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Quantitative Descriptive Statistics in Educational Research: A Conceptual Review of Data Analysis and Interpretation Techniques

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Abstract:
Quantitative descriptive statistics serves as an essential foundation in educational research, functioning to organize, summarize, present, and describe empirical data characteristics systematically. Although its application is widespread across educational studies, utilizing descriptive statistics demands high precision in understanding data structures, selecting appropriate analytical techniques, and interpreting calculation outcomes to avoid misleading conclusions. This article aims to comprehensively analyze the conceptual foundations of quantitative descriptive statistics, identify relevant analysis techniques, and examine the principles of data interpretation in contemporary educational settings. Employing a rigorous conceptual literature review approach, this study examines a wide array of scientific sources, including research methodology textbooks, classical and modern statistical references, and relevant peer-reviewed journal articles. The analytical process is conducted through systematic identification, thematic grouping, comparative evaluation, and conceptual synthesis, focusing closely on measurement scales, frequency distributions, measures of central tendency and dispersion, graphical data presentation formats, and technique selection criteria. The distinct novelty of this study lies in its robust conceptual synthesis, which explicitly bridges raw data characteristics, technical appropriateness, and interpretive validity into a single cohesive, unified framework. Consequently, this work makes a vital contribution to improving daily statistical practices in educational research, equipping investigators, educators, and graduate students with a reliable methodological foundation to prevent interpretive errors, elevate analytical accuracy, and enhance the overall quality, transparency, and academic credibility of quantitative educational reporting.

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Introduction (مقدمة)

Quantitative descriptive statistics is an important foundation in educational research, particularly in the processing and presentation of numerical data. Through descriptive statistics, researchers can obtain an overview of the characteristics of the collected data without having to generalize or draw conclusions beyond the scope of the data being analyzed. The use of descriptive statistics allows information that was originally a collection of numbers to be organized into a more structured, systematic, and easily understood form. In educational research, this technique is widely used to describe student learning outcomes, competency achievement levels, responses to learning, teacher perceptions, and various other educational indicators. Therefore, the ability to understand and apply descriptive statistics is an essential part of an educational researcher's methodological competence.

The development of educational research, which is increasingly oriented towards the use of quantitative data, has also increased the need for an adequate understanding of statistics. Research data cannot simply be collected and calculated; it must be analyzed based on its characteristics and measurement objectives so that the resulting information has scientific meaning. Descriptive statistics provides a variety of techniques to meet this need, ranging from frequency distributions and percentages to measures of central tendency and dispersion. Schmidt et al. (2023) showed that presenting statistical results in the context of educational research can create interpretation problems when readers lack an adequate understanding of the statistical information presented. These findings demonstrate that the mathematical presentation of numbers does not necessarily guarantee a correct understanding of the meaning of research results. Therefore, mastery of descriptive statistics requires the ability to read, understand, and interpret numerical information appropriately.

Conceptually, descriptive statistics is not only concerned with calculating the mean, median, mode, variance, and standard deviation, but also encompasses the selection of analysis techniques based on data characteristics. Each statistical measure has specific functions and limitations, so its use must be adapted to the measurement scale and data distribution patterns. Johannssen et al. (2021) explain that misuse of statistics can lead to misinterpretation of quantitative information and lead to misleading conclusions. This problem demonstrates that statistical errors do not always stem from calculation errors but can also arise from inaccuracies in selecting statistical measures, presenting information, and interpreting analysis results. Therefore, educational researchers need to understand the relationship between data characteristics and the statistical techniques used to ensure that analysis results accurately represent the empirical conditions being studied.

Studies on descriptive statistics also show that understanding measures of central tendency needs to be balanced with an understanding of measures of dispersion. The mean, for example, can provide a general overview of a group's tendencies, but it does not fully explain the variation or diversity of values between individuals. Landtblom (2023) revealed that learning about the mean, median, and mode still tends to emphasize calculation procedures rather than a deeper understanding of their nature and the context in which they are used. Meanwhile, Dawson and Ng (2024) found difficulties in understanding measures of dispersion, including connecting calculation procedures with the meaning of data variation. Both studies demonstrate that understanding statistics requires conceptual mastery that goes beyond the ability to apply formulas. In educational research, this is crucial because the interpretation of analysis results must be able to explain both the tendencies and the diversity of characteristics of the data obtained.

In line with the development of these studies, research in Indonesia also shows attention to

the application of descriptive statistics as part of the quality of data analysis. Subhaktiyasa et al. (2025) emphasize the importance of applying descriptive statistics through the stages of data preparation, processing, analysis, visualization, and interpretation of results. The study shows that the use of descriptive statistics requires systematic procedures so that the results of the analysis can be presented accurately and responsibly. Furthermore, Harahap et al. (2025) explain that measures of central tendency and data dispersion are two complementary components in describing the characteristics of a data set. Using measures of central tendency without considering dispersion has the potential to produce less representative interpretations. These two studies provide the basis that the accuracy of descriptive statistical analysis is determined not only by the ability to perform calculations, but also by an understanding of the function of each statistical measure in explaining research data.

Although various previous studies have discussed the concept of descriptive statistics, its application, and the importance of data interpretation, discussions regarding the relationship between data characteristics, the choice of analytical techniques, and the accuracy of interpretation still need to be developed in a more integrated manner in the context of educational research. Some studies emphasize the general application of descriptive statistics, while others focus more on understanding specific statistical measures or the interpretation of research results. This situation indicates the need for a conceptual study that integrates these various aspects into a systematic methodological framework. Such a study is important so that researchers not only understand how to calculate statistical measures but also understand the reasons for choosing techniques, the conditions under which they are used, and the limitations in drawing meaning from the analysis results.

Based on these issues, this article offers a conceptual synthesis of quantitative descriptive statistics by linking the characteristics and measurement scales of data, the selection of analysis techniques, the presentation of results, and the principles of data interpretation in educational research. The distinct novelty of this study lies in establishing a unified conceptual framework that explicitly bridges the gap between raw data characteristics, statistical technique selection, and interpretive validity. By doing so, this study makes a vital contribution to improving statistical practices in educational research moving researchers away from mechanical formula application toward rigorous, context-aware, and responsible data analysis that elevates the overall quality and reliability of quantitative educational reporting. Through a conceptual literature review approach, the discussion is developed by examining various relevant scientific sources to obtain a theoretical and methodological foundation that can be used by educational researchers. Thus, this article aims to examine the conceptual foundations of quantitative descriptive statistics, explain various relevant analysis techniques, and formulate principles for appropriate and responsible data interpretation in educational research. The results of this study contribute a robust methodological framework designed specifically to elevate statistical practices and help researchers select, apply, and interpret descriptive statistics more systematically and scientifically.

Method (منهج)

This study uses a qualitative approach with a conceptual literature review to in-depth examine the concepts, analysis techniques, and interpretation principles of quantitative descriptive statistics in educational research. The study was conducted by examining various relevant scientific sources, primarily national and international journal articles and academic books discussing quantitative research methodology and statistics. The obtained literature was analyzed through a process of identification, grouping, comparison, and synthesis of concepts to build a comprehensive understanding of the relationship between data characteristics, the

selection of statistical techniques, presentation, and interpretation of analysis results. To ensure the reader can understand and trace the study process, this research method is described based on the type and approach of the research, data sources and literature criteria, data collection procedures, data analysis techniques, and the validity and credibility of the study.

1. Types and Approaches of Research
   This research uses a qualitative approach with a conceptual literature review. This approach was chosen because the research focuses on the analysis, assessment, and integration of various concepts and methodological principles regarding quantitative descriptive statistics in educational research. A conceptual review allows researchers to identify relationships between concepts, compare theoretical perspectives, and build a more comprehensive understanding of a field of study. Barry et al. (2022) explain that a literature review can produce a synthesis of knowledge through the process of interpretively reviewing and integrating various scientific sources. Based on this approach, this research is not directed at testing hypotheses or measuring the influence between variables, but rather at developing a conceptual understanding of the basis for selecting analysis techniques and the accuracy of interpreting descriptive statistics in educational research.
2. Data Sources and Literature Criteria
   The research data is sourced from secondary literature relevant to the focus of the study, including national and international scientific journal articles, quantitative research methodology books, statistics books, and academic publications discussing the analysis and interpretation of numerical data. Literature searches were conducted through Google Scholar, ERIC, DOAJ, Garuda, and Crossref databases to obtain sources related to the research topic. Keywords used include descriptive statistics, quantitative descriptive statistics, educational research, quantitative data analysis, descriptive statistics, quantitative educational research, and data interpretation. These keywords were combined using Boolean operators such as AND and OR to broaden and narrow the search results according to the study's needs.
   Literature selection was conducted purposively based on the relevance of its substance and contribution to the research objectives. Prioritized literature was publications from 2016–2026, while still considering classical sources that have a fundamental position in the development of statistical theory and research methodology. Inclusion criteria included: (1) discussing the concepts or principles of descriptive statistics; (2) explaining quantitative data analysis techniques, especially measures of central tendency and dispersion; (3) examining the presentation and interpretation of statistical data; and (4) having relevance to the application of statistics in educational research. Meanwhile, literature that did not have a clear publication identity, was not relevant to the focus of the study, or only contained discussions of inferential statistics without any connection to descriptive statistics was not used as a primary source. The determination of these criteria was intended to ensure that the analyzed literature had a direct connection to the research problem and objectives.
3. Data Collection Procedures
   Data collection was conducted through documentation techniques by tracing, identifying, selecting, and collecting various literature sources that met the research criteria. The literature collection procedure was carried out through several stages, namely determining the focus and search keywords, searching publications in academic databases, examining titles and abstracts, reviewing document content, and selecting literature that met relevance criteria.

Each selected source was then recorded based on the publication identity, discussion objectives, main concepts, statistical techniques studied, and its contribution to the understanding of descriptive statistics in educational research.

The search and source selection procedures were conducted transparently to ensure the study process could be understood and retraceable. Van Wee and Banister (2023) emphasized that reporting a literature review should explain the database, keywords, search strategy, document selection process, and rationale for source selection. Similarly, Haddaway et al. (2022) explained that structured documentation of the literature search strategy is essential for increasing transparency and repeatability of the scientific search process. Therefore, this study uses source recording and documentation of search results as a basis for maintaining traceability of the literature collection process.

4. Data Analysis Techniques

   Data analysis was conducted using content analysis and thematic synthesis of the selected literature. Content analysis was used to identify concepts, principles, characteristics, and descriptive statistical techniques described in various sources. Next, thematic synthesis was conducted by grouping information based on substantive similarities, interconceptual relationships, and differences in methodological perspectives found in the literature. The analysis process was carried out through the stages of reading and understanding sources, identifying important information, coding relevant concepts, grouping information into themes, comparing study results, and compiling a conceptual synthesis.

   The analysis themes in this study include: (1) the nature and function of quantitative descriptive statistics in educational research; (2) data characteristics and measurement scales; (3) analysis techniques for measures of central tendency and data dispersion; (4) frequency distribution, percentages, and data presentation; and (5) principles of interpretation and the appropriateness of selecting statistical techniques. These groupings are used to establish links between data characteristics, calculation procedures, and the meaning of the analysis results. Priatna et al (2025) show that conceptual literature analysis can be carried out through the identification of main concepts, thematic categorization, and theoretical synthesis to produce a more integrated understanding. Thus, the analysis in this study is directed at producing a methodological understanding that not only explains calculation techniques, but also outlines the appropriateness of their use in the context of educational research.

5. Validity and Credibility of the Study

   The validity of the study was maintained through an examination of the relevance, credibility, and consistency of information from various literature sources. Each concept and methodological principle was compared with other scientific sources to avoid reliance on a single perspective or publication. The examination was conducted by considering the suitability between the concepts presented, the characteristics of the data discussed, and the application of statistical techniques in the context of educational research. Furthermore, the literature was interpreted critically, considering the context, objectives, and limitations of each statistical technique. This process is expected to produce a conceptual synthesis that has an adequate theoretical foundation, is consistent, and is academically accountable.

Results (نتائج)

The results of the literature review indicate that quantitative descriptive statistics play a crucial role in educational research, particularly in organizing, simplifying, presenting, and systematically describing data characteristics. The use of descriptive statistics is not limited to calculating averages, percentages, or other statistical measures, but also encompasses the process of understanding data characteristics and determining appropriate analysis techniques. In the context of educational research, data obtained from student learning outcomes, responses to learning, teacher perceptions, and program evaluation results need to be processed with an appropriate approach to provide a meaningful empirical picture. Therefore, the accuracy of descriptive statistical analysis is greatly influenced by the researcher's ability to connect data types, processing techniques, presentation formats, and interpretation of results.

Crucially, the novelty of our findings demonstrates that treating descriptive statistics as an isolated set of calculation steps is a primary driver of statistical errors in educational studies. By synthesizing data characteristics, measurement scales, technique selection, presentation, and interpretation into an interconnected workflow, this study provides a concrete blueprint for reforming everyday statistical practices in educational research.

One of the main findings of this study is that the characteristics and measurement scale of the data serve as the basis for determining the descriptive statistical techniques used. Educational research data can be either categorical or numerical. Categorical data, such as student response categories, gender, or participation levels, are more accurately described using frequency distributions and percentages. Meanwhile, numerical data, such as learning outcome scores, motivation scores, and questionnaire scores, can be analyzed using measures of central tendency and dispersion. The selection of these techniques also requires consideration of the measurement scales: nominal, ordinal, interval, and ratio. Misunderstanding data characteristics can lead to the use of inappropriate statistical measures, resulting in information that does not fully reflect the actual situation.

Friedrich et al. (2024) explain that statistical and data literacy encompasses the ability to understand, represent, and interpret statistical information. These findings demonstrate that statistical understanding is demonstrated not only through the ability to read numbers but also through the ability to assign meaning to the information presented. In line with this, this study emphasizes that educational researchers need to have a methodological understanding before determining analysis techniques. Therefore, recognizing data characteristics is not merely a technical step in data processing, but also a foundation for ensuring that the statistical techniques used truly align with the research objectives.

Understanding data characteristics further relates to the use of measures of central tendency and dispersion. Measures of central tendency, including the mean, median, and mode, are used to describe the central tendency of a data set. Meanwhile, measures of dispersion, such as the range, variance, standard deviation, and interquartile range, provide information about the level of variation or diversity in the data. These two groups of measures have complementary functions . Measures of central tendency can indicate values that represent a group, but they do not necessarily explain whether the values within the group have a high degree of uniformity or are widely dispersed. For example, two classes can have the same average learning outcome score but have different standard deviations. This condition indicates that the same average achievement does not necessarily reflect the same level of equality in learning outcomes.

These results align with those of Akar and Bostan (2025) , who emphasized the importance of understanding and justifying the use of measures of central tendency and variability. Sasaki (2025) also identified difficulties in understanding the basic concepts of descriptive statistics, particularly measures of central tendency, dispersion, and quartiles. Both studies demonstrate that mastery of statistics is not solely oriented toward calculation skills but must also be accompanied by an understanding of the meaning and usefulness of each measure. In the context of educational research, these findings reinforce the importance of using measures of central

tendency and dispersion simultaneously to provide researchers with a more comprehensive picture of the data. In other words, reporting average scores alone is not necessarily sufficient to explain the characteristics of learning outcomes or student responses.

In addition to selecting the right statistical measures, the study also shows that data presentation is crucial for producing easily understood information. Analyzed data can be presented through frequency distribution tables, percentages, bar charts, line charts, or histograms, depending on the characteristics and objectives of the analysis. Tables can be used to present the number and percentage of students by achievement category, while graphs can help demonstrate distribution patterns, comparisons, or trends in the data. Appropriate presentation allows readers to identify key information without having to sift through the entire raw data. Conversely, inappropriate use of tables or graphs can obscure information and even lead to misunderstandings of the research results.

The importance of data presentation is supported by Hasanah et al. (2024) , who demonstrated that the ability to read and interpret various data representations, such as tables, pictograms, bar charts, and line graphs, still needs to be strengthened. Kazunga and Bansilal (2023) also found that the ability to perform statistical calculations is not always accompanied by the ability to explain the meaning of the calculation results based on the problem context. These findings indicate that data representation and interpretation are two interrelated skills. However, the discussion in this article provides a broader emphasis, namely that researchers are not only required to be able to read and present data but also must consider the appropriate form of presentation based on the type of information to be conveyed. Therefore, tables and graphs should function as a means of scientific communication, not simply as a complement to the display of research results.

Next, interpreting the results is the crucial step in determining the meaningfulness of descriptive statistics in educational research. Calculation results cannot simply be reported numerically; they need to be explained by linking them to the research objectives and the conditions being studied. For example, the average learning outcome score needs to be interpreted by considering the range of scores, the level of distribution, the number of students, and the criteria for completion used. Similarly, the percentage of student responses to a lesson needs to be explained based on the indicators and categories measured. This kind of interpretation helps researchers explain the conditions reflected in the data without drawing conclusions that go beyond the available information.

Azis and Dahlan (2024) explain that statistical literacy encompasses the ability to read, understand, process, represent, interpret, and critically evaluate statistical information. Meanwhile, Kazunga et al. (2023) show that the ability to calculate statistical measures does not necessarily translate to the ability to explain the rationale for selecting those measures in a given context. Both studies reinforce the view that interpretation is an integral part of statistical analysis. In this study, this principle is also linked to the limitations of descriptive statistics. Descriptive statistics are primarily used to describe the characteristics of the data obtained, not to prove relationships between variables, test the significance of differences, or determine causal influences. If the research objective is to examine relationships, differences, or influences, researchers need to use inferential statistical techniques appropriate to the design and characteristics of the study.

Based on the overall results of the study, it can be understood that the use of quantitative descriptive statistics is an interconnected process, starting from identifying data characteristics, determining statistical measures, presenting information, and interpreting the analysis results. The relationships between these components are summarized in Table 1.

Table 1.
Conceptual Synthesis of the Use of Quantitative Descriptive Statistics in Educational Research

Component	Focus of analysis	Expected results
Data characteristics and scale	Identifying data types and measurement scales	Determining the appropriate statistical technique
Centralization measure	Using mean, median, and mode	Overview of data center trends
Size of spread	Using range, variance, standard deviation, and interquartile range	Description of data variation or diversity
Data presentation	Using tables, frequency distributions, and graphs	Systematic and easy to understand data information
Interpretation of results	Connecting the analysis results with the research objectives and context	Meaningful description and proportional conclusion

The table shows that each component has a distinct function, but they are inseparable in the analysis process. Data characteristics determine the techniques that can be used, statistical measures provide an overview of the data's condition, presentation helps communicate results, and interpretation clarifies the meaning of the information based on the research context. This integration is crucial because accurate calculations alone do not guarantee that research results have been correctly explained. Researchers must also be able to justify their choice of analysis techniques and explain the limits of the information that can be derived from the analyzed data.

Compared with previous publications, some studies focus more on specific aspects, such as understanding measures of central tendency, variability, or statistical literacy. Friedrich et al. (2024) , for example, examines the development of statistical and data literacy research in STEM education, while Akar and Bostan (2025) focus on reasoning regarding measures of central tendency and variability. Kazunga (2023) examines prospective elementary school teachers' understanding of the mean and median, while Azis and Dahlan (2024) discuss the statistical literacy levels of mathematics education students. These studies provide an important foundation for understanding more specific aspects of statistics. However, this study attempts to connect these various aspects into a conceptual framework oriented towards the needs of data analysis in educational research.

Thus, the primary contribution of this study lies in affirming that quantitative descriptive statistics should not be understood merely as a collection of formulas or calculation procedures, but as an analytical process that requires alignment between data characteristics, the selection of statistical techniques, presentation, and interpretation. This conceptual framework can serve as a reference for educational researchers in processing data in a more focused manner, presenting information accurately, and developing objective and accountable interpretations. This understanding is expected to reduce errors in the selection of analytical techniques and encourage a more meaningful use of descriptive statistics in educational research.

Discussion (مناقشة)

The study results indicate that quantitative descriptive statistics in educational research must be understood as an interrelated analytical process, starting from identifying data characteristics, determining appropriate analysis techniques, presenting the data, and interpreting the results. These four stages are inseparable because the accuracy of interpretation depends heavily on the suitability of the statistical technique to the type of data and the research objectives. Therefore, the use of descriptive statistics is not sufficient simply to calculate the average value, percentage, or standard deviation; it also requires an understanding of the information that can be explained by each statistical measure.

The primary contribution of this research centers on reshaping how descriptive statistics is operationalized and practiced in educational research. While previous literature has predominantly investigated isolated components such as conceptual understanding of the mean (Kazunga et al., 2023), graphical literacy (Engledowl & Weiland, 2021), or teacher data literacy (Beck & Nunnaley, 2021) our conceptual framework bridges these fragmented domains into a cohesive operational model. This directly addresses the critique raised by Schmidt et al. (2023) regarding persistent misinterpretations in educational reporting.

The importance of this understanding aligns with Beck and Nunnaley's (2021) perspective , which explains that data literacy for teachers encompasses the ability to use and understand data to support educational decision-making. Data serves not only as a collection of numbers but also as a source of information for identifying learning conditions, student needs, and learning outcomes. In the context of educational research, this ability helps researchers determine what information needs to be analyzed and how the results can be used to explain the phenomena under study. Therefore, descriptive statistics plays a crucial role in transforming numerical data into information that can be understood and utilized appropriately.

The alignment between data characteristics and analysis techniques is also a crucial aspect in the use of descriptive statistics. Researchers need to understand that nominal, ordinal, interval, and ratio data have different characteristics, so not all statistical measures can be applied appropriately to each type of data. For example, categorical data is more appropriately described using frequencies and percentages, while numerical data can be analyzed using measures of central tendency and dispersion based on its distribution characteristics. Inaccurate analysis techniques can result in the information presented not reflecting the data's state proportionally. This suggests that the choice of statistical technique should be based on the characteristics of the data and the research question, rather than simply following the conventions of using a particular formula.

The discussion of measures of central tendency and dispersion also shows that a single statistical measure is not always sufficient to describe the characteristics of a data set. The mean can provide a general overview of the trend of the results, but it does not necessarily reflect the condition of all group members. If there are very high or very low values, the mean can shift, making it less representative of the majority of the data. In such circumstances, the median can be a more informative measure. Meanwhile, the range, variance, and standard deviation are needed to provide complete information about the level of data variability. Litke and Hill (2020) , through a study of statistics learning in elementary school mathematics classes, showed that learning often emphasizes calculations and graphing rather than statistical investigation and understanding data variation. This reinforces the importance of paying attention to data distribution, not just the results of calculations of measures of central tendency.

In educational research, the use of measures of central tendency and dispersion can help researchers obtain a more complete picture of student performance. For example, when analyzing a class's test results, the mean score can be used to describe overall achievement, while the standard deviation provides information about differences in results across students. If the class mean is high but the scores are also widely dispersed, researchers should be cautious in concluding that student achievement is evenly distributed. Conversely, a relatively moderate mean with a small dispersion may indicate that student achievement tends to be close together. Therefore, statistical interpretation requires considering multiple measures simultaneously to avoid relying solely on a single number.

Another aspect that requires attention is data presentation through tables, diagrams, and graphs. Good presentation is not just about making data more attractive, but also about helping readers recognize patterns, trends, differences, and variations within the data. Hudiburgh and

Garbinsky (2020) explain the use of data visualization in statistics learning as a means to help students understand and communicate statistical information. In the context of educational research, frequency distribution tables, bar charts, histograms, and line graphs should be selected based on the presentation objectives and data characteristics. Researchers also need to pay attention to titles, labels, scales, and captions to ensure visualizations do not lead to misunderstandings.

The accuracy of data presentation is closely related to the reader's ability to interpret the information presented. Engledowl and Weiland (2021) discuss how misleading data visualizations can impact the understanding of statistical information, while also highlighting the importance of developing statistical literacy so readers can critically assess data representations. In educational research, the use of disproportionate graphic scales, inappropriate diagram formats, or the omission of important information can create a different impression than the actual data. Therefore, researchers need to present data honestly, clearly, and proportionately. Interpretation should not be directed at strengthening a particular conclusion while ignoring information that does not support it.

The need to connect analysis to the educational context is also a key element of this discussion. Descriptive statistics produce numerical summaries, but the meaning of these summaries needs to be explained based on the research objectives and the context being studied. Schreiter et al. (2024) emphasize the importance of statistical and data literacy in STEM education, including teachers' ability to understand, use, and teach data. This perspective is relevant to educational research because the results of statistical analysis should not just be expressed in numbers but connected to the learning issues that are the focus of the research. For example, the percentage of learning completion needs to be explained by referring to the completion criteria used, student characteristics, and the context in which the learning is implemented. This way, statistical results become meaningful information, not just numerical reports.

However, the use of descriptive statistics has limitations that researchers need to understand. Descriptive statistics serve to describe the characteristics of the data obtained, but they do not, by themselves, prove causal relationships, test statistically significant differences, or determine the effect of a treatment. If the research objective is to determine the effect of a learning model or examine differences in outcomes between groups, researchers need to consider inferential statistical techniques appropriate to the design and characteristics of the data. Therefore, research conclusions must be formulated proportionally to the type of analysis conducted. The use of terms such as "increase," "influence," or "cause" needs to be supported by a research design and analysis that allows for such conclusions to be drawn.

Overall, this study confirms that the primary contribution of quantitative descriptive statistics to educational research lies in its ability to organize data into a systematic, understandable, and relevant empirical picture of the research problem. The conceptual novelty of this article lies in its emphasis on the relationship between data characteristics, statistical technique selection, presentation, and interpretation as a unified analysis process. This framework can help educational researchers avoid the mechanical use of statistical techniques and encourage more critical interpretation. By understanding the interconnectedness of each stage, researchers are expected to be able to produce data descriptions that are accurate, transparent, and within the capabilities of descriptive statistics.

Furthermore, data comprehension skills need to be developed not only in students but also in teachers and educational researchers. Friedrich et al. (2024), through a review of 42 studies, showed that there are still gaps in statistical knowledge and skills, as well as data literacy, among teachers. These findings reinforce the importance of data comprehension as a crucial component of educators' professional competence. In educational research, researchers with a sound

understanding of statistics are better able to select analysis techniques, interpret results, and convey conclusions responsibly.

Overall, this study confirms that the primary contribution of quantitative descriptive statistics to educational research lies in its ability to organize data into a systematic, understandable, and relevant empirical picture of the research problem. The conceptual contribution of this article lies in emphasizing the relationship between data characteristics, statistical technique selection, presentation, and interpretation as a unified analysis process. This framework can help educational researchers avoid the mechanical use of statistical techniques and encourage more critical interpretation. By understanding the interconnectedness of each stage, researchers are expected to be able to produce data descriptions that are accurate, transparent, and within the capabilities of descriptive statistics.

Conclusion (خاتمة)

This study concludes that quantitative descriptive statistics is an indispensable component of educational research, serving to systematically organize, summarize, present, and characterize data. Addressing critical needs for methodological enhancement, the primary novelty and contribution of this work lie in its comprehensive conceptual synthesis, which unifies data characteristics, analytical technique selection, data presentation, and interpretive validity into a single integrated framework.

By examining foundational concepts, analysis techniques, and interpretation principles, the findings demonstrate that analytical accuracy relies not merely on calculation skills, but on understanding data scales, choosing appropriate techniques, and interpreting results within a specific research context. Consequently, descriptive statistics must be treated as a holistic analytical process rather than a mere mechanical application of formulas to generate numbers.

This framework broadens traditional statistical discussions by emphasizing that measures of central tendency (such as the mean, median, and mode) must be interpreted alongside measures of dispersion (such as the range, variance, standard deviation, and interquartile range) to prevent partial data representations. Furthermore, the appropriate selection of tables and graphs ensures transparent communication, providing researchers and educators with a robust foundation for analyzing learning outcomes, student responses, and teacher perceptions critically and responsibly.

Although this study is constrained by its reliance on a literature synthesis without empirical testing across diverse educational settings, it establishes a vital methodological basis. Future research should focus on testing this framework's applicability using real-world data across various educational levels, comparing its interpretive accuracy with conventional approaches, and developing practical literacy tools to enhance decision-making in education.

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