. This structured progression enables them to interpret data, conduct simulations, and apply statistical inference in real-world contexts.
4.	Kim et al. (2020)	(1) Students create unique and varied statistical graphs, representing data based on their initial understanding, even if they do not yet follow standard conventions; (2) Students draw informal and unconventional statistical graphs, demonstrating an emerging recognition of scale usage. They maintain consistency in their representations, even though the scales and visuals used are not yet standardized, (3) Students construct statistical graphs that focus on individual cases, perceiving data as separate instances rather than as an aggregated whole; (4) Students develop statistical graphs with an attempt to aggregate data, beginning to group individual cases together to achieve specific graphing objectives; (5) Students build statistical graphs with an aggregate perspective, interpreting data as a collective whole and applying an overall dataset approach; (6) Students construct statistical graphs with an integrated perspective, combining their understanding of individual cases with an aggregate approach to create a more comprehensive representation of data.	Instructional design should support students' progression from informal, case-oriented graphing to more structured, aggregate-based representations. Activities should encourage exploration, gradual refinement of graphing conventions, and integration of individual and collective data views.

No	Authors & year	Learning trajectory	Implications for Instructional Design
5	Dijke-Droogers et al. (2022)	(1) Hands-on Exploration, Students experiment with a physical black box to develop curiosity and intuitive understanding of statistical concepts; (2) Visualizing Distributions, Students use graphical representations to illustrate and analyze statistical patterns; (3) Simulation-Based Learning, Students examine sampling distributions through simulation software to refine statistical reasoning; and (4) Real-World Inference, Students interpret sampling distributions to make data-driven inferences in real-life contexts.	Instructional design should integrate hands-on exploration and visual learning tools to build intuitive statistical understanding. Technology-enhanced instruction, such as simulation-based learning, can support deeper reasoning about sampling distributions. Finally, applying statistical inference to real-world contexts ensures that students develop practical data analysis and decision-making skills.
6	B ü scher (2022)	(1) Identifying Patterns and Variability, sanalyze weather data using line charts and dot plots to distinguish between variability and patterns; (2) Understanding Measures of Center and Spread, Students explore mean and range to assess climate changes and recognize the importance of both measures in interpretation; (3) Exploring Different Measures of Spread, Students examine range, mean, and quartiles to evaluate climate trends and understand the role of different statistical measures; (4) Contextualizing Statistical Measures, Students analyze Arctic sea ice extent using median, maximum, and minimum values, learning to choose relevant measures based on context; (5) Introducing Box Plots, Students are introduced to box plots as a tool for summarizing and interpreting distributions; and (6) Comparing Dot Plots and Box Plots, Students evaluate the strengths of dot plots versus box plots, understanding the trade-off between detail and summary representation.	Instructional design should emphasize data interpretation by guiding students to analyze different graphical representations and recognize patterns. Learning activities need to integrate statistical measures like center and spread to develop a comprehensive understanding of data. Additionally, instruction should help students choose appropriate representations based on context, balancing detailed and summarized data visualization.
	(Utari et al., 2024)	(1) Data Awareness, where students understand the importance of data, sampling techniques, and the use of technology and Project-Based Learning (PjBL) to organize data; (2) Statistical Concepts and Ideas stage, students learn fundamental statistical concepts and efficiently process data using Excel; (3) Data Representation stage, they present data through graphs or diagrams to facilitate interpretation; (4) Data Interpretation stage,	The learning trajectory implies that students will develop essential statistical literacy skills, enabling them to critically analyze and interpret real-world data. The use of technology and Project-Based Learning (PjBL) fosters active engagement, collaboration, and problem-solving, making statistical concepts more applicable and meaningful. Additionally, this structured approach prepares students for data-driven decision-

No	Authors & year	Learning trajectory	Implications for Instructional Design
		students analyze data, think critically, and draw conclusions based on their findings.	making in academic and professional settings.

Table 2 illustrates that learning trajectories in statistical literacy follow a systematic progression, starting from an initial understanding of data and advancing toward more complex statistical inference. Each study highlights different instructional strategies but generally emphasizes the importance of activating prior knowledge, utilizing real-world data, incorporating simulation-based learning, and gradually transitioning from concrete experiences to abstract reasoning. For instance, Sharma (2017) focuses on interpretation skills and critical thinking, while Budgett & Rose (2017) and Dijke-Droogers et al. (2022) highlight the role of simulations in deepening statistical understanding. Additionally, studies such as Kim et al. (2020) and B ü scher (2022) demonstrate how graphical representations help students develop a deeper understanding of variability and data distribution. In the others hand, these findings suggest that effective instructional design should incorporate exploratory learning, technology integration, and a structured approach to statistical modeling to enhance students' statistical literacy.

d. Discussion

The analysis of various learning trajectories in statistical literacy highlights the progressive development of students' understanding, from initial awareness of data to complex statistical inference. Across the studies analysed, instructional design plays an important role in facilitating this progression by integrating hands-on activities, technology-based learning, and the application of real-world data. The findings suggest that an effective learning trajectory should take students from an intuitive and informal understanding of data representations towards a structured and integrated statistical reasoning process.

Several studies emphasise the importance of prior knowledge activation and contextualised learning (Budgett & Rose, 2017; Sharma, 2017). By engaging students in authentic data sets and real-world scenarios, instructional design can support meaningful learning and improve students' ability to critically analyse statistical information. Similarly, studies such as Arnold et al. (2018) and Dijke-Droogers et al. (2022) suggest the integration of simulation-based learning and hands-on exploration, which helps students build statistical intuition as well as transition from concrete experience to abstract reasoning.

Research on statistical inference conducted in the Netherlands has developed a learning trajectory based on Realistic Mathematics Education (RME) principles (van Dijke-Droogers et al., 2022). This approach emphasises a gradual transition from informal mathematical understanding to formal mathematical reasoning using models. The learning process follows four main phases: informal mathematics, where students explore concepts intuitively; models of,

where they use representations to describe real-world situations; models for, where these representations become tools for structured reasoning; and finally, formal mathematics, where students develop a deep abstract understanding of statistical concepts (Heuvel-panhuizen et al., 2014).

Another key aspect observed was the role of visualisation and representation in statistical literacy. Studies such as Kim et al. (2020) and B ü scher (2022) describe how students gradually refine their ability to construct and interpret statistical graphs. The instructional design implications suggest that students should be guided through the stages of graphical representation, starting from an individual case-based perspective to an aggregate-based perspective. This is in line with research showing that students' ability to understand variability and statistical measures improves when they interact with multiple representations (e.g., dot plots, box plots, and histograms).

In addition, this research highlights the importance of technology integration and project-based learning to enhance engagement and problem-solving skills (Utari et al., 2024) The use of digital tools such as Excel and statistical software provides opportunities for students to analyse and visualise data efficiently, strengthening their ability to draw meaningful conclusions. Such an approach is in line with contemporary educational strategies that promote data literacy as an essential 21st century skill.

While there are strengths in the various instructional designs analysed, challenges remain in ensuring smooth transitions between different levels of statistical reasoning. Some studies suggest that students may have difficulty in understanding probabilistic concepts and inferential statistics without adequate scaffolding (Arnold et al., 2018; van Dijke-Droogers et al., 2022). Further research needs to explore adaptive instructional strategies that provide personalised support for students with varying levels of statistical proficiency. In addition, this synthesis of learning trajectories emphasises the importance of structured and evidence-based instructional design in building statistical literacy. By aligning instructional strategies with students' cognitive development, educators can create more effective learning experiences that prepare students for data-driven decision-making in academic and professional contexts.

4. CONCLUSION

Learning trajectories in statistical literacy have been systematically developed to guide students from basic data awareness to advanced statistical inference. These trajectories emphasize the importance of activating prior knowledge, utilizing real-world data, incorporating simulation-based learning, and progressively transitioning from concrete experiences to abstract reasoning. Instructional design plays a crucial role by integrating exploratory learning, technology-enhanced activities, and structured statistical modeling.

This study contributes to the field by providing a synthesized understanding of how learning trajectories have been conceptualized and implemented in statistical literacy instruction, particularly for prospective teachers. It highlights the limited yet growing efforts to develop structured and contextually relevant instructional sequences in this domain. The use of thematic coding has allowed the identification of key instructional elements, such as real-world integration, progressive learning stages, and the use of digital tools, that can be leveraged to design more effective teaching strategies.

Based on the findings, it is recommended that future instructional models for prospective teachers adopt a learning trajectory framework that is not only systematic but also contextually grounded. Educators and curriculum developers should consider embedding culturally relevant contexts and integrating critical thinking components to strengthen the applicability of statistical concepts. Moreover, further empirical research is needed to validate the effectiveness of specific learning trajectories in improving statistical literacy across diverse educational settings.

REFERENCES

Afriansyah, E. A., & Arwadi, F. (2021). Learning Trajectory of Quadrilateral Applying Realistic Mathematics Education: Origami-Based Tasks. *Mathematics Teaching Research Journal*, *13*(4), 42-78.

Almašiov á , A., Koh ú tov á , K., & Fričov á , J. (2021). The level of statistical literacy in future teachers and the use of available technology with the aim to increase it. In *AIP Conference Proceedings* (Vol. 2343). American Institute of Physics Inc.

Andriatna, R., & Kurniawati, I. (2021). Analisis Level Literasi Statistik Mahasiswa Calon Guru Matematika. *Jurnal Pendidikan Matematika Dan Matematika*, *5*(2), 619 – 632. https://doi.org/10.36526/tr.v%vi%i.1497

Arnold, P., Confrey, J., Jones, R. S., Lee, H. S., & Pfannkuch, M. (2018). *Statistics Learning Trajectories* (Ben-Zvi, Ed.; pp. 295 – 326). Springer International Publishing. https://doi.org/10.1007/978-3-319-66195-7_9

Ben-Zvi, D. (2020). Data handling and statistics teaching and learning. In S. Lerman (Ed.), *Encyclopedia of Mathematics Education* (2nd Edition, pp. 177 – 180). Springer. https://doi.org/10.1007/978-3-030-15789-0

Bilgin, E. A. (2021). Developing a mobile application to improve the levels of statistical literacy among graduate students. *International Journal of Education and Literacy Studies*, *9*(4), 113 – 122. https://doi.org/10.7575/aiac.ijels.v.9n.4p.113

Borremans, L. F. N., Koomen, H. M. Y., & Spilt, J. L. (2024). Fostering Teacher – student Relationship-Building Competence: A Three-Year Learning Trajectory for Initial Pre-Primary and Primary Teacher Education. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1349532

Budgett, S., & Rose, D. (2017). Developing statistical literacy in the final school year. *Statistics Education Research Journal*, *16*(1), 139 – 162. https://doi.org/https://doi.org/10.52041/serj.v16i1.221

B ü scher, C. (2022). Design principles for developing statistical literacy on middle schools. *Statistics Education Research Journal*, *21*(1). https://doi.org/10.52041/serj.v21i1.80

Callingham, R., & Watson, J. M. (2017). The development of statistical literacy at school. *Statistics Education Research Journal*, *16*(1), 181 – 201. https://doi.org/https://doi.org/10.52041/serj.v16i1.223

Chance, B., Tintle, N., Reynolds, S., Patel, A., Chan, K., & Leader, S. (2023). Student performance in curricula centered simulation-based inference. *Statistics Education Research Journal*, *21*(3), 2 – 24. https://doi.org/10.52041/serj.v21i3.6

Daro, P., Mosher, F. A., & Corcoran, T. B. (2011). *Learning Trajectories in Mathematics: A Foundation for Standards, Curriculum, Assessment, and Instruction.* https://doi.org/10.12698/cpre.2011.rr68

Gal, I. (2002). Adults' statistical literacy: meanings, components, and responsibilities. *International Statistical Review*, *70*(1), 1 – 25. https://doi.org/10.1111/j.1751-5823.2002.tb00336.x

Gal, I. (2019). Understanding statistical literacy: About knowledge of contexts and models. *Actas Del Tercer Congreso Internacional Virtual de Educaci ó n Estad í stica*, 1 – 15. https://www.ugr.es/~fqm126/civeest/ponencias/gal.pdf

Gravemeijer, K., & Cobb, P. (2006). Design research from a learning design perspective. In Akker, Jan van den., Gravemeijer, Koeno., McKenney, Susan., & Nieeven, Nienke. (Ed.), *Educational Design Research* (pp. 29 – 63). Routledge. https://doi.org/10.4324/9780203088364-12

Hassad, R. A. (2011). Constructivist and Behaviorist Approaches: Development and Initial Evaluation of a Teaching Practice Scale for Introductory Statistics at the College Level. *Numeracy*, *4*(2). https://doi.org/10.5038/1936-4660.4.2.7

Iqrima, Zulkarnain, I., & Kamaliyah. (2023). Soal Matematika dalam Materi Statistika Berbasis Etnomatematika untuk Mengukur Literasi Matematis Siswa. *Plusminus: Jurnal Pendidikan Matematika*, *3*(1), 39-50. https://doi.org/10.31980/plusminus.v3i1.1221

Jayanti, R., & Cesaria, A. (2024). Pengaruh kemampuan literasi numerasi dan dukungan orang tua terhadap hasil belajar matematika soal cerita di sekolah dasar. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, *3*(2), 137-148. https://doi.org/10.31980/pme.v3i2.1441

Kim, E. M., Nabors Ol á h, L., & Peters, S. (2020). A Learning Progression for Constructing and Interpreting Data Display. *ETS Research Report Series*, *2020*(1), 1 – 27. https://doi.org/10.1002/ets2.12285

Llinares, A. Z. (2022). Prospective Teachers' Use of Conceptual Advances of Learning Trajectories to Develop Their Teaching Competence in the Context of Pattern Generalization. *Mathematics*, *10*(12), 1974. https://doi.org/10.3390/math10121974

Meriyati, M., Shaulita, R., & Turnip, L. N. (2018). Problem Based Learning Strategy: The Impact on Mathematical Learning Outcomes Viewed From Anxiety Levels. *Al-Jabar Jurnal Pendidikan Matematika*, *9*(2), 199 – 208. https://doi.org/10.24042/ajpm.v9i2.3719

Muñiz-Rodr í guez, L., Rodr í guez-Muñiz, L. J., & Alsina, Á. (2020). Deficits in the statistical and probabilistic literacy of citizens: Effects in a world in crisis. *Mathematics*, *8*(11), 1 – 20. https://doi.org/10.3390/math8111872

Mutiakandi, N. M., & Sari, N. M. (2024). Literasi Matematis dan Self-Confidence pada Model Problem-Based Learning. *Plusminus: Jurnal Pendidikan Matematika*, *4*(2), 369-384. https://doi.org/10.31980/plusminus.v4i2.1484

Odom, A. L., & Bell, C. V. (2017). Developing PK-12 preservice teachers' skills for understanding data-driven instruction through inquiry learning. *Journal of Statistics Education*, *25*(1), 29 – 37. https://doi.org/10.1080/10691898.2017.1288557

Schield, M. (2017). GAISE 2016 promotes statistical literacy. *Statistical Education Research Journal*, *16*(1), 50 – 54. https://doi.org/https://doi.org/10.52041/serj.v16i1.214

Sharma, S. (2017). Definitions and models of statistical literacy: a literature review. *Open Review of Educational Research*, *4*(1), 118 – 133. https://doi.org/10.1080/23265507.2017.1354313

Tarabant, C., & Wozniak, F. (2023). The teaching of statistical literacy in France: A curricular study. *Thirteenth Congress of the European Society …*. https://hal.science/hal-04413700/

Tiro, M. A. (2018). National Movement for Statistical Literacy in Indonesia: An Idea. *Journal of Physics: Conference Series*, *1028*(1). https://doi.org/10.1088/1742-6596/1028/1/012216

Tishkovskaya, S., & Lancaster, G. A. (2010). *Teaching Strategies to Promote Statistical Literacy: Review and Implementation*. www.stat.auckland.ac.nz/~iase/

Ünal, D., Çığşar, B., Alam, D., Atalar, Ş. E., et al. (2023). Reading The World with Statistical Literacy: Results of An Emprical Study. Bilge International Journal of Science and Technology Research, 7(2), 198-203. https://doi.org/10.30516/bilgesci.1251429

Utari, R. S., Amalia, L., & Rohman. (2024). Developing a Local Instructional Theory using TPACK Framework to Support Students' Collaborative Skills. *AIP Conference Proceedings*, *3052*(1). https://doi.org/10.1063/5.0201052

Utari, R. S., Putri, R. I. I., Zulkardi, Z., & Hapizah, H. (2024). Designing Learning Trajectories to Support Prospective Teachers' Statistical Literacy Skills. *Mosharafa: Jurnal Pendidikan Matematika*, *13*(4), 877-894. https://doi.org/10.31980/mosharafa.v13i4.2546

van den Heuvel-Panhuizen, M., Drijvers, P., Education, M., Sciences, B., & Goffree, F. (2014). Realistic Mathematics Education. In *Encyclopedia of Mathematics Education* (pp. 521 – 532). https://doi.org/10.1007/978-94-007-4978-8

van Dijke-Droogers, M., Drijvers, P., & Bakker, A. (2022). Introducing Statistical Inference: Design of a Theoretically and Empirically Based Learning Trajectory. *International Journal of Science and Mathematics Education*, *20*(8), 1743 – 1766. https://doi.org/10.1007/s10763-021-10208-8

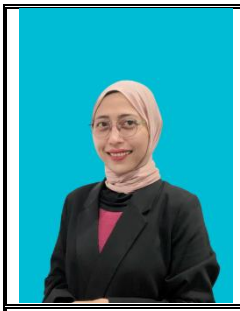
Wahyuni, I., Suwarno, S., & Afdhila, D. (2024). Realistic Mathematics-Based E-Booklets to Improve Students' Mathematical Literacy Ability. *Mosharafa: Jurnal Pendidikan Matematika*, *13*(1), 151-162. https://doi.org/10.31980/mosharafa.v13i1.1983

Wallman, K. K. (1993). Enhancing statistical literacy: enriching our society. *Journal of the American Statistical Association*, *88*(421), 1 – 8. https://doi.org/10.1080/01621459.1993.10594283

Watson, J., & Smith, C. (2022). Statistics education at a time of global disruption and crises: A growing challenge for the curriculum, classroom, and beyond. *Curriculum Perspectives*, *42*(2), 171 – 179. https://doi.org/10.1007/s41297-022-00167-7

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, *39*(1), 93 – 112. https://doi.org/10.1177/0739456X17723971

AUTHOR'S BIOGRAPHY

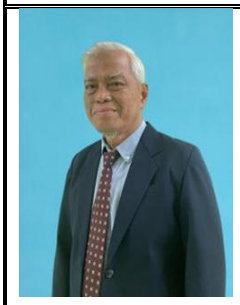


Rahma Siska Utari

A doctoral student in Mathematics Education at the Faculty of Teacher Training and Education, Universitas Sriwijaya. Her research focuses on statistical literacy and the local wisdom of South Sumatra.

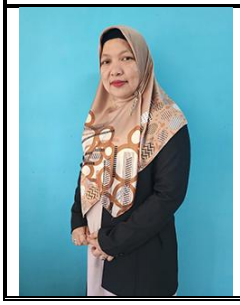
Prof. Dr. Ratu Ilma Indra Putri, M.Si.

A Professor in the Doctoral Program of Mathematics Education at the Faculty of Teacher Training and Education, Universitas Sriwijaya. She is an expert in Mathematics Education in Indonesia and has collaborated extensively on both national and international research projects. Her research focuses on Realistic Mathematics Education (RME/ PMRI), Design Research, and Lesson Study. She has also participated in a four-month post-doctoral program at the Freudenthal Institute, Utrecht University, and attended a design research session school at Jaen University, Spain. Now, she is Head of the Doctoral Program in Mathematics Education at Universitas Sriwijaya since 2024.



Prof. Dr. Zulkardi, M. I. Komp., M.Sc.

A Professor of Mathematics Education at Universitas Sriwijaya, Palembang, Indonesia. He has held various leadership roles, including Head of the Doctoral Program in Mathematics Education at Universitas Sriwijaya since 2016 and Coordinator of the Center for Writing and Publication Management (PMPP) at Universitas Sriwijaya in 2024. His expertise encompasses Realistic Mathematics Education (RME/ PMRI), the development of PISA-type problems, and the integration of ICT in mathematics education. Prof. Zulkardi has actively engaged in national and international research collaborations, contributing significantly to the advancement of mathematics education in Indonesia and beyond



Dr. Hapizah, M.T.

A senior lecturer and the Coordinator of the Master's Program in Mathematics Education at Universitas Sriwijaya. Her research interests include Mathematics Education, Blended Learning, and Computational Thinking. She has contributed to various national and international research collaborations, focusing on developing innovative teaching methods and integrating technology into mathematics education.

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