



VALIDITY OF A MULTIPLE-LITERACY-BASED STATISTICS TEXTBOOK ON THE ISSUE OF STUNTING

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Abstract

This study aims to test the validity of a dual literacy-based statistics textbook that integrates statistical literacy with social literacy through the context of stunting issues in Indonesia. This study uses a Research and Development (R&D) approach with a modified ADDIE development model, including the stages of analysis, design, development, and evaluation. The research subjects consisted of three expert validators, namely two statistical material experts and one learning media expert. The instrument used was a validation sheet with a 1-4 Likert scale covering aspects of content feasibility, presentation feasibility, language feasibility, and graphic feasibility. Data were analyzed descriptively quantitatively to determine the level of validity of the textbook. The results showed that the textbook obtained an average validity score of 3.72 out of a maximum scale of 4.00 with the category of "very valid". The aspect of content feasibility obtained a score of 3.78, presentation feasibility 3.67, language feasibility 3.76, and graphic feasibility 3.70. These findings indicate that the dual literacy-based statistics textbook with the context of stunting issues is suitable for use in statistics learning in higher education. The implications of this research contribute to the development of contextual and meaningful statistics teaching materials for students.

Keywords: Dual Literacy; Statistics Textbook; Stunting; Validity

Abstrak

Penelitian ini bertujuan untuk menguji validitas buku ajar statistika berbasis literasi ganda yang mengintegrasikan literasi statistik dengan literasi sosial melalui konteks isu stunting di Indonesia. Penelitian ini menggunakan pendekatan Research and Development (R&D) dengan model pengembangan ADDIE yang dimodifikasi, meliputi tahap analisis, desain, pengembangan, dan evaluasi. Subjek penelitian terdiri dari tiga validator ahli, yaitu 2 ahli materi statistika dan 1 ahli media pembelajaran. Instrumen yang digunakan berupa lembar validasi dengan skala Likert 1-4 yang mencakup aspek kelayakan isi, kelayakan penyajian, kelayakan bahasa, dan kelayakan kegrafikan. Data dianalisis secara deskriptif kuantitatif untuk menentukan tingkat validitas buku ajar. Hasil penelitian menunjukkan bahwa buku ajar memperoleh nilai validitas rata-rata 3,72 dari skala maksimal 4,00 dengan kategori "sangat valid". Aspek kelayakan isi memperoleh nilai 3,78, kelayakan penyajian 3,67, kelayakan bahasa 3,76, dan kelayakan kegrafikan 3,70. Temuan ini mengindikasikan bahwa buku ajar statistika berbasis literasi ganda dengan konteks isu stunting layak digunakan dalam pembelajaran statistika di perguruan tinggi. Implikasi penelitian ini memberikan kontribusi terhadap pengembangan materi ajar statistika yang kontekstual dan bermakna bagi mahasiswa.

Kata kunci: Buku Ajar Statistika; Literasi Ganda; Stunting; Validitas

INTRODUCTION

Statistics is a branch of science that plays a crucial role in equipping students with data-driven critical thinking skills. However, evidence from the field shows that statistics courses are often perceived as rigid, formula-heavy, and disconnected from practical applications in everyday life. A preliminary study was conducted by distributing a questionnaire to 22 students in the Mathematics Education Program, class of 2025, who had taken a statistics course during the even semester in January 2026. The questionnaire was used to identify challenges in learning statistics as well as students' needs for contextual teaching materials.

The results of the preliminary study showed that 78% of students had difficulty understanding the application of statistics in real life, while 85% of students stated that the available teaching materials lacked contextual examples relevant to current social issues. This situation leads students to tend to view statistics as a mechanical activity rather than a tool for in-depth analysis of social phenomena. In fact, statistical literacy encompasses the ability to understand, evaluate, and communicate data in various decision-making contexts; therefore, overly procedural learning can actually hinder its development (Kurnia et al., 2024; Schreiter et al., 2024).

The development of this dual-literacy-based statistics textbook stems from an analysis of how students perceive the study of statistics a subject that has long been viewed as a course filled with difficult-to-understand formulas, complex theories, and a lack of clarity regarding the application of these concepts in everyday life. This situation leads students to view statistics as knowledge detached from reality, thereby diminishing their motivation to learn and their deep understanding of the concepts. Research shows that statistics is often perceived as an abstract discipline, but this perception can be minimized if instruction is linked to real-life contexts relevant to students' understanding (Hasim et al., 2024). In light of this issue, this textbook was developed with the primary goal of directly applying statistical concepts and formulas to the issue of stunting in Indonesia; thus, every section from data presentation to graphical analysis uses real-world data for analysis.

From a needs analysis perspective, this situation highlights the urgent need for innovation in learning materials that can foster deeper understanding by integrating real-world contexts into the learning process. Research on improving the quality of statistics instruction shows that using a contextual approach can enrich classroom discussions, increase student participation, and help students understand the connection between statistical concepts and everyday situations (Schoen et al., 2025). Research on the development of statistical knowledge confirms that students' understanding of concepts is more solid when they interact with data representations derived from real-world phenomena, rather than merely abstract examples (Londoño & Alsina, 2023). This reinforces the argument that statistics course material should not be presented in a "vacuum," but should be designed contextually so that students can see the meaning behind the numbers and connect them to relevant social issues.

In addition to considering the learning context, the development of instructional materials must also be based on the principles of systematic instructional design. Effective instructional materials not only present the content accurately but must also ensure alignment between learning objectives, content, learning activities, and the assessment methods used (Suyitno et al., 2023). In addition, instructional materials need to be designed conceptually so that students can connect the concepts they learn to real-life problems in their daily lives (Hidayah, 2023). Interactivity, readability, and student engagement are also important components in the design of instructional materials because they can foster a more meaningful learning experience and enhance conceptual understanding (Namestovski & Kovari, 2022). Therefore, the development of a dual-literacy-based statistics textbook in this study was designed with consideration for the principles of contextual relevance, integration of learning components, readability, and interactivity.

Although several studies have developed statistics teaching materials based on literacy (Fanolong & Hamdi, 2025; Idris et al., 2024), Although the author's literature review remains very limited, it has been found that in the development of statistics teaching materials particularly those that integrate statistical literacy and an understanding of social context through the issue of stunting this study fills that gap by developing and validating a statistics textbook that uses stunting data as a learning context.

In this study, the concept of dual literacy is a new construct developed as a synthesis of the statistical literacy framework (Gal, 2002) and the framework of social literacy (Law et al., 2018) which emphasizes the ability to access, manage, evaluate, integrate, and critically use information in various contexts of life. This concept is further reinforced by the idea of dual literacy, which refers to the ability to simultaneously

integrate technical competencies and contextual understanding in the learning process (Kurnia et al., 2024). By combining these two aspects, dual literacy not only encourages students to become data users with technical expertise, but also individuals who are attuned to the social meanings embedded in numbers. Table 1 presents a mapping of the indicators for both frameworks.

Table 1. Mapping of Indicators from the Two Frameworks

Aspect of Multiple Literacies	Theoretical Source	Indicators
Statistical Literacy	(Gal, 2002)	Reading data, interpreting tables/graphs, evaluating statistical information, drawing data-based conclusions, and communicating the results of analysis.
Social Literacy	(Law et al., 2018)	Accessing, evaluating, and interpreting information within its social context; utilizing information for informed decision-making; and understanding the social implications of data..
Multiple Literacies	Researcher's Synthesis	Analyzing statistical data while concurrently understanding the meaning and the social implications embedded within the data.

The issue of stunting has emerged as a social phenomenon that is crucial to include in statistics education due to its significant impact on the quality of human resources and national progress. Stunting is not merely a health issue but also a social one that requires in-depth data analysis to identify its causal factors and distribution patterns. References on statistical literacy in the public decision-making process underscore the importance of the ability to understand health data in supporting evidence-based policies.(Umbach, 2022). An interdisciplinary approach to the development of statistical literacy shows that incorporating real-world contexts, such as health issues, can increase the relevance of learning while simultaneously strengthening students' ability to interpret data (Appelt & Maia, 2025). Thus, the use of data on stunting in teaching materials serves not only as context but also as a tool for transforming students into "data detectives" capable of understanding the realities of human life.

The integration of health-related elements into statistics education is supported by research showing that statistical literacy is a crucial skill for understanding evidence-based information and facilitating sound decision-making in the health and social sectors (Woltenberg, 2021). Other research findings indicate that statistical skills can be significantly improved through a structured learning approach that focuses on conceptual understanding, so that students are not only proficient in computational procedures but are also able to interpret the meaning of data more deeply (Sidik et al., 2023). Therefore, the development of teaching materials that incorporate real-world contexts such as the issue of stunting is believed to improve students' understanding of statistics, enhance their data analysis skills, and raise their awareness of the social implications of the data they are studying.

Nevertheless, the development of innovative instructional materials must be integrated with a structured evaluation process to ensure their quality and suitability before they are implemented in learning activities. Studies on the measurement of statistical literacy indicate that instructional materials must undergo a validation phase to ensure the relevance of the content, the accuracy of the presentation, and the clarity of the language in order to support the efficient achievement of learning objectives (Setio, 2023). Empirical studies on the analysis of college students' statistical literacy skills indicate that differences in student characteristics such as educational background and level of learning comprehension influence statistical literacy achievement. Therefore, teaching materials that are systematically designed and validated are needed to address these differences (Riwayani et al., 2024). Thus, the validation process by

experts is a crucial step in research on the development of instructional materials, as it serves as a quality assurance mechanism before the product is implemented in the pilot phase.

Various global studies in recent years have confirmed that statistical literacy and data literacy are crucial 21st-century skills that must be developed through contextual learning focused on real-world problems. Systematic reviews indicate that curricula and teaching methods in many countries are increasingly highlighting the importance of the ability to understand, interpret, and utilize data in decision-making, so that the study of statistics is no longer viewed merely as a procedural activity, but as a tool for building critical understanding of social phenomena (Friedrich et al., 2024; Schreiter et al., 2024).

Based on the above explanation, this study aims to develop a dual-literacy-based statistics textbook addressing the issue of stunting. In addition, this study aims to analyze the validity of the developed textbook in terms of content, presentation, and graphics through expert evaluation to ensure the product's suitability before conducting a pilot test with users.

METHOD

This study employs a Research and Development (R&D) approach aimed at producing a dual-literacy-based statistics textbook that addresses the issue of stunting. Developmental research is a process used to develop and validate educational products (Husamah et al., 2022). The development model used in this study is a modified version of the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The ADDIE model was chosen because it is a systematic, structured development model that is widely used in the development of instructional materials in the field of education (Siregar et al., 2021). The modifications were carried out by focusing on four main stages: analysis, design, development, and evaluation. The implementation stage was omitted because this study focused on product validation.

The analysis phase involved identifying students' needs for context-based statistics textbooks, analyzing the characteristics of students as the target audience, and reviewing the statistics material to be developed (Liu et al., 2026). At this stage, an in-depth literature review was also conducted on multiple literacies, statistical literacy, social literacy, and the issue of stunting in Indonesia.

The design phase includes developing the textbook framework, creating dual literacy indicators to be integrated, selecting relevant stunting data, and designing the textbook's visual layout. The textbook framework is based on the syllabus for an introductory statistics course, which covers data presentation, measures of central tendency, measures of dispersion, the normal distribution, and correlation analysis. Each chapter is designed to integrate national and local stunting data as a learning context. The dual literacy indicators were developed with reference to the statistical literacy framework from (Gal, 2002) and social literacy as conceptualized by international organizations (Law et al., 2018), which was subsequently adapted to the context of statistics instruction in Indonesian higher education.

The development stage is the stage in which the design is transformed into a textbook ready for validation. The textbook manuscript was written with attention to proper and correct language usage, a logical writing structure, and the integration of multiple literacies in each chapter. The stunting data used was sourced from the 2023 Indonesian Health Survey (SKI) published by the Indonesian Ministry of Health, as well as data from various provincial and district/city health offices. Illustrations and infographics are designed to aid students' visual understanding of the presented data and statistical concepts. The developed textbook consists of five main chapters totalling 180 pages, complete with dual-literacy-based exercises and a mini-project on stunting data analysis.

Product validation was conducted to assess the suitability of a dual-literacy-based statistics textbook addressing the issue of stunting before its implementation in the classroom. The validation process involved three validators: two statistics subject matter experts and one educational media expert. Validators were selected through purposive sampling based on the following criteria: (1) possessing expertise relevant to

the field of evaluation, (2) having experience in developing instructional materials or conducting research in mathematics education, and (3) having scientific publications relevant to their field of expertise. The use of expert validators is a standard procedure in development research to ensure a product's suitability before it is used in the classroom. (Inayati & Rahayu, 2020; Jannah & Rahayu, 2022). This study received approval from all validators before the data collection process. Each validator was provided with information regarding the study's objectives, the assessment procedures, and the use of the validation data for scientific publication. All participation was voluntary, and the validators' identities were kept confidential in accordance with research ethics principles..

The research instrument consists of a textbook validation sheet developed based on the textbook suitability criteria established by the Book Center of the Ministry of Education and Culture. The validation sheet consists of four main aspects, namely: (1) content suitability, which covers alignment with the curriculum, accuracy of the material, and the integration of multiple literacies; (2) presentation suitability, which covers the structure of the presentation, the learning approach, and learning stimuli; (3) language suitability, which covers adherence to Indonesian language rules, clarity of definitions and terminology, and readability; and (4) graphic design suitability, which covers cover design, layout, typography, and illustrations. Each aspect consists of several items rated on a 1–4 Likert scale, with the following criteria: 1 = poor, 2 = fair, 3 = good, and 4 = very good (Gómez-caballero et al., 2026). The validation instrument underwent content validation before use to ensure the relevance and clarity of the items.

The validation procedure is carried out in several stages. First, validators are briefed on the research objectives and the product being developed. Second, validators are provided with the textbook and validation sheets to assess independently. Third, validators provide evaluations and suggestions for improvement on each aspect evaluated. Fourth, discussions and consultations are held with the validators to clarify the suggestions and feedback provided. The validation process is conducted in two rounds to ensure product quality. The first round yields feedback and suggestions for improvement, which are then incorporated into revisions. The second round is conducted to validate the revised product and ensure the accuracy of the improvements made. This phased process is also applied in educational media development research to ensure that the product meets feasibility criteria before being used in learning activities. (Maliyana & Rahayu, 2023; Setianingsih & Rahayu, 2024).

The validation data were analyzed using quantitative descriptive techniques. The scores assigned by the validators for each indicator were calculated to obtain the average score for each assessment aspect and the overall average score. The average validity score was calculated using the formula:

$$\bar{X} = \frac{\sum X}{n}$$

Note :

$\bar{X}$: Mean validity score;

$\sum X$: sum of the obtained scores;

n : the number of indicators assessed.

Next, the average scores obtained were converted into validity categories to determine the level of suitability of the developed product. In addition to quantitative analysis, data in the form of comments, criticisms, and suggestions from validators were analyzed using qualitative descriptive methods and used as the basis for product improvements during the development stage. Validity categories were determined based on the following classification: scores of 3.25–4.00 were classified as “highly valid”; scores of 2.50–3.24 as “valid”; scores of 1.75–2.49 as “less valid”; and scores of 1.00–1.74 as “invalid.” (Ristanto et al., 2023). A product is deemed suitable for use if it receives at least a “valid” rating and has been revised in accordance with the feedback provided by the validator.

RESULTS AND DISCUSSION

The results of the validation of a dual-literacy-based statistics textbook addressing the issue of stunting indicate that the developed product falls into the “highly valid” category. The assessment results from two subject matter experts and one media expert are presented in Table 2.

Table 2. Textbook Validity Results Based on Assessment Aspects

Assessment Aspects	V1 (Material I)	V2 (Material II)	V3 (Media)	Mean	Category
Content Feasibility	3,80	3,74	3,82	3,78	Highly Valid
Presentation Feasibility	3,71	3,55	3,75	3,67	Highly Valid
Language Feasibility	3,83	3,67	3,78	3,76	Highly Valid
Graphic Feasibility	3,80	3,75	3,55	3,70	Highly Valid
Overall Mean	3,78	3,67	3,72	3,72	Highly Valid

As shown in Table 2, all aspects were classified as “highly valid,” with an overall mean score of 3.72. The content feasibility aspect achieved the highest score (3.78), whereas the presentation aspect recorded the lowest score (3.67), yet it remained within the “highly valid” category. These findings indicate that the textbook satisfies the feasibility criteria in terms of content, presentation, language, and graphical design, and is therefore appropriate for use in the trial phase.

Beyond the quantitative findings, the validators offered several recommendations for improvement, including incorporating stunting case studies from diverse regions, adding ethical reflections on data use, refining the visual hierarchy, applying consistent colour coding, and making editorial revisions. Based on this feedback, the product was revised before the second round of validation.

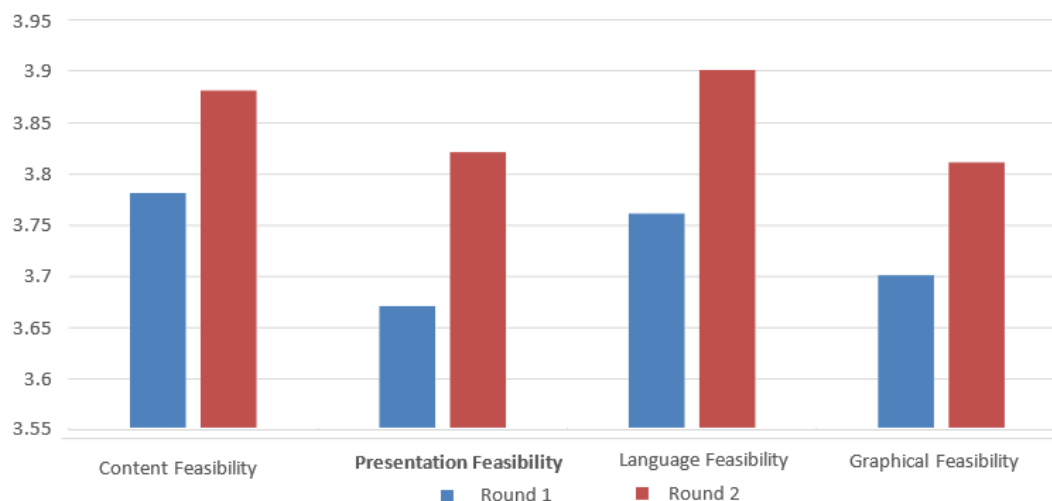


Figure 1. Comparison of Textbook Validity Scores in Round I and Round II

The second-round validation results demonstrated an increase in the mean score from 3.72 to 3.85, with all aspects classified as “highly valid.” This improvement suggests that the revisions effectively enhanced the overall quality of the textbook, particularly in terms of presentation. The findings reveal that the statistics textbook based on multiple literacies, situated within the context of stunting issues, was classified as “highly valid” by experts. This provides empirical support that integrating statistical literacy and social literacy into a single textbook is feasible with an adequate level of quality. The successful development of this textbook aligns with previous research (Andriatna & Kurniawati, 2021; Hoz-Ruiz et

al., 2024) which suggests that statistical literacy-based instructional materials for pre-service mathematics teachers should be developed through contextualized data processing and interpretation activities. Moreover, the explicit integration of statistical literacy into instructional materials can enhance students' abilities in data analysis and interpretation (Schreiter et al., 2024). The use of real-world data has been demonstrated to strengthen the linkage between statistical concepts and their application in everyday contexts (Cujba & Pifarré, 2024; Wright et al., 2024).

The presentation aspect received the lowest score among all aspects, although it remained within the "highly valid" category. Validators' feedback on visual hierarchy and the use of color coding underscores the importance of presentation design in instructional materials that integrate multiple types of information. These findings are in line with Wilkerson et al. (2025) which suggests that data visualization grounded in authentic contexts can facilitate learners in linking statistical concepts to the phenomena under investigation. Furthermore, Legacy et al. (2025) highlight that effective visual representations play a critical role in enabling learners to understand the relationship between data and its statistical representations.

Regarding the language and graphical aspects, the results indicate that the textbook demonstrates a high level of readability and is supported by well-designed visual elements. The use of clear and communicative language enables students to grasp abstract statistical concepts without compromising conceptual accuracy. These findings are aligned with Alcocer et al. (2024) who argue that the use of real-world data-based learning resources and accessible language can foster the development of students' data literacy.

The uniqueness of this study lies in the integration of statistical literacy and social literacy through the context of stunting issues. The use of SKI 2023 data enables students to develop the ability to understand, interpret, and utilize data as a basis for evidence-based decision-making. These findings are consistent with Nurmayadani et al. (2025) who demonstrate that the use of contextual data can enhance numeracy literacy in statistics learning. In addition, statistical literacy and data literacy are currently regarded as essential competencies in education, as they support critical thinking toward quantitative information (Friedrich et al., 2024). The integration of social contexts in statistics learning also contributes to the development of students' ability to critically understand social phenomena (Engel & Weberstein, 2023).

The concept of multiple literacies employed in this study offers an alternative approach to the development of statistics instructional materials. Statistical literacy encompasses not only the ability to understand statistical concepts and procedures but also the ability to interpret, evaluate, and communicate data-based information (Kurnia et al., 2024; Riwayani et al., 2024). Meanwhile, an understanding of social contexts helps students relate data analysis results to real-world issues occurring in society (Ünal et al., 2023). This approach is relevant to the demands of data-driven learning, which emphasizes critical and evidence-based decision-making skills (Burke, 2024; Witte et al., 2025).

Although the findings indicate a "highly valid" category, several limitations should be acknowledged. First, the validation involved only three expert validators; therefore, the generalizability of the validity results should be interpreted with caution. Future studies may involve a larger number of validators with more diverse backgrounds. Second, this study is limited to the expert validation stage and has not yet proceeded to field testing with students. The effectiveness of the textbook in improving students' multiple literacies needs to be examined through controlled experimental studies. Third, the stunting context used is limited to data from Indonesia; therefore, adaptation may be required for implementation in other countries with different health issue characteristics.

CONCLUSION

Based on the findings, it can be concluded that the statistics textbook based on multiple literacies

within the context of stunting issues was successfully developed and achieved a “highly valid” category. The textbook obtained a mean validity score of 3.72 out of a maximum scale of 4.00, categorized as “highly valid,” supported by the assessment results across the aspects of content feasibility (3.78), presentation feasibility (3.67), language feasibility (3.76), and graphical feasibility (3.70), all of which fall within the “highly valid” category. Expert validation results indicate that the textbook achieved a “highly valid” classification across all assessment aspects, indicating its suitability for use in the instructional trial phase. These findings demonstrate that the integration of statistical literacy and social literacy in statistics instructional materials can be systematically realized through the use of contextual data relevant to social issues.

Therefore, future research is recommended to conduct field testing to examine the effectiveness of the textbook in improving students’ competencies, develop an interactive digital version to enhance learning accessibility, and adapt the multiple literacies approach to other topics or courses. In addition, further studies are needed to focus on the development and psychometric validation of the multiple literacies construct as a measurement instrument, for example, through testing construct validity, convergent and discriminant validity, as well as instrument reliability using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). This would enable multiple literacies to function not only as a framework for instructional material design but also as an empirically measurable construct in educational research.

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