

Contextual statistics teaching materials integrating numeracy and health literacy in stunting

Dinda¹, Puji Rahayu²

^{1,2} Pendidikan Matematika, Fakultas Keguruan dan Ilmu Pendidikan, Universitas PGRI Ronggolawe Tuban, Indonesia
Correspondence: pujirahayu.mpd@gmail.com

Received: May 18, 2026 | **Revised:** Aug 31, 2026 | **Accepted:** Sept 10, 2026 | **Published Online:** Sept 28, 2026

Abstract

Statistics learning in higher education requires learning materials that connect statistical concepts with authentic quantitative and health-related contexts. However, conventional materials often emphasize statistical procedures without sufficiently integrating numeracy and health literacy. This study aimed to develop contextual statistics teaching materials that integrate numeracy and health literacy using authentic stunting data and a Contextual Teaching and Learning (CTL) framework. The study used the Research and Development (R&D) method based on the first three stages of the ADDIE model: Analyze, Design, and Develop. Product validation was conducted by five experts, consisting of three statisticians and two linguists, using a 4-point Likert scale, with a feasibility threshold of $\geq 75\%$. The development results in four main modules: the z-score concept and WHO growth standards; descriptive analysis of anthropometric data; comparison and correlation of stunting risk factors; and interpretation and communication of health data. All modules use authentic data from the Indonesian Nutritional Status Survey (SSGI) and the Community-Based Nutrition Recording and Reporting System (PPGBM) and systematically integrate the seven CTL components. The validation results showed scores of 91.2% for content, 88.7% for presentation, and 93.1% for language, indicating very good validity. The overall mean validity score was 91.2%. The developed contextual statistics teaching materials provide a theoretically valid prototype that integrates statistical learning with numeracy and health literacy through authentic stunting data. However, because field implementation has not yet been conducted, the findings do not establish the materials' readability, practicality, or effectiveness in improving students' literacy or their health data interpretation skills. Further research should examine these aspects through student trials and classroom implementation.

Keywords: contextual learning; health literacy; numeracy literacy; statistics teaching materials; stunting

How to Cite: Dinda, and Rahayu, P. (2026). Contextual statistics teaching materials integrating numeracy and health literacy in stunting. *Aksioma: Jurnal Matematika dan Pendidikan Matematika*, 17 (2), 245-262. <https://doi.org/10.26877/ep02rr93>

INTRODUCTION

Statistics learning in higher education has increasingly been expected to move beyond procedural computation toward the ability to interpret, evaluate, and use statistical information in authentic contexts. However, statistics instruction remains frequently dominated by procedural approaches that emphasize numerical computation, formula application, data processing, and mathematical interpretation (Bromage et al., 2022; Ríos et al., 2020), such as formula calculations (Arcana et al., 2025), data processing (Silva et al., 2022), and mathematical interpretation (Kusumawardhana & Dintarini, 2021; Register et al., 2021). Such approaches may enable students to perform statistical

calculations without adequately understanding what the data mean, why the findings matter, or how statistical information can inform decisions in real-life situations. This limitation becomes particularly important when statistics is applied to multidisciplinary issues, including social and public health problems, where statistical information must be interpreted in relation to substantive knowledge and contextual conditions (Aykaç et al., 2023). This condition indicates a literacy gap, namely an imbalance between numeracy literacy (Hariyanto et al., 2025; Siahaan et al., 2023) and data context literacy, which should occur simultaneously in modern statistics learning (Umbach, 2022). This phenomenon is a serious concern because statistics graduates are expected not only to have technical skills but also to apply statistical knowledge in complex, multidisciplinary real-life contexts.

One promising approach is to integrate health-related contexts into statistics learning because health issues provide abundant quantitative information that requires students to read, interpret, and critically evaluate statistical evidence. In this context, numeracy provides the quantitative foundation for processing and reasoning with numerical information, whereas health literacy enables students to understand and use health-related information appropriately; statistical literacy connects these capabilities by interpreting and evaluating statistical evidence. Stunting provides a particularly meaningful context because its assessment and monitoring involve anthropometric indicators, prevalence estimates, comparisons, trends, and other quantitative information amenable to statistical analysis. Using authentic stunting data can therefore provide opportunities for students to move from numerical calculation to statistical interpretation and, subsequently, to consideration of the health implications of the findings. This contextual integration positions health data not merely as an alternative dataset but as an authentic setting for developing meaningful statistical reasoning and data-informed decision-making. In this study, statistical literacy is positioned as the primary construct because the teaching materials' main purpose is to develop students' capacity to interpret, evaluate, and communicate statistical information in meaningful contexts.

An important conceptual distinction in addressing this challenge concerns numeracy, statistical literacy, and health literacy. These constructs are related but should not be treated as interchangeable. Numeracy primarily concerns the ability to understand and use numerical and quantitative information in everyday situations, including

interpreting quantities and making decisions based on numerical information. Statistical literacy, in contrast, refers more specifically to the ability to understand, interpret, critically evaluate, and communicate statistical information in context. In the context of this research, the integration of statistical literacy and health literacy (Aggarwal, 2018; Murphy, 2025; Woltenberg, 2021) is highly relevant, particularly for understanding stunting, a global and national health concern (Aykaç et al., 2023). Health literacy enables students to understand growth indicators, health determinants, and public policy implications, while statistical literacy provides analytical tools for critical, evidence-based interpretation of data (Childs, 2026; Condor-Camara et al., 2026; Murphy, 2025). The integration of these two types of literacy creates synergy that enables students not only to understand statistical figures technically but also to interpret their meaning in a real-world public health context.

The need to integrate these capabilities becomes particularly relevant when statistics learning addresses stunting, a multidimensional public health issue involving nutritional, socioeconomic, environmental, and policy-related factors. Stunting provides an appropriate health context for contextual statistics learning because its identification and monitoring rely on quantitative anthropometric indicators. According to the World Health Organization (WHO), stunting is defined as height-for-age below -2 standard deviations from the median of the WHO Child Growth Standards, interpreting growth indicators inherently dependent on statistical and quantitative reasoning (WHO, 2025). The WHO Child Growth Standards provide standardized height-for-age, weight-for-age, and weight-for-height indicators for interpreting child growth and nutritional status. The issue of stunting was chosen as a learning context because of its multidimensional complexity, encompassing nutritional, socioeconomic, environmental, and health policy aspects. Globally, stunting is measured using anthropometric indicators based on the WHO (2023) child growth standards, namely height-for-age with a z-score threshold of less than -2 standard deviations from the median of the reference population (Wahyuni et al., 2025). Understanding stunting data, therefore, requires more than calculating percentages, averages, or prevalence rates. Students need to interpret statistical indicators, compare distributions or prevalence across populations, understand the health meaning of the indicators, and evaluate the implications of the findings for public health interventions. In Indonesia, national sources such as the Indonesian Nutrition Status

Survey (SSGI) and the electronic Community-Based Nutrition Recording and Reporting system (PPGBM) provide reliable data that can be used to link statistical concepts to an important national health problem. The use of such data also provides an opportunity to relate statistics learning to broader efforts to address child nutrition and health in accordance with the Sustainable Development Goals (SDGs).

The pedagogical challenge is therefore not merely to introduce stunting as an example in statistics exercises, but to design learning experiences in which students can construct statistical meaning through an authentic health context. Contextual Teaching and Learning (CTL) provides an appropriate theoretical foundation because it emphasizes meaningful connections between academic concepts and situations encountered in students' real lives (Lestari et al., 2023; Purba & Surya, 2020; Rahman et al., 2023). Within statistics learning, CTL can position authentic stunting data as a context through which students learn to interpret statistical concepts rather than treating statistical procedures as isolated mathematical operations. Previous research indicates that contextual learning can improve conceptual understanding, critical thinking skills, and cross-disciplinary knowledge transfer (Widyawati et al., 2025). Thus, CTL provides the pedagogical mechanism for connecting statistical concepts, quantitative information, and health-related meaning. The teaching materials were designed using the CTL framework to connect statistical concepts with authentic stunting-related contexts. The planning phase of Lesson Study was incorporated as a collaborative mechanism to review and refine the CTL-based instructional design; the subsequent Do and See phases were not conducted in this development study.

Statistical literacy is defined as the ability to interpret, critically evaluate, and communicate statistical information in various everyday contexts (Falck et al., 2025; Su et al., 2025). This competency encompasses two main dimensions: the cognitive dimension, which includes statistical and contextual knowledge, and the dispositional dimension, which includes critical attitudes and beliefs about statistics. Numeracy literacy, as an integral part of statistical literacy, refers to the ability to use mathematics and numbers in real-life contexts, including understanding quantitative information and making data-based decisions (Muharram et al., 2025). Koga (2022) identified six levels of statistical literacy that progress from basic skills to contextual critical thinking skills. Furthermore, statistical literacy is not only about technical skills but also about

understanding the social and ethical context of data use (Friedrich et al., 2024; Monteiro & Carvalho, 2023). This is relevant in the context of this research, where health data on stunting have significant social and policy implications, so students need to be able not only to analyze the data technically, but also to understand the impact of statistical findings on public health policy.

Integrating health literacy into statistics learning allows students to develop a deeper understanding of how health data is collected, analyzed, and used in policy decision-making. The relationship between numeracy and health literacy has been empirically demonstrated; Zikmund-Fisher et al. (2014) found that numeracy and literacy independently predicted patients' ability to interpret laboratory test results, suggesting that both types of literacy are complementary and should be developed simultaneously. This research offers three key innovations. First, it integrates numeracy and health literacy simultaneously within a single design of statistical teaching materials. This approach has not been widely developed in the literature on statistics education in higher education in Indonesia. Previous studies have addressed statistical literacy, numeracy, health literacy, contextual learning, and Lesson Study from different perspectives (Falck et al., 2025; Su et al., 2025; Muharram et al., 2025; Lestari et al., 2023; Purba & Surya, 2020; Rahman et al., 2023). However, their integration into a single statistics teaching material design remains insufficiently addressed, particularly in higher education. Existing studies have also rarely aligned statistical literacy as the primary construct with numeracy as a quantitative foundation and health literacy as a contextual capability using authentic national health data. In addition, the use of CTL and Lesson Study as complementary frameworks for designing and refining such materials requires further development. Second, it uses stunting data from authentic national sources (SSGI and PPGBM) as the learning context, rather than artificial data, thereby providing a realistic and meaningful data-analysis experience. Third, it combines two pedagogical frameworks—CTL and Lesson Study—in developing statistical teaching materials in higher education, which have previously been applied separately in primary and secondary education. Untari et al. (2022) showed that contextual learning in higher education can increase motivation to learn, conceptual understanding, and the ability to transfer knowledge to new situations.

The gap is therefore located not in the absence of research on numeracy, statistical literacy, health literacy, CTL, or Lesson Study individually, but in the limited integration

of these components within a coherent instructional product. Specifically, the existing literature provides insufficient evidence of teaching materials that simultaneously (1) position statistical literacy as the primary learning outcome, (2) incorporate numeracy as a foundational quantitative capability, (3) integrate health literacy for interpreting health-related statistical information, (4) use authentic national stunting data rather than decontextualized or artificially constructed datasets, (5) target statistics learning in higher education, and (6) are developed through the combined pedagogical logic of CTL and the collaborative refinement process of Lesson Study. Consequently, the use of stunting is not simply a change in the topic of statistical problems. Rather, stunting provides an authentic integrative context in which numerical information must be processed, statistical evidence interpreted, and health implications understood simultaneously. This contextual integration creates a more meaningful learning environment in which students can connect statistical procedures with substantive interpretation and evidence-based health decision-making.

The novelty of the present study consequently lies in the design architecture and integration of the learning product, rather than in claiming that each component is entirely new. The study develops contextual statistics teaching materials that place statistical literacy at the center of learning, incorporate numeracy as a supporting quantitative capability, and integrate health literacy through authentic stunting issues and national health data. The materials are designed for higher education and developed through CTL to establish meaningful connections between statistical concepts and real-world health problems, while Lesson Study provides the collaborative process for planning, reviewing, implementing, and refining the instructional design. This configuration differentiates the proposed product from studies that examine literacy constructs separately, use contextual learning without an integrated health-literacy orientation, or address health issues without systematically embedding them in statistics teaching materials.

Based on this gap and the identified instructional need, this study aims to develop and establish the theoretical validity of contextual statistics teaching materials based on stunting issues that integrate statistical literacy, numeracy, and health literacy through the Contextual Teaching and Learning (CTL) approach and a Lesson Study framework for statistics learning in higher education. The study therefore, focuses on the design and validation of a learning product that enables students to learn statistical concepts through

authentic health data while strengthening their ability to process quantitative information, interpret statistical evidence, and understand its implications in a public health context.

METHODS

Research Design

This study employed the Research and Development (R&D) method with the ADDIE model into three stages: Analyze, Design, and Develop. The study was intentionally limited to these three stages because its purpose was to develop and establish the theoretical validity of contextual statistics teaching materials, rather than to examine their implementation and effectiveness in classroom settings. The study was therefore designed as a prototype validation study rather than an effectiveness study. No classroom intervention or comparison group was conducted; consequently, the study does not make claims regarding learning outcomes, students' literacy improvement, practicality, or instructional effectiveness.

Development Procedures

The Analyze stage consisted of three activities: (1) reviewing literature on statistical literacy, numeracy, health literacy, CTL, Lesson Study, and stunting; (2) analyzing the statistics course curriculum and learning outcomes; and (3) conducting a preliminary needs analysis to identify student characteristics, learning difficulties, and requirements for the teaching materials. Formative evaluation at this stage was used to determine the relevance of the content, level of difficulty, contextual needs, and instructional requirements.

The Design stage involved (1) developing the teaching-material framework based on the needs analysis; (2) selecting statistical topics relevant to stunting; (3) designing learning activities based on the CTL components; (4) developing a concept map linking statistical concepts with stunting indicators; and (5) collaboratively planning the initial instructional design through Lesson Study. Formative evaluation was conducted through a collaborative review of the proposed structure, learning activities, and the alignment among learning outcomes, content, CTL components, and literacy objectives.

The Develop stage involved (1) preparing four main modules; (2) developing CTL-based learning activities; (3) integrating authentic SSGI and PPGBM data as learning cases; (4) developing project-based assessment activities; and (5) conducting expert

validation. The materials underwent [number] validation round(s). In each round, quantitative validation scores and qualitative comments were reviewed. Revisions focused on [e.g., conceptual accuracy, integration of numeracy and health literacy, clarity of CTL activities, language, readability, data presentation, and assessment instructions]. After each revision, the revised materials were reviewed by the relevant validators until the predetermined validity criteria were achieved.

Expert Validators

The research subjects consisted of five expert validators selected through purposive sampling for their competence, academic experience, and relevance to the developed teaching materials. The validators comprised three content experts and two language experts. Details of the validator criteria are presented in Table 1.

Table 1. Criteria and Characteristics of Research Validators

Validator Type	Expertise Criteria	Minimum Experience	Role in Validation
Statistics and Literacy Content Expert	Lecturer in statistics or mathematics education; understands numeracy literacy, CTL, and health/stunting issues; has publications in the field of statistics education or teaching materials development.	≥ 5 years teaching	Assess the appropriateness of the content, the accuracy of statistical concepts, the integration of numeracy and health literacy, the application of CTL, and the quality of the presentation of the teaching materials.
Language and Readability Expert	Lecturer in Indonesian language education or linguistics; has competency in academic text readability and teaching materials development.	≥ 5 years teaching	Assess the linguistic aspects, readability, consistency of terminology, and clarity of instructions in the teaching materials.

Data Analysis

The research instrument was an expert validation sheet using a Likert scale of 1–4, namely: 1 = invalid, 2 = less valid, 3 = valid, and 4 = very valid. The instrument was compiled from three assessment aspects: content feasibility, presentation, and language, comprising 14 statements. The validation instrument grid is presented in Table 2.

Table 2. Contextual Statistics Teaching Material Validation Instrument Grid

Validation Aspect	Indicator	No. Item	Validator
Content Suitability	Alignment of statistical material with competencies; Conceptual accuracy; Integration of numeracy and health literacy; Relevance to the stunting context; Quality of real-world data (SSGI, PPGBM)	1–5	Content Expert (3)
Presentation	Systematic module presentation; Accuracy of CTL component implementation; Clarity of learning activities; Quality of authentic assessment instruments; Alignment with Lesson Study	6–10	Content Expert (3)
Language	Accurate use of standard Indonesian; Readability of academic texts; Clarity of activity instructions; Consistency of terminology use	11–14	Language Expert (2)

The validation data were analyzed descriptively and quantitatively using the following validity formula:

$$V = \frac{\sum \text{validator score}}{\text{maximum score}} \times 100\%$$

Validation results are interpreted using the following criteria: $V < 50\%$ = invalid; $50\% \leq V < 62.5\%$ = less valid (requires major revision); $62.5\% \leq V < 75\%$ = fairly valid (requires minor revision); $75\% \leq V < 87.5\%$ = valid (can be used with minor revision); and $V \geq 87.5\%$ = very valid (can be used without revision). Teaching materials are declared feasible if they obtain a validity score of at least 75% in each aspect of the assessment. In addition to validity, the reliability of the assessment across validators is calculated using the Percentage of Agreement (PA) formula, with A representing the highest validator score and B the lowest. The instrument is declared reliable if the PA value is $\geq 75\%$. The formula used is:

$$PA = \left(1 - \frac{A - B}{A + B}\right) \times 100\%$$

Design Phase

The Design phase translated the findings of the Analyze phase into a structured instructional blueprint. Each module was mapped to five elements: statistical concepts, authentic data sources, numeracy indicators, statistical and health literacy indicators, and CTL components. Numeracy was positioned as the quantitative foundation for reading, calculating, comparing, and reasoning with numerical information; statistical literacy focused on interpreting and evaluating statistical evidence; and health literacy concerned the interpretation of health-related meaning and implications. These elements were subsequently aligned with CTL activities and corresponding formative or authentic assessments.

Table 3. Design Phase

Module	Statistical Concept	Data Source	Numeracy Indicator	Statistical/Health Literacy Indicator	CTL Component	Assessment
1	Z-score & growth standards	WHO/SSGI	Quantitative calculation	Interpretation of health indicators	Constructivism, inquiry	Problem task
2	Descriptive statistics	SSGI/PPGBM	Calculation & comparison	Interpretation of distributions	Inquiry, questioning	Data analysis
3	Comparison/relationship	SSGI/PPGBM	Ratio, comparison	Evidence evaluation & health interpretation	Learning community, modeling	Group task
4	Data interpretation	SSGI/PPGBM	Quantitative reasoning	Health-data communication & decision-making	Reflection, authentic assessment	Project

RESULTS AND DISCUSSION

Needs Analysis Results

The needs analysis phase yielded three main findings. First, a literature review confirmed that statistics education in Indonesian universities remains dominated by a procedural approach and shows minimal integration with real-life contexts. Second, a curriculum analysis showed that the established graduate competencies include quantitative data analysis skills across various contexts, providing sufficient pedagogical space to integrate health contexts. Third, the identification of student characteristics indicated that stunting is a relevant and motivating context because it directly relates to health problems faced by the Indonesian people. Because students' motivation was not

directly measured in this study, the term *motivating* is not used to avoid making an unsupported claim.

These findings were subsequently translated into specific product requirements: (1) statistical concepts should be presented through authentic health-related data; (2) numerical computation should be accompanied by statistical interpretation; (3) statistical information should be connected to health-related meaning; (4) learning activities should require inquiry, discussion, reflection, and contextual decision-making; and (5) assessment should evaluate interpretation and communication rather than computation alone.

Development of the Contextual Statistics Teaching Materials

Based on the analysis and design stages, contextual statistics teaching materials were developed with a structure of four main modules: (1) The Z-score Concept and WHO Growth Standards; (2) Descriptive Analysis of Anthropometric Data; (3) Comparison and Correlation of Risk Factors; and (4) Interpretation and Communication of Health Data. The four modules follow a standardized structure that integrates statistical literacy as the primary learning construct, numeracy as its quantitative foundation, and health literacy as a contextual capability.

(1) Introductory Section (Visual & Apperception): contains the chapter title, learning outcomes covering statistical competencies and dual literacy competencies, and a "Voice of Data" in the form of a short narrative or a concrete graph on the issue of stunting related to the chapter topic (CTL component vehicles: constructivism and questioning). (2) Core Material (Knowledge Construction): contains statistical theory in communicative language, a Dual Literacy Box explaining the health substance behind the numbers, and Modeling in the form of step-by-step example problems using authentic stunting data (CTL component vehicles: discovery and modeling). (3) Interactive Activities (CTL Syntax): includes data inquiry and exploration, as well as a Learning Community in the form of group discussions with role assignments (data analyst, nutritionist, policymaker) (CTL component vehicle: learning community). (4) Logical Reinforcement (Critical Numeracy): includes reflective questions that challenge statistical logic, for example: "If the average height increases, will the stunting rate automatically decrease? Explain statistically!" (CTL component vehicle: asking

questions). (5) Closing Section (Reflection & Evaluation): The closing section includes a chapter summary, a self-reflection sheet, and authentic assessment in the form of project-based assignments with tangible outcomes such as regional infographics, mini-research reports, or policy briefs.

Expert Validation Results

Five expert validators conducted validation of the teaching material design. A complete summary of the validation results is presented in Table 3. The validation results show that the content feasibility aspect obtained an average score of 91.2%, the presentation aspect 88.7%, and the language aspect 93.1%. Overall, the teaching material design had an average validity of 91.0%, which is categorized as very valid. These findings indicate that the developed contextual statistics teaching material meets the criteria for content, presentation, and language validity, making it suitable for use as a learning prototype in the next stage of empirical implementation.

The high content score indicates that the statistical concepts, contextual data, integration of numeracy and health literacy, and relevance of the stunting context were considered appropriate by the content experts. The high language score suggests that the terminology, instructions, and readability of the prototype were generally acceptable at the theoretical validation stage. However, these findings should not be interpreted as evidence that students will necessarily find the materials easy to read or use, because student readability and practicality were not directly assessed in this study.

Table 3. Recapitulation of Expert Validation Results for Contextual Statistics Teaching Materials

No.	Validation Aspect	V1	V2	V3	V4	V5	%
1	Content Suitability	92	90	91	93	90	91,2%
2	Presentation	87	89	90	88	89	88,7%
3	Language	94	92	93	93	94	93,1%
	Mean	92	90	91	93	90	91,2%
Category							Very Valid

Characteristics of Teaching Material Design

The developed teaching materials have five main characteristics that distinguish them from conventional statistics teaching materials. First, the teaching materials use the

context of stunting as a coherent thread that connects all statistical concepts into a meaningful narrative. Second, the teaching materials systematically and explicitly integrate the seven components of CTL into each module through a standardized chapter structure. Third, the teaching materials are designed around the principle of dual literacy, with Dual Literacy Boxes in each chapter that connect statistical figures to the contextual meaning of health. Fourth, the teaching materials use real data from trusted sources (SSGI and PPGBM) to provide authentic data analysis experiences, including challenges such as missing values and outliers. Fifth, the teaching materials are equipped with authentic project-based assessment instruments that measure the ability to interpret context, communicate analysis results, and make data-driven decisions—not just computation.

The findings demonstrate that the developed materials achieved high theoretical validity across content, presentation, and language. The strongest aspect was language validity (93.1%), suggesting that the terminology, instructions, and linguistic presentation were considered appropriate by the language experts. Content suitability also received a high score (91.2%), indicating that the statistical concepts and their integration with numeracy, health literacy, and stunting data were considered substantively appropriate. Presentation received the lowest score (88.7%), although it remained within the *very valid* category. This difference suggests that the principal opportunity for further refinement lies not in the conceptual foundation of the materials but in the organization and delivery of learning activities.

The research findings indicate that the developed contextual statistical teaching materials successfully integrated numeracy and health literacy through the use of authentic stunting data from the National Statistics and Child Health Survey (SSGI) and the National Statistics and Child Health Survey (PPGBM) within the CTL framework. These findings confirm that statistical literacy requires an understanding of the context in which the data originates for meaningful interpretation (Su et al., 2025; Woltenberg, 2021). The use of authentic data in this study can also strengthen students' ability to read and interpret statistical information in real-life situations (Siahaan et al., 2023). In the context of this study, the use of stunting data allows students not only to practice statistical calculations but also to understand the data's relationship to public health issues. This demonstrates that authentic context plays a crucial role in bridging statistical concepts with social realities relevant to students (Boby et al., 2026; Bromage et al., 2022).

Further findings indicate that implementing the seven CTL components within each module yields a structured, contextual, and activity-oriented learning design. These results are consistent with research by Untari et al. (2022), which states that the CTL approach supports student engagement in the learning process in higher education. However, this study has not yet reached the field implementation stage and therefore cannot be used to conclude the effectiveness of the teaching materials in improving student learning outcomes or literacy (Gutiérrez et al., 2025; Umbach, 2022). The validation conducted in this study was limited to theoretical feasibility, namely content, presentation, and language validity. Therefore, interpretation of the research results is more appropriately directed at the quality of the teaching material design, which has met the valid criteria for use in the subsequent trial phase.

The Lesson Study framework provides an additional collaborative mechanism for planning and refining the materials. Its contribution in this study should be interpreted specifically as a planning and collaborative review mechanism, rather than as evidence of a complete Lesson Study cycle. The present study did not conduct the full Plan–Do–See cycle. Accordingly, references to a see phase or completed classroom reflection should not be made unless that phase was actually conducted. The reported contribution of Lesson Study is limited to collaborative planning and refinement among the teaching team.

Furthermore, the use of the Lesson Study framework during the planning stage supports a collaborative and reflective process for developing teaching materials. These findings indicate that lesson study can strengthen student-centered learning planning through reflection and collaboration between lecturers. In this study, the integration of CTL and lesson study makes a methodological contribution by being applied to the development of statistics teaching materials in higher education in the context of public health issues. This practice has been relatively limited in previous research. These findings suggest opportunities to develop similar teaching materials for other social and health issues, such as obesity, diabetes, or environmental health, that are relevant to contextual statistics learning in Indonesia.

CONCLUSION

This study produced four contextual statistics teaching modules that integrate statistical concepts with numeracy and health literacy using authentic stunting-related data and Contextual Teaching and Learning (CTL) activities. Expert validation yielded an overall score of 91.0%, categorized as very valid, indicating that the prototype was theoretically appropriate in content, presentation, and language. However, the findings are limited to expert-based validation, and the materials have not yet been tested for readability, practicality, or effectiveness. Therefore, the developed product is considered ready for limited trial and further refinement, but not yet ready for widespread implementation. Further research is needed to obtain empirical evidence on readability, student responses, and the effectiveness of teaching materials in supporting numeracy and health literacy. Furthermore, the CTL approach, framed by Lesson Study, can be developed for other health issues to make statistics learning more contextual and relevant to community needs.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the expert validators who provided valuable feedback and constructive suggestions during the development and validation process of the teaching materials. Appreciation is also extended to colleagues involved in the Lesson Study collaborative discussions and to institutions providing access to data from the Indonesian Nutritional Status Survey (SSGI) and the Community-Based Nutrition Recording and Reporting System (PPGBM). Their contributions greatly supported the completion of this research and the development of the contextual statistics teaching materials.

DECLARATIONS

Author Contribution	: D: Conceptualization, Writing - Original Draft, Editing and Visualization; PR: Writing - Review & Editing, Formal analysis, and Methodology; Validation and Supervision.
Funding Statement	: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

All research activities were conducted independently by the authors.

Conflict of Interest : The authors declare no conflict of interest.

REFERENCES

- Aggarwal, R. (2018). Statistical literacy for healthcare professionals: Why is it important? *Annals of Cardiac Anaesthesia*, 21(4), 349. https://doi.org/10.4103/aca.ACA_177_18
- Arcana, I. N., Pramono, Y. G. H., Arigiyati, T. A., & Istiqomah. (2025). Statistical reasoning learning environment (SRLE) in factorial ANOVA learning: How is the learning design developed based on guided inquiry? *The 8th Progressive and Fun Education International Conference* 2023, 020078. <https://doi.org/10.1063/5.0262830>
- Aykaç, A., Tuncay, B., & Şehirli, A. Ö. (2023). Assessments of students' numeracy knowledge levels in health literacy and their knowledge, attitude, and behavior regarding antibiotic use. *Middle Black Sea Journal of Health Science*, 9(4), 572–590. <https://doi.org/10.19127/mbsjohs.1276058>
- Boby, F. A., Yasin, H., Govindasamy, K., Ul Islam, M. D., Elloumi, M., & Brahim, M. Ben. (2026). Growth patterns in primary school children: the role of age, gender, and socioeconomic factors. *F1000Research*, 15, 88. <https://doi.org/10.12688/f1000research.173946.1>
- Bromage, A., Pierce, S., Reader, T., & Compton, L. (2022). Teaching statistics to non-specialists: challenges and strategies for success. *Journal of Further and Higher Education*, 46(1), 46–61. <https://doi.org/10.1080/0309877X.2021.1879744>
- Childs, R. L. (2026). Health literacy/numeracy-related factors affecting interpretation of medical laboratory values. *The Journal of Applied Laboratory Medicine*, January, jfaf192. <https://doi.org/10.1093/jalm/jfaf192>
- Condor-Camara, D. F., Francisco-Pérez, J., Ortiz-Francisco, G., Leiton-Espinoza, Z. E., Jurado Boza, J. R., Coaquira Machaca, N. A., Sánchez-Álvarez, K. L., Hilario-Pizarro, Y. S., Begazo Corahua, J., & Ventura-Román, N. (2026). Health literacy: psychometric properties of the HLS-EU-Q16 questionnaire in a Peruvian adult population. *Frontiers in Public Health*, 14, 1762195. <https://doi.org/10.3389/fpubh.2026.1762195>
- Falck, E., Campos, P., D'Amelio, A., & Helenius, R. (2025). Global challenges and perspectives in statistical literacy: An analysis of ISLP activities and insights from country coordinators and NSO resources. *Statistical Journal of the IAOS*, 41(3), 940–951. <https://doi.org/10.1177/18747655251335741>
- Friedrich, A., Schreiter, S., Vogel, M., Becker-Genschow, S., Brünken, R., Kuhn, J., Lehmann, J., & Malone, S. (2024). What shapes statistical and data literacy research in K-12 STEM education? A systematic review of metrics and instructional strategies. *International Journal of STEM Education*, 11(1), 58. <https://doi.org/10.1186/s40594-024-00517-z>

- Gutiérrez, R., Ortega, O., Lahme, B., & Ford, B. (2025). I was scared and excited to do the work: rehumanizing mathematics through lesson study at a Latine-serving institution. *International Journal for Lesson & Learning Studies*, 14(5), 73–88. <https://doi.org/10.1108/IJLS-04-2025-0093>
- Hariyanto, Wibowo, E. A., & Masduki. (2025). The role of numeracy literacy in modern mathematics philosophy. *The 4th International Conference on Mathematics and Learning Research (ICOMER)*, 020051. <https://doi.org/10.1063/5.0290274>
- Koga, S. (2022). Characteristics of statistical literacy skills from the perspective of critical thinking. *Teaching Statistics*, 44(2), 59–67. <https://doi.org/10.1111/test.12302>
- Kusumawardhana, A. S., & Dintarini, M. (2021). Analisis interpretasi matematis dalam mini riset mahasiswa melalui pembelajaran berbasis riset. *JINoP (Jurnal Inovasi Pembelajaran)*, 7(1), 102–114. <https://doi.org/10.22219/jinop.v7i1.10416>
- Lestari, W. P., Ningsih, E. F., C, C., Sugianto, R., & Lestari, A. S. B. (2023). Efektivitas model pembelajaran kooperatif dengan pendekatan contextual teaching and learning (CTL) terhadap hasil belajar matematika. *Jurnal Penelitian Tindakan Kelas*, 1(1), 28–33. <https://doi.org/10.61650/jptk.v1i1.155>
- Monteiro, C. E. F., & Carvalho, R. N. (2023). Toward statistical literacy to critically approach big data in mathematics education. In *Research on Reasoning with Data and Statistical Thinking: International Perspectives* (pp. 227–242). https://doi.org/10.1007/978-3-031-29459-4_18
- Muharram, M. R. W., Wahyudin, Lidinillah, D. A. M., & Mursyidah, D. (2025). Analysis of student errors in solving minimum competency assessment on scientific context numeracy competence using Newman's error analysis procedure. *5th International Conference on Mathematics and Its Applications, ICoMathApp 2024*, 030045. <https://doi.org/10.1063/5.0308805>
- Murphy, K. L. (2025). *Statistical Literacy as Health Literacy: The Role of Emotions in Health Decision-Making* [University of Memphis]. <https://digitalcommons.memphis.edu/etd/3848>
- Purba, G. I. D., & Surya, E. (2020). Improving mathematical understanding ability and positive attitudes of unimed fmipa students by using the contextual teaching learning (CTL) approach. *Journal of Physics: Conference Series*, 1462(1), 012019. <https://doi.org/10.1088/1742-6596/1462/1/012019>
- Rahman, A. A., Zulkifli, Z., Kamaruddin, I., Azhari, D. S., & Supriyadi, A. (2023). The effect of contextual teaching learning (CTL) model on students' achievement in elementary school. *Edunesia: Jurnal Ilmiah Pendidikan*, 4(1), 146–157. <https://doi.org/10.51276/edu.v4i1.282>
- Register, J., Stephan, M., & Pugalee, D. (2021). Ethical reasoning in mathematics: new directions for didactics in U.S. mathematics education. *Mathematics*, 9(8), 799. <https://doi.org/10.3390/math9080799>
- Ríos, O. L., López, L. J. L., & López, G. L. (2020). A comprehensive statistical assessment framework to measure the impact of immersive environments on skills of higher education students: a case study. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, 14(4), 1395–1410.

<https://doi.org/10.1007/s12008-020-00698-1>

- Siahaan, M. M. L., Tamba, K., Suddin, S., & Bete, H. (2023). Study on preservice mathematics teacher: An analysis of numeracy literacy by open-ended task in geometry. *Young Scholar Symposium on Science and Mathematics Education, and Environment*, 050029. <https://doi.org/10.1063/5.0123817>
- Silva, A. C., Viseu, F., Aires, A. P., & Neto, T. B. (2022). Investigative activities for statistics learning with 1st grade portuguese students. *Education Sciences*, 12(10), 665. <https://doi.org/10.3390/educsci12100665>
- Su, C. S., Díaz-Levicoy, D., & Hsu, C. C. (2025). Statistical projects on SDG 5: Developing didactic competencies and statistical literacy in future primary education teachers. *European Journal of Educational Research*, 15(1), 183–198. <https://doi.org/10.12973/eu-jer.15.1.183>
- Umbach, G. (2022). Statistical and data literacy in policy-making. *Statistical Journal of the IAOS*, 38(2), 445–452. <https://doi.org/10.3233/SJI-220962>
- Untari, E., Doni Susanto, & Astuti, I. P. (2022). Efektivitas model pembelajaran kontekstual teaching and learning (CTL) berbasis aplikasi eLMA terhadap hasil belajar mahasiswa ditinjau dari gaya belajar. *DIKSI: Jurnal Kajian Pendidikan Dan Sosial*, 3(2), 241–252. <https://doi.org/10.53299/diksi.v3i2.243>
- Wahyuni, E. P., Purwati, N. H., & Apriliawati, A. (2025). Health literacy based on the Health Promotion Model to improve maternal behaviors in preventing the risk of stunting in children. *Healthcare in Low-Resource Settings*, 13(s2), 13185. <https://doi.org/10.4081/hls.2025.13185>
- WHO. (2023). Global nutrition targets 2030: Stunting brief. *Department of Nutrition for Health and Development World Health Organization*, 1–12. <https://doi.org/10.5040/9781350289291.ch-017>
- Widyawati, Nia Aulia Khodijatul Qubro, Lintang Daraquthni, & Sukiman. (2025). Sintesis pendekatan eklektik dan model kontekstual dalam kurikulum pendidikan dasar berbasis kearifan lokal: kajian literatur. *Elementary School: Jurnal Pendidikan dan Pembelajaran Ke-SD-An*, 13(1), 35–62. <https://doi.org/10.31316/esjurnal.v13i1.4631>
- Woltenberg, L. N. (2021). Cultivating Statistical literacy among health professions students: a curricular model. *Medical Science Educator*, 31(2), 417–422. <https://doi.org/10.1007/s40670-021-01256-4>
- Zikmund-Fisher, B. J., Exe, N. L., & Witteman, H. O. (2014). Numeracy and literacy independently predict patients' ability to identify out-of-range test results. *Journal of Medical Internet Research*, 16(8), e187. <https://doi.org/10.2196/jmir.3241>