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# Development of Statistical Literacy-based Mathematics Module for Junior High School Students in the Context of MSMEs' Empowerment

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**Abstract:** Statistical Literacy is needed by students in understanding information and presenting data in various forms of representation. This study aims to develop a mathematics module based on statistical literacy for junior high school students in the context of empowering Micro, Small, and Medium Enterprises (MSMEs) that is valid, practical, and effective. The research method uses a development research design with ASSURE stages. Twenty students of class VIII A were used as research samples, considering the ease and accessibility in conducting the research. Validity data were obtained through a validation questionnaire assessed by competent experts in their fields. Practicality data were obtained through a student response questionnaire. Effectiveness data were obtained based on the results of the statistical literacy pre-test and post-test. While observation data were used as supporting data to describe the module trial activities in learning. Quantitative data analysis used average values to analyze the results of the validation questionnaire and student responses, as well as the Wilcoxon test to determine the effectiveness of the developed module in learning. The validation results show that the developed module meets the validity criteria and receives positive responses from students and teachers. In addition, the Wilcoxon test results indicate the influence of module use in learning, that supported by the N-Gain test results of 0.59, indicating that the developed learning module is quite effective in improving students' statistical literacy. Although the development results are quite effective, students need to be accustomed to dealing with problems that contain the surrounding context, increase assignments, and integrate strategies, media, and learning models that focus on developing statistical literacy. Thus, the developed module has met the criteria of validity, practicality, and effectiveness. However, the results of the statistical literacy test evaluation indicate limitations in students' abilities to interpret and draw conclusions. This research provides an important contribution in developing relevant, innovative teaching materials, while highlighting crucial aspects for future learning, especially focusing on statistical literacy and contextual-based learning.

**Keywords:** statistical literacy, MSMEs empowerment, statistical module.

## ▪ INTRODUCTION

The freedom and ease of access to information in the digital age encourage students to select and sort information. To ensure that the information absorbed is conveyed accurately and precisely, learning that equips students with the ability to use statistical data and information is essential (Weber-Stein & Engel, 2025). Therefore, teachers play a crucial role in developing students' statistical competencies (Pallauta, Jácome Anaya, Lemarie Oyarzun, & Markovits Rojas, 2025).

Statistical literacy is useful in minimizing errors related to activities involving data (Takaria, Wahyudin, Sabandar, & Dahlan, 2020). It helps someone understand statistical concepts and make decisions based on data analysis (François, Monteiro, & Allo, 2020). This ability goes beyond simply understanding the basics of statistics, but also

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encompasses the ability to use statistical information from various sources to make informed decisions (Gómez-Blancarte, Chávez, & Aguilar, 2021). Therefore, the ability to analyze and present data is required (Berndt et al., 2021).

Lukman, Wahyudin, Suryadi, Dasari, & Prabawanto (2022) state that a person demonstrates adequate statistical literacy when they understand why and how to conduct a statistical investigation, along with the concepts behind proper data collection and analysis. Therefore, as Büscher (2022) emphasizes, individuals must be able to visualize and interpret information from data analysis results. Riwayani, Istiyono, Supahar, Perdana, & Soeharto (2024) add that they must also predict outcomes and explain the underlying reasons.

Gal (2002) defines statistical literacy as the ability to interpret, evaluate, and communicate data analysis results. Gómez-Blancarte et al. (2021) describe it as the ability to understand basic statistical concepts and use statistical information from various sources to make informed decisions. van Dijke-Droogers, Drijvers, & Bakker (2025) added that it includes the ability to interpret and apply information from data presentations and use statistical methods. Therefore, statistical literacy involves understanding basic statistical concepts, representing information in various forms, interpreting data analysis, and drawing accurate conclusions.

However, many students still lack statistical knowledge due to low statistical literacy skills (Takaria et al., 2020). Maryati, Fisher, Yatim, & Mauladaniyati (2024) report that students show little interest in studying statistics. Lian, Yew, & Meng (2022) found that students often struggle to connect statistical results to real-world problems. Furthermore, increasingly complex and varied information often leads students to misinterpret data and draw incorrect conclusions (L'Boy & Nazim Khan, 2023).

Watson & Callingham (2003) propose three levels of statistical literacy: understanding basic terms, applying them in social contexts, and questioning unsupported claims. Hariyanti, Budayasa, & Setianingsih (2025) identify four aspects of statistical literacy: understanding basic statistical concepts, representing and interpreting statistical data, drawing conclusions and making decisions, and critically evaluating information. Students demonstrate the first aspect by explaining and identifying concepts such as population, sample, data types, mean, median, and mode. They show the second aspect by presenting and communicating information in forms suited to its purpose. They exhibit the third by predicting patterns, drawing conclusions, and making decisions. They fulfill the fourth by identifying data sources.

Gal (2011) emphasizes that statistical literacy depends on context, which must be meaningful and relevant. Boels, Boels, Alberto, & Hoogland (2025) argue that context guides procedures and interpretations. Büscher (2024) highlights that understanding context requires effective communication. Utomo (2021) notes that everyday contexts support understanding, argumentation, and creative problem-solving.

Akkaş (2021) reports a growing trend of integrating entrepreneurship into mathematics. Chu (2025) recommends teaching statistics practically and linking it to students' lives through active learning. Bakar & Ismail (2020) found that involving students in entrepreneurial experiences enhances their understanding of mathematical concepts. Romafilani, Aminah, & Omar (2024) confirm that entrepreneurship-based materials improve students' problem-solving skills.

Puspitowati, Siswandari, Rochsantiningsih, & Wiranto (2022) explain that learning modules promote student independence. Sirisuthi & Chantarasombat (2021) assert that modules help students acquire knowledge from real-life contexts. Madrazo & Dio (2020) argue that modules bridge learning gaps. These benefits highlight the importance of integrating real-world problem contexts into module development.

While previous studies support integrating entrepreneurship and practical statistics learning, no research has developed statistical literacy modules within the MSME empowerment context. This research introduces students to MSME products and production through problem scenarios. It aims to help students understand and apply basic statistical concepts to real-life situations. The MSME context also seeks to enhance students' awareness of statistical applications and their concern for MSMEs' development. Mastering these skills requires the ability to read and write statistically (Weiland, 2017).

This study developed a mathematics module for junior high school students that integrated statistical literacy with MSMEs' empowerment to deepen students' statistical understanding and connect mathematics to socio-economic issues. In doing so, the research contributes not only to effective learning module development but also to a model for linking mathematics concepts with real-world economic and social challenges, particularly in supporting MSMEs.

## ▪ METHOD

### Participants

The research population comprised all 207 eighth-grade students of MTs Negeri 3 Banjarnegara, a Public-Islamic Junior High School. Class VIII A, consisting of 20 students, served as the research sample and was chosen for its practicality and ease of access during the research implementation.

### Research Design and Procedures

This research developed a junior high school mathematics learning module based on statistical literacy within the context of MSME empowerment. The development follows the ASSURE model (Smaldino, Lowther, & Russell, 2011). In the Analyze Learner Characteristics stage, initial observations identified students' common obstacles in learning statistics. In the State Performance Objectives stage, indicators were formulated based on junior high school statistics and learning outcomes. These indicators guided the module design and aligned with statistical literacy objectives.

Module's characteristics were defined in the Select Methods, Media, and Materials stage. The module promoted statistical literacy through MSMEs-related contexts to enhance both conceptual understanding and contextual problem-solving. In the Utilize Materials stage, a teaching module was developed aligned with the defined objectives. Experts validated the draft module and their feedback informed revisions before the learning trial. In the Require Learner Participation stage, one class participated in a learning trial using the module. In the Evaluate and Revise stage, learning outcomes were evaluated, and the module was revised based on questionnaire responses. The module selection and use stage was modified by adapting content to statistical literacy indicators within the MSMEs context. The implementation and evaluation stages were combined to improve practicality and streamline analysis during the limited trial.

**Instruments**

The research instruments including questionnaires, tests, and observation sheets. The questionnaires were used to measure validity and practicality, tests to assess effectiveness, and observation sheets to evaluate the module's impact during learning. Fourteen-item validation questionnaire was distributed to obtain validity that focused on content, construct, didactic, and aesthetic aspects. Experts with doctoral qualifications in educational statistics conducted the validation. Furthermore ten-item student response questionnaire was distributed to obtain practicality data by assessing design quality, ease of use, learning effectiveness, and content relevance. Both questionnaires were rated on a 1–5 scale, rated on a 1–5 scale, where "1" indicated poor and "5" very satisfied.

A test instrument was developed based on modified statistical literacy indicators (Gal, 2002; Watson & Callingham, 2003). The indicators used were: understanding basic information, with criteria able to identify all key information and questions; the representation indicator, with criteria able to connect relevant information to appropriate data presentations; the interpretation and conclusion indicator, with criteria able to interpret data accurately and draw relevant conclusions based on the context. The test was administered before and after the learning to measure students' statistical literacy improvement.

The Observation sheets were used to record student activity during learning, focusing on discussion participation, independent learning, and task completion. All of the instruments used were validated for content and construct.

**Data Analysis**

Validity data were analyzed using the average score from expert validation, with the criteria score was higher than 3.40 out of a maximum of 5. Practicality data were also analyzed using average questionnaire responses, with scores above 3.40 indicating the module developed was practical.

The effectiveness of the modules developed was analyzed using SPSS through paired comparison tests and N-Gain analysis. Before conducting these tests, the Wilcoxon test was used to assess data normality. At a significance level of $\alpha = 0.05$, differences were considered significant if the Sig value was below 0.05. N-Gain value, used to support effectiveness analysis, followed the criteria in Table 1 and was presented using a bar chart.

**Table 1.** Effectiveness criteria (Hake, 1998)

| N-Gain ($g$) | Criteria |
|---|---|
| $g < 0.3$ | Low/Ineffective |
| $0.3 \leq g \leq 0.7$ | Moderate/Quite Effective |
| $g > 0.7$ | High/Effective |

## ▪ RESULT AND DISSCUSSION

The research took place during the even semester of the 2023–2024 academic year, focusing on developing a junior high school mathematics module that integrates statistical literacy within the context of MSMEs' empowerment. The results and discussion are divided into two main parts, namely the module development section and the effectiveness of learning using the developed module.

**Module Development Stage**

This section describes the module development process until it meets validity and practicality criteria. The development follows the ASSURE model. Each stage of module development is outlined below based on the adapted ASSURE model.

The student analysis stage identifies common obstacles students encounter when learning statistics, including a) difficulty presenting data accurately in diagrams, b) focusing only on explicitly shown information, c) inaccurate calculations, d) challenges solving problems using mean, mode, median, and range, and e) trouble interpreting word problems.

These issues align with previous research indicating that students struggle to read and interpret statistical information, hindering their ability to construct or understand mathematical models (Takaria et al., 2020). Other studies have also reported difficulties in understanding concepts, interpreting data, and selecting appropriate data presentation forms (Lian et al., 2022). These findings guided the formulation of objectives aligned with students' learning outcomes.

In the second stage, the objectives were formulated, aligned with junior high school mathematics learning outcomes for statistics. These objectives include a) identifying the role of statistics in daily life, b) distinguishing between populations and samples using real examples, c) analyzing data types, d) presenting and interpreting data using bar charts, e) using and interpreting pie charts, and f) applying mean, mode, median, and range to solve problems related to MSME empowerment.

The MSMEs empowerment context was chosen to help students learn statistical concepts through a familiar and socially relevant lens. Statistics should be taught practically and connected to real-life contexts (Chu, 2025). At the Design and Material Context Selection Stage, the module design, validation, response questionnaires, and a statistical literacy test were developed, all integrating the MSMEs empowerment theme. The module includes two parts: an introduction and core content.

The introduction contains a preface, table of contents, material overview, concept map, and usage instructions. The core content features four learning activities: a) basic statistical concepts, b) data presentation with bar charts and interpretation, c) data presentation with pie charts and interpretation, and d) applying mean, mode, median, and range to solve MSMEs-related problems. The module ends with an evaluation section to assess students' statistical literacy. Teachers use this section to measure students' mastery of the material (Koga, 2025).

The cover displays various MSMEs' product images to introduce the material and provide contextual cues. Effective visuals support students in expressing ideas both verbally and in writing (Kaya, 2020). A concept map and clear instructions were included to help students understand the learning sequence. Concept maps help students visualize the material structure (Gavens, Doignon-Camus, Chaillou, Zeitler, & Popa-Roch, 2020).

Learning Activity 1 introduces the role of statistics in everyday life, particularly within the MSME context. It presents statistical concepts such as population, sample size, and data classification. At the end of the activity, students completed the exercise to reinforce their understanding of data classification (Figure 1).

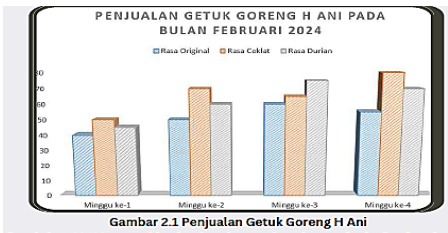
**Permasalahan 1.3:**

Bu Ani, seorang pengusaha UMKM sektor makanan akan mendaftarkan usahanya secara resmi. Ia diminta mengisi formulir pendaftaran yang berisi informasi tentang jenis usaha, jumlah karyawan, omset per tahun, Lokasi, dan bentuk usaha. Pengisian formular dilengkapi dengan persyaratan dokumen, yaitu KTP dan NPWP. Bu Anis dikenai biaya administrasi pendaftaran sebesar Rp. 500.000. Berdasarkan ilustrasi tersebut sebutkan jenis data dan berikanlah alasannya.

Mrs. Ani, a small business owner in the food sector, will officially register her business. She is asked to complete a registration form containing information about the type of business, number of employees, annual revenue, location, and business structure. Filling out the form must also be accompanied by required documents, namely an ID card (KTP) and a tax identification number (NPWP). Mrs. Ani is charged a registration administration fee of Rp500,000. Based on this illustration, identify the types of data and explain your reasons.

**Figure 1.** Problems in learning activity 1

The beginning of the module in Learning Activity 2 provides a graphical representation of H. Ani's fried getuk sales in February 2024 (Figure 2). The graph was used to stimulate students' understanding of how to present data using bar charts in the context of MSME empowerment.




**Gambar 2.1 Penjualan Getuk Goreng H Ani**

Produk UMKM semakin berkembang dan bervariasi. Begitu juga dengan produk getung goreng. Getuk goreng H Ani menjual 3 varian rasa, yaitu: rasa original, coklat, dan durian. Dalam tiap minggunya penjualan 3 varian rasa selalu bervariasi. Dari Gambar 2.1 dapatkah Anda akan mendapatkan berbagai macam informasi. Informasi-informasi yang dapat diperoleh diantaranya.

a. Varian rasa yang paling banyak diminati.
b. Kenaikan dan penurunan jumlah penjualan untuk setiap varian rasa.
c. Rata-rata penjualan getuk goreng untuk setiap varian rasa.

Masih banyak informasi yang dapat diperoleh berdasarkan Gambar 2.1.

**Figure 2.1 Sales of Getuk Goreng H Ani**

MSME products continue to grow and diversify, as do fried getuk products. Getuk Goreng H Ani offers three flavor variants: original, chocolate, and durian. The weekly sales of these three flavor variants always vary. From Figure 2.1, you can obtain various kinds of information, including:

a. The most popular flavor variant.
b. The increase and decrease in sales for each flavor variant.
c. The average sales of fried getuk for each flavor variant.

**Figure 2.** Stimulus in learning 2nd activity

Through the provided stimuli and several probing questions, students were trained to extract and write the information from diagrams to solve problems. Similar to the previous learning activity, several problems were presented at the end to help students practice presenting and interpreting data to solve problems.

The presentation format in Learning Activity 3 followed the same structure as Learning Activity 2. The difference lay in the material focus. This activity focused on presenting data using pie charts. In contrast, Learning Activity 4 focused on understanding and applying the concepts of mean, median, mode, and range to solve problems related to MSMEs empowerment. Data presentations from previous activities were used as stimuli for this session. To assess students' comprehensive understanding,

the evaluation questions were provided at the end of the module, covering material from Learning Activities 1 to 4.

The researchers piloted the revised module in Class VIII A of MTs Negeri 3 Banjarnegara over four learning sessions. The limited trial produced data on students' responses and their statistical literacy after using the module. During the learning sessions, the teacher began by presenting contextual problems involving graphs of MSMEs' product sales. These graphs served to explore students' ability to extract and write information accurately. The teacher also used the graphs to help students understand how to use diagrams appropriately. Before assigning problems, the teacher first reviewed how to construct diagrams to refresh students' prior knowledge.

**Figure 3.** Groups' problem-solving activities in the module

The next learning activity required students to solve problems from the module in groups (Figure 3). The teacher provided guidance and assistance to groups that needed help (Figure 4). Several tasks contained in the module trained students in solving problems related to the topic. During group discussions, the teacher observed the class and monitored the problem-solving process. Some groups struggled to present and write information from the data displayed in diagrams. The teacher provided guidance to ensure all groups could complete the tasks.

Once the discussions were deemed sufficient, several groups presented their results and received feedback from their peers. The learning process included formulating questions, collecting and analyzing data, and interpreting results (Batur & Baki, 2022).

**Figure 4.** Providing assistance to groups experiencing difficulties

During the evaluation and revision phase, students received a response questionnaire and a statistical literacy test. Twenty students completed the evaluation. The questionnaire results indicate that the module received positive feedback, especially on its appearance and instructions. Students gave an average score of 4.4 for appearance, which made the module enjoyable to read, and 4.6 for instructions, which made it easier to learn. Learning modules with clear objectives, easy-to-follow instructions, and engaging activities can improve student outcomes (Ayong, 2025). The language aspect received an average score of 4.3, indicating that the wording helped students understand the content.

Students also gave positive feedback on the examples in the module, with an average score of 4.35, suggesting that relevant illustrations and examples helped them understand the material. The module effectively guided students in identifying types of data and presenting them in diagrams, with an average score of 4.35, and in interpreting data from those diagrams, with an average score of 4.25. The problems and contexts used in the module challenged students and encouraged critical thinking. In addition, students reported that the MSMEs-based context provided new knowledge and experiences, as reflected by an average score of 4.6. The lowest score appeared on the item about opportunities to practice using mean, median, mode, and range in solving MSMEs-related problems; however, this score still met the criteria for an excellent response.

Overall, the questionnaire results show that students responded positively to the module, particularly regarding visual presentation, clarity of instructions, material relevance, and MSME context. To enhance its impact, the Exercises section should be reviewed and strengthened to ensure students can fully apply the concepts. Student responses supported by teacher feedback, which yielded an average score of 4.8 out of 5.

**Effectiveness Test Stage**

The effectiveness test stage uses pre-test and post-test data that measure students' statistical literacy. Before conducting the effectiveness test, a prerequisite test was conducted using the Kolmogorov-Smirnov test to determine the distribution of the data. The results of the residual normality test for each statistical literacy indicator using the Kolmogorov-Smirnov test obtained a Sig. value = 0.000 for the first indicator, a Sig. value = 0.000 for the second indicator, and a Sig. value = 0.018 for the third indicator. The three test results indicate that the Sig. Value <0.05. Thus, it can be said that statistically, the three residual statistical literacy data are not normally distributed. Because the three data sets are not normally distributed, the Wilcoxon test was used to test 2 paired samples with the following statistical hypothesis:

Ho: No difference between pretest-posttest results on students' statistical literacy indicators.

Ha: Different pretest-posttest results on students' statistical literacy indicators.

The Wilcoxon test uses a value of $\alpha = 0.05$, and the Ho test criteria are accepted if the Sig value is > 0.05. The output results of the Wilcoxon test are presented in Table 2.

**Table 2.** Wilcoxon test statistics

| | **1st indicator** | **2nd indicator** | **3rd indicator** |
|---|---|---|---|
| Z | -1.890[b] | -3.954[b] | -3.460[b] |

| | | | |
|---|---|---|---|
| **Asymp. Sig. (2-tailed)** | .059 | .000 | .001 |
| a. Wilcoxon Signed Ranks Test | | | |
| b. Based on negative ranks. | | | |

The Wilcoxon test yields a Sig value of 0.059 for the first indicator, 0.000 for the second, and 0.001 for the third. These values indicate that the analysis accepts Ho for the first indicator and rejects it for the second and third. Thus, the first indicator indicates no significant difference between pre-test and post-test results, while the second and third indicators show statistically significant differences. The N-Gain scores in Figure 5 support these findings.

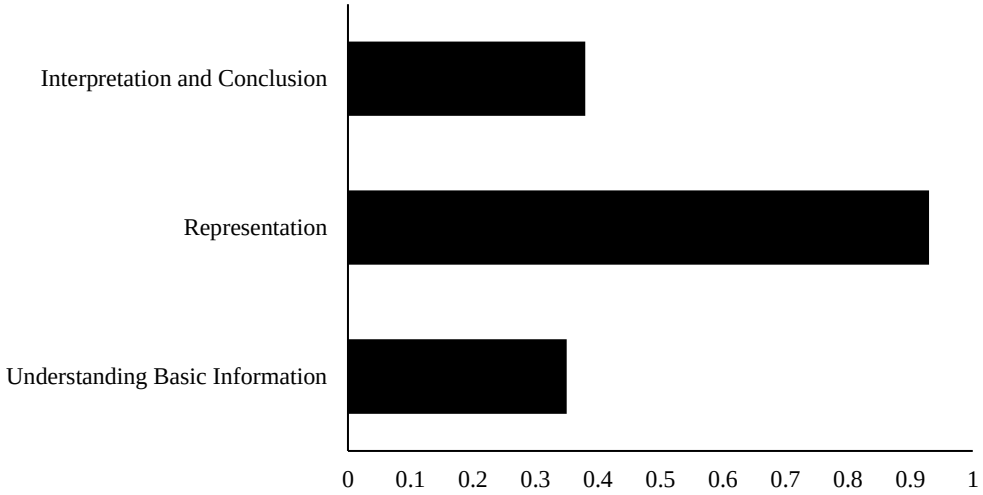



**Figure 5.** N_Gain score statistical literacy indicator

Figure 5 indicates that the N-Gain score reaches 0.35 for the first indicator, 0.93 for the second, and 0.38 for the third. These results place the first and third indicators in the moderate category and the second in the high category, based on the criteria in Table 1. Although the first indicator's N-Gain value is categorized as moderate, the Wilcoxon test does not indicate a statistically significant increase to reject Ho. This likely occurred because students did not struggle to understand basic information during either the pre-test or post-test. They accurately wrote the given and the asked matters in the problem. The representation indicator indicates significant improvement, as shown by the Wilcoxon test and high N-Gain score. These results prove that the module effectively improves students' ability to represent information using diagrams suited to the problem context.

The third indicator (interpreting results and drawing conclusions) also indicates improvement, although not as much as the second. This likely occurs because some students still make errors when interpreting data and drawing conclusions from MSMEs-related problems. These findings align with previous research, which indicates that students score lower in statistical literacy when solving problems with real research data compared to artificial data in realistic contexts (Phadke, Beckman, & Morgan, 2024). Moreover, students often struggle to connect information (Rone et al., 2023), which likely contributes to errors in drawing conclusions and making decisions. Students' lack of

statistical knowledge and skills prevents them from solving problems effectively (Kurnia, Lowrie, & Patahuddin, 2024). Educators can address this by assigning more statistical problems with varied data visualizations (Setiawan, Sukoco, & Agustyani, 2023). Additionally, teachers should implement models that develop students' statistical literacy (Riwayani et al., 2024).

The Wilcoxon test was used to assess the module's impact, yielding a Sig value of 0.000 and an N-Gain of 0.59. These results indicate a significant improvement in students' statistical literacy. The statistical literacy-based junior high school mathematics module with an MSME context proves valid, practical, and effective. Experts validated its material, structure, and context to meet academic standards. Students also favored the module, as indicated by their positive responses. The MSMEs context effectively enhances students' statistical literacy, with the N-Gain score indicating a moderate category. Although this research produces a module that promotes a comprehensive learning experience, it still has limitations. These include 1) it develops statistical literacy without addressing affective factors that may influence it, and 2) students still need learning activities that train them to connect information, interpret data, and draw accurate conclusions.

## ▪ CONCLUSION

The mathematics module based on statistical literacy for junior high school students and the context of MSMEs' empowerment met the criteria for validity, practicality, and effectiveness. Validators confirmed the module's validity through average scores and concluded that the module met validity standards with minor revisions. The module also met the criterion for practicality, as demonstrated by positive questionnaire responses, and the majority of students agreed that the module provided a novel learning experience in the context of MSMEs' empowerment. The effectiveness test results showed a statistically significant difference between the pre-test and post-test scores on students' mathematical literacy. This finding aligns with the N-Gain result of 0.59, which falls within the moderate criteria. Therefore, the developed module is statistically quite effective in improving junior high school students' statistical literacy.

The development of this module not only contributes to improving students' statistical literacy but also enhances the relevance of education and the development of 21st-century skills. However, this study has limitations. It focused solely on statistical literacy without considering other factors, such as student interest or learning independence. Future research should integrate measures of affective aspects and examine their relationship to statistical literacy. Further investigation with wider dissemination is also needed to obtain more comprehensive results.

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