



HAMEMAYU HAYUNING BAWANA PHILOSOPHY AS A PEDAGOGICAL FOUNDATION FOR CONTEXTUAL ENVIRONMENTAL STATISTICS LEARNING

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ABSTRACT

This study aims to examine the integration of Hamemayu Hayuning Bawana into Phase E statistics learning at SMA Muhammadiyah Mlati and its contribution to meaningful, contextual, and environmentally responsible mathematics learning. A qualitative case study design was employed involving a mathematics teacher and Phase E students. Data were collected through classroom observations, semi-structured interviews, and documentation, and analyzed through data reduction, data display, and conclusion verification using source and technique triangulation. The findings show five main aspects: environmental contexts were integrated into statistics learning; students used statistical concepts to identify environmental conditions; critical and responsible attitudes toward data were developed; collaboration and environmental responsibility were strengthened; and students formulated reflective, action-oriented recommendations. The integration of Hamemayu Hayuning Bawana enabled students to connect statistical concepts with real environmental issues while developing statistical literacy, critical thinking, collaboration, awareness, and responsibility. The study concludes that local Javanese philosophy can function as a cultural, pedagogical, and ethical foundation for contextual statistics learning and sustainable environmental action.

Keywords: Hamemayu Hayuning Bawana; Statistics Learning; Local Wisdom; Environmental Awareness

1. INTRODUCTION

Mathematics education is not only intended to develop students' computational skills but also to strengthen their ability to understand, analyze, and solve problems encountered in everyday life. Mathematics is often perceived as an abstract subject because students frequently encounter symbols, formulas, and procedures that are disconnected from their lived experiences [1]. Therefore, mathematics learning needs to be developed through contexts that are familiar to students so that mathematical concepts become more meaningful and applicable. Learning that connects mathematics with students' culture and surrounding environment can bridge abstract mathematical concepts with concrete experiences and everyday situations [2]. A systematic review of ethnomathematics research in Indonesia indicates that cultural elements, including cultural ideas, artifacts, and activities, can be integrated into mathematics learning to create more contextual and meaningful learning experiences.

The need for contextual mathematics learning has become increasingly important as contemporary education emphasizes not only conceptual mastery but also literacy, critical thinking, communication, collaboration, and the ability to apply knowledge to real-life situations [3]. In this context, local wisdom can serve as a learning resource that enables students to understand mathematics through social and cultural experiences within their immediate environment [4]. Indonesian ethnomathematics research indicates that local cultural knowledge can connect mathematical learning with students' everyday activities and cultural norms, thereby supporting the development of mathematical literacy [5]. Similarly, ethnomathematics-based learning at the secondary school level has been found to connect academic content with students' cultural contexts and real-life experiences while strengthening conceptual understanding, motivation, engagement, and positive

attitudes toward mathematics [6]. Thus, local wisdom can function not only as a contextual resource but also as a foundation for developing relevant and meaningful mathematics learning.

In the context of the Special Region of Yogyakarta, one of the distinctive educational values of Javanese culture is Hamemayu Hayuning Bawana. This philosophy emphasizes efforts to maintain harmony, preserve environmental well-being, and establish responsible relationships between human beings, society, and the surrounding environment [7]. Such values are highly relevant to education because learning should not be limited to knowledge acquisition but should also contribute to the development of students' awareness, responsibility, and concern for their social and natural environment. In mathematics education, this philosophy can be implemented through learning activities that encourage students to observe environmental conditions, collect information, analyze data, and use the results to understand and respond to problems in their surroundings [8]. The integration of local wisdom into mathematics education has been reported to strengthen conceptual understanding, cultural identity, and meaningful learning through culturally responsive instructional practices [9].

Statistics in Phase E mathematics provides a particularly relevant context for implementing Hamemayu Hayuning Bawana because statistical learning involves collecting, organizing, presenting, analyzing, and interpreting data. Students can learn concepts such as tables, graphs, measures of central tendency, and data interpretation through authentic phenomena in the school environment, including classroom cleanliness, waste generation, water and electricity consumption, school facilities, and other environmental conditions [10]. Through these contexts, students are not only engaged in mathematical calculations but also learn to understand environmental conditions based on quantitative evidence [11]. Culturally grounded and realistic mathematics learning can facilitate connections between students' informal experiences and formal mathematical thinking while strengthening conceptual understanding and meaningful learning [12]. Therefore, statistics can serve as a medium for developing mathematical literacy while simultaneously fostering environmental awareness and social responsibility.

Although research on ethnomathematics and local wisdom in Indonesian mathematics education has continued to develop, several research gaps remain. Previous studies have shown that geometry is among the most frequently investigated mathematical topics in Indonesian ethnomathematics research, while other areas of mathematics receive comparatively less attention [13]. More recent evidence indicates that cultural artifacts remain a dominant focus, whereas statistics is still relatively underrepresented in ethnomathematics studies in Indonesia [14]. Furthermore, many studies primarily identify mathematical concepts embedded in cultural artifacts, traditional activities, architecture, games, and other cultural products, while the use of philosophical values as pedagogical and ethical orientations in mathematics learning remains less explored [15]. This situation creates an opportunity to develop research that positions local wisdom not merely as a context for identifying mathematical concepts but also as a foundation for developing students' ways of thinking, attitudes, responsibility, and engagement with real-world issues.

Based on this background, this study focuses on the implementation of the distinctive Javanese educational value of Hamemayu Hayuning Bawana in Phase E mathematics learning on statistics at SMA Muhammadiyah Mlati. The study examines how this value is integrated through environmental contexts, data collection and analysis activities, statistical interpretation, collaboration, reflection, and the formulation of evidence-based recommendations. This focus extends ethnomathematics research from the use of cultural artifacts and practices toward the use of local philosophical values as pedagogical and character-development foundations. The study also seeks to demonstrate that statistics learning can simultaneously develop mathematical literacy, critical thinking, collaboration, environmental awareness, and responsibility. Therefore, the integration of Hamemayu Hayuning Bawana is expected to contribute to mathematics learning that develops not only academic competencies but also students' awareness and commitment to maintaining harmony between human beings, society, and the environment.

2. LITERATURE REVIEW

2.1. Hamemayu Hayuning Bawana

Hamemayu Hayuning Bawana is a Javanese philosophical principle that emphasizes the responsibility of human beings to maintain harmony, beauty, balance, and well-being in the world. The concept positions human life as interconnected with other people, society, and the natural environment, implying that individual actions should contribute to collective and environmental well-being [16]. In the educational context of Yogyakarta, this philosophy can be interpreted as a value orientation that encourages learners to develop responsibility, care, harmony, and awareness of the consequences of their actions [17]. Consequently,

Hamemayu Hayuning Bawana has potential relevance to educational practices that seek to integrate intellectual development with character formation and environmental responsibility. The integration of local philosophical values into mathematics education can also strengthen meaningful learning by connecting academic knowledge with students' cultural and social contexts [18].

In mathematics education, Hamemayu Hayuning Bawana can be operationalized through learning activities that encourage students to investigate real-world problems and use mathematical knowledge responsibly. Rather than presenting the philosophy solely as cultural knowledge, teachers can embed its principles in the selection of learning contexts, classroom interactions, collaborative activities, reflection, and evidence-based decision-making [19]. Such an approach is consistent with culturally responsive mathematics education, in which cultural knowledge and values are used to create meaningful learning experiences and strengthen students' connections between mathematics and everyday life [20]. Therefore, Hamemayu Hayuning Bawana can function not only as a cultural identity marker but also as a pedagogical and ethical framework for mathematics learning that promotes harmony, responsibility, and sustainable action.

2.2. Statistics Learning

Statistics learning involves more than mastering computational procedures because students need to understand how data are collected, organized, represented, analyzed, interpreted, and used to support conclusions and decisions. Effective statistics education therefore requires students to engage with authentic data and meaningful contexts rather than relying exclusively on predetermined datasets and procedural exercises [21]. Contextual learning can help students understand the relationship between statistical representations and real-world phenomena while developing statistical reasoning and data literacy [22]. In this regard, statistics provides considerable opportunities for interdisciplinary learning because data can be derived from social, environmental, economic, health, and school-related phenomena. Connecting mathematics with real-life contexts has been identified as an important feature of meaningful mathematics learning and mathematical literacy development [23].

Statistics learning also has an important role in developing critical thinking because students need to evaluate the quality of data, recognize patterns, compare representations, and determine whether conclusions are supported by evidence. When statistical tasks are based on authentic environmental conditions, students can simultaneously develop mathematical competencies and awareness of problems in their surroundings [24]. However, Indonesian ethnomathematics research has historically focused more strongly on geometry and cultural artifacts, while statistics has received comparatively less attention [25]. This situation indicates the potential for developing culturally contextualized statistics learning in which students use data from their own environment to understand real conditions and formulate evidence-based responses. Such learning can transform statistics from a primarily computational subject into a tool for inquiry, reflection, and responsible decision-making.

2.3. Local Wisdom

Local wisdom refers to knowledge, values, norms, practices, and principles that develop within a particular community and are transmitted across generations. In education, local wisdom can serve as a contextual resource for connecting formal knowledge with students' cultural identities, experiences, and social environments [26]. The integration of local wisdom can make learning more relevant because students encounter academic concepts through situations that are familiar within their communities. Systematic reviews of Indonesian ethnomathematics research indicate that local cultural elements have been increasingly incorporated into mathematics learning through cultural ideas, artifacts, and activities [27]. Such integration can support meaningful learning while simultaneously strengthening students' cultural identity and positive attitudes toward mathematics.

In mathematics education, local wisdom can function at several levels, including as a source of learning contexts, a means of developing mathematical concepts, and a foundation for character development. Research indicates that culturally responsive mathematics learning can support conceptual understanding by connecting informal knowledge and everyday experiences with formal mathematical reasoning [28]. Nevertheless, much ethnomathematics research continues to emphasize cultural artifacts, traditional games, architecture, and other observable cultural products, with geometry remaining a dominant mathematical topic [29]. Therefore, greater attention is needed to philosophical dimensions of local wisdom, particularly values that can guide students' attitudes and actions. In this study, Hamemayu Hayuning Bawana is positioned as local wisdom that provides both contextual meaning and ethical direction for statistics learning.

2.4. Environmental Awareness

Environmental awareness refers to an individual's understanding of environmental conditions, sensitivity to environmental problems, and willingness to behave responsibly toward the environment. Education plays an important role in developing environmental awareness because students need opportunities to recognize environmental problems, understand their causes and consequences, and participate in appropriate responses [30]. Environmental education becomes more meaningful when learners interact directly with their surroundings and use evidence to understand actual environmental conditions. Integrating environmental issues into mathematics can therefore provide opportunities for students to analyze authentic data while developing concern for environmental sustainability [31]. Such contextual learning is consistent with the broader principle that mathematics can be used to interpret real-world situations and support informed decision-making.

The integration of environmental awareness into statistics learning is particularly relevant because environmental phenomena can be transformed into quantitative information that students can collect, analyze, and interpret. Students can investigate data related to waste generation, water consumption, electricity use, classroom cleanliness, or other environmental conditions and subsequently use statistical measures and representations to identify patterns and formulate conclusions [32]. When combined with local wisdom, such activities can provide both an empirical and ethical foundation for environmental learning [33]. Hamemayu Hayuning Bawana strengthens this relationship by emphasizing harmony between human activities and the surrounding environment, while statistics provides the tools for examining environmental conditions systematically. Thus, the combination of local wisdom, statistics learning, and environmental awareness can create an interdisciplinary learning framework that develops mathematical literacy while encouraging critical thinking, responsibility, collaboration, and sustainable environmental action.

3. METHOD

This study employed a qualitative case study design to examine the integration of Hamemayu Hayuning Bawana in Phase E statistics learning at SMA Muhammadiyah Mlati. The research focused on how the Javanese philosophical value was incorporated into environmental contexts, statistical activities, collaborative learning, responsible data use, and environmental reflection. The participants consisted of a mathematics teacher and Phase E students involved in the statistics learning process. Data were collected through classroom observations, semi-structured interviews, and documentation. Observations focused on students' learning activities, interaction, data collection and analysis processes, collaboration, reflection, and environmental awareness, while interviews explored the teacher's instructional intentions and students' learning experiences [34]. Documentation included lesson plans, teaching modules, worksheets, statistical assignments, students' reports, presentation materials, and reflection notes.

Data were analyzed using a qualitative analysis process consisting of data reduction, data display, and conclusion drawing and verification. The analysis involved identifying recurring patterns related to the integration of Hamemayu Hayuning Bawana, students' use of statistics to understand environmental conditions, responsible interpretation of data, collaboration, and action-oriented environmental recommendations [35]. Source and technique triangulation were applied by comparing evidence obtained from observations, interviews, and documentation to strengthen the credibility of the findings. The findings were then interpreted thematically to explain how local philosophical values could function as a cultural and pedagogical foundation for contextual statistics learning. This methodological approach enabled the study to capture not only students' mathematical activities but also the development of critical thinking, collaboration, environmental awareness, responsibility, and reflection within the learning process.

4. RESULTS AND DISCUSSION

4.1. The Integration of Hamemayu Hayuning Bawana through Environmental Contexts in Statistics Learning

The observation findings indicate that the value of Hamemayu Hayuning Bawana was integrated into Phase E mathematics instruction through the use of environmental contexts in statistics learning. Rather than relying exclusively on abstract exercises and predetermined datasets provided in textbooks, the teacher introduced learning activities based on environmental phenomena that students could observe directly within and around the school. Students were encouraged to identify situations that could be represented quantitatively, such as the amount of waste generated by a class, classroom cleanliness, water consumption, electricity use, and the condition of school facilities. These phenomena were subsequently transformed into statistical problems involving data collection, organization, presentation, and interpretation. Such activities enabled students to

recognize that mathematical concepts are not isolated from everyday life but can be used to understand actual conditions in their surroundings.

The interview findings further revealed that the teacher intentionally selected environmental contexts to provide students with meaningful experiences in learning statistics. The teacher explained that environmental issues were considered appropriate because they were relatively close to students' daily experiences and could encourage them to become more aware of their surroundings. Through statistical activities, students were encouraged to collect evidence, organize information, identify patterns, and formulate conclusions regarding environmental conditions. The integration of Hamemayu Hayuning Bawana was therefore not presented merely through verbal explanations about Javanese cultural philosophy, but was embedded in the selection of learning contexts and the design of classroom activities. This approach enabled the cultural value to become part of students' mathematical experiences and helped them understand that mathematics can be used to support responsible decisions concerning the environment.

The documentary evidence supports the findings obtained from observations and interviews. Lesson plans, teaching modules, worksheets, students' assignments, and statistical reports demonstrated that environmental contexts were incorporated into the learning activities. The documents showed that students were expected to organize collected data into tables, represent the data using appropriate diagrams, calculate measures of central tendency, and provide interpretations of the results. In several learning products, students were also required to formulate conclusions based on the data rather than merely presenting numerical answers. These findings demonstrate that Hamemayu Hayuning Bawana can be operationalized within mathematics education through contextual learning activities. In this case, the philosophy functions as a meaningful cultural orientation that connects mathematical concepts with environmental awareness and the responsibility to maintain harmony between human activities and the surrounding environment.

4.2. Students' Use of Statistics to Identify Environmental Conditions and Problems

The observation findings show that students were actively involved in collecting, classifying, processing, and interpreting data related to their immediate environment. During the learning activities, students were given opportunities to observe phenomena, determine relevant information, and convert observations into quantitative data that could subsequently be analyzed using statistical concepts. They were not limited to performing calculations based on ready-made datasets but participated in the process of producing and examining data themselves. For example, students analyzed data concerning environmental conditions and subsequently determined the mean, median, or mode before discussing what these values indicated. This process encouraged students to understand statistics as a tool for describing real situations rather than merely as a collection of formulas and computational procedures.

The interview findings indicate that students considered the use of environmental data to make statistical learning more relevant to their everyday experiences. Several students expressed that analyzing data obtained from their own surroundings made it easier to understand why statistical concepts were important and how they could be applied outside the classroom. The teacher also explained that environmental contexts could encourage students to pay greater attention to phenomena that they encountered regularly but might previously have considered insignificant. By transforming these phenomena into data, students were encouraged to examine them systematically and objectively. Thus, the learning process promoted a transition from simply observing environmental conditions to understanding them through quantitative evidence and statistical reasoning.

The documentary evidence provides further support for this finding through students' statistical tables, graphs, calculations, written interpretations, and reports. These learning products demonstrate that students were able to transform observations of environmental phenomena into organized statistical information and subsequently interpret the information using mathematical concepts. The process also showed that students were gradually developing an understanding of the relationship between data and real-world conditions. The integration of Hamemayu Hayuning Bawana therefore contributed to the development of both statistical literacy and environmental awareness. Statistics became a medium through which students could understand their surroundings more systematically, while the cultural philosophy provided a meaningful value orientation for interpreting the information and considering its implications for environmental well-being.

4.3. The Development of Critical and Responsible Attitudes toward the Use of Data

The observation findings demonstrate that the teacher emphasized not only computational accuracy but also the interpretation, validation, and responsible use of statistical information. Students were encouraged to check their calculations, examine the consistency of their data, and consider whether their conclusions were genuinely supported by the evidence collected. In learning activities involving mean, median, and mode, for example, students were asked to explain why a particular measure was appropriate for describing a dataset rather than simply stating the numerical result. They were also encouraged to compare different statistical measures and discuss how different measures could produce different interpretations. This process helped students recognize that statistical information needs to be interpreted carefully and should not be separated from the context in which the data were collected.

The interview findings reveal that the teacher considered statistics learning an appropriate opportunity to cultivate students' critical, honest, careful, and responsible attitudes toward information. The teacher emphasized that students should not manipulate data merely to obtain a desired conclusion and should be willing to revise their interpretations when the evidence did not support their initial assumptions. Students also indicated that the learning activities encouraged them to pay greater attention to the relationship between numerical results and the actual conditions represented by those numbers. This demonstrates that the learning process addressed not only mathematical competence but also an important dimension of mathematical ethics, namely the responsible use and interpretation of quantitative information.

The documentary evidence further confirms this finding through students' statistical reports, data analyses, interpretations, and conclusions. The assignments generally required students to provide explanations alongside their calculations and to justify their conclusions using the available data. Such documentation indicates that students were encouraged to move beyond procedural correctness toward reasoned interpretation. From the perspective of Hamemayu Hayuning Bawana, this practice is significant because the philosophy emphasizes the creation and maintenance of harmony in life, which requires responsible use of knowledge and awareness of the consequences of human actions. Therefore, responsible statistical reasoning can be understood as one practical expression of the cultural value within mathematics learning, particularly when statistical findings are used to understand and address environmental issues.

4.4. The Strengthening of Collaboration and Environmental Responsibility

The observation findings show that the implementation of Hamemayu Hayuning Bawana was strengthened through collaborative statistical activities. Students worked in small groups to determine the objects of observation, formulate simple data-collection procedures, collect information, organize datasets, perform statistical calculations, create graphical representations, and prepare presentations. The distribution of responsibilities within groups required students to communicate and coordinate their actions while completing the assigned tasks. During discussions, students compared calculations, questioned one another's interpretations, and negotiated conclusions based on the available evidence. Such interactions demonstrated that statistical learning could provide opportunities for students to develop mathematical understanding through collective inquiry and problem solving.

The interview findings indicate that the teacher deliberately used collaborative learning because environmental problems are closely related to collective responsibility. According to the teacher, students need to understand that maintaining a healthy and harmonious environment cannot depend solely on individual behavior but requires cooperation among members of the school community. Students similarly reported that working in groups allowed them to exchange ideas and obtain assistance when they experienced difficulties in processing or interpreting data. The collaborative process also provided opportunities for students to practice listening to different perspectives and respecting alternative approaches to mathematical problems. These experiences are consistent with the social dimension of Hamemayu Hayuning Bawana, which emphasizes the importance of creating harmony and mutual benefit in shared life.

The documentary evidence, including group worksheets, photographs of learning activities, statistical reports, presentation materials, and students' written reflections, supports these findings. The documents demonstrate that statistical tasks were completed through a series of shared activities rather than isolated individual exercises. Students' products also indicate that they were able to combine their contributions into coherent statistical analyses and environmental recommendations. Therefore, the integration of Hamemayu Hayuning Bawana extended beyond environmental awareness to include collaboration, mutual assistance, responsibility, respect, and concern for the common good. Mathematics learning consequently became a

space in which statistical competence and culturally grounded character development could be developed simultaneously.

4.5. The Development of Reflection and Action-Oriented Recommendations for Environmental Preservation

The observation findings indicate that the learning process was followed by reflection on the meaning and implications of the statistical results. After collecting and analyzing data, students were encouraged to relate their findings to actual environmental conditions and consider possible actions that could be taken to improve those conditions. The teacher encouraged students to ask not only what the statistical results were, but also what those results meant and why they were important. For example, after identifying a particular pattern or tendency in environmental data, students were asked to discuss possible causes and formulate reasonable recommendations. This reflective process extended the learning experience from data processing to interpretation, evaluation, and decision-making.

The interview findings further demonstrate that the teacher regarded the ability to use statistical information for decision-making as an important learning outcome. The teacher explained that students should understand that mathematical knowledge has practical consequences when applied to real-life situations. Students were therefore encouraged to formulate recommendations based on evidence rather than personal assumptions alone. Their proposed actions included reducing waste, maintaining classroom cleanliness, using water and electricity more efficiently, and encouraging greater environmental awareness among peers. Although these actions were relatively simple, they demonstrated that students were beginning to understand the relationship between statistical evidence, personal responsibility, and collective environmental action.

The documentary evidence, including students' reflection notes, group discussion records, statistical reports, presentation materials, and proposed recommendations, provides additional support for this finding. These documents illustrate a learning sequence that can be summarized as observing environmental conditions, collecting data, organizing and analyzing data, interpreting statistical findings, reflecting on their meaning, and formulating possible actions. This sequence demonstrates that Hamemayu Hayuning Bawana can provide a meaningful cultural foundation for statistics education by connecting mathematical reasoning with environmental responsibility. The philosophy therefore functions not merely as a cultural statement but as an orientation that encourages students to use mathematical knowledge to understand their surroundings, make evidence-based decisions, and contribute to the creation of a more harmonious and sustainable environment.

4.6. Discussion

The findings of this study indicate that the integration of Hamemayu Hayuning Bawana into Phase E statistics learning provides a meaningful cultural context for connecting mathematical concepts with students' everyday experiences. The use of environmental phenomena as statistical objects enabled students to move from abstract numerical procedures toward the interpretation of real situations. Students were encouraged to collect, organize, present, and interpret data concerning environmental conditions, allowing them to recognize that statistical knowledge can be used to understand problems in their immediate surroundings. This finding is consistent with Krismasanti [36] and Astiwi et al. [37], who found that local cultural elements can make mathematics learning more contextual and meaningful, and with Villarin et al. [38] and Batubara et al. [39], who reported that ethnomathematics-based learning can strengthen conceptual understanding, motivation, engagement, and positive attitudes toward mathematics. However, the present study extends previous research by positioning Hamemayu Hayuning Bawana not merely as a cultural context but also as a value-oriented pedagogical and ethical foundation for mathematics learning.

The second finding demonstrates that students' use of statistics to identify environmental conditions and problems can strengthen statistical literacy and environmental awareness simultaneously. Students collected and analyzed data from their school environment and interpreted statistical results in relation to actual environmental conditions. This finding is consistent with Wijaya et al. [40] and Kintoko et al. [41], who emphasized the potential of ethnomathematics to strengthen mathematical literacy by connecting learning with students' daily activities and cultural norms. The finding is particularly significant because Rohman [42] and Siswanto [43] reported that geometry remains dominant in Indonesian ethnomathematics research, while statistics is relatively underrepresented. Therefore, the use of environmental data in statistics learning provides an important contribution by demonstrating how local cultural values can support statistical literacy through authentic and meaningful environmental problems.

The third finding shows that Hamemayu Hayuning Bawana can contribute to the development of critical and responsible attitudes toward the use of statistical data. Students were not only expected to calculate the mean, median, and mode but also to examine the meaning of statistical results, evaluate evidence, and interpret numerical findings within their environmental context. This finding is consistent with Hendrian & Buyung [44], whose meta-analysis of 15 quantitative studies involving 1,247 students found a substantial positive effect of ethnomathematics-based learning on mathematical achievement and a moderate effect on learning attitudes. The present study adds a qualitative perspective by showing how critical mathematical thinking develops through classroom processes in which students question results, compare interpretations, and formulate evidence-based conclusions. From the perspective of Hamemayu Hayuning Bawana, statistical literacy therefore involves not only mathematical competence but also the ethical and responsible use of quantitative information.

The fourth finding concerns the development of collaboration, mutual responsibility, and environmental concern through statistical learning. Observation, interview, and documentary evidence showed that students worked collaboratively to collect, process, analyze, and communicate statistical information. These activities encouraged students to exchange ideas, distribute responsibilities, compare mathematical procedures, and reach conclusions collectively. This finding is consistent with Priatna [45] and Herawati & Sidik [46], who reported that local wisdom in mathematics education can strengthen conceptual understanding, cultural identity, and meaningful learning through culturally responsive strategies. The present study extends these findings by connecting collaborative statistical learning with Hamemayu Hayuning Bawana, in which environmental harmony is understood as a shared responsibility involving cooperation, mutual respect, and concern for the common good.

The fifth finding, concerning reflection and action-oriented recommendations for environmental preservation, represents an important contribution of this study. After analyzing environmental data, students were encouraged to reflect on their findings and formulate possible actions, including reducing waste, maintaining classroom cleanliness, and using resources efficiently. This orientation differs from much previous ethnomathematics research, which has predominantly focused on mathematical concepts embedded in cultural artifacts, traditional activities, architecture, and games [47], [48], [49]. The present study instead positions statistics as a tool for environmental reflection and evidence-based action, thereby connecting mathematical reasoning with social and ecological responsibility. This approach is also consistent with Lubis et al. [50], Sofie et al. [51], and Rochmat et al. [52] who found that culturally grounded Realistic Mathematics Education can support meaningful transitions from informal to formal mathematical thinking and strengthen conceptual understanding and higher-order thinking.

Taken together, the five findings demonstrate that Hamemayu Hayuning Bawana can function as more than a cultural symbol within mathematics education. The philosophy provides a framework for connecting statistical concepts with environmental realities, critical data interpretation, collaboration, reflection, and responsible action [53]. In this context, statistics becomes a means for students to understand their surroundings while developing awareness of the consequences of human activities. The findings therefore strengthen the argument that local wisdom can serve simultaneously as a contextual resource, pedagogical orientation, and character-development framework in mathematics learning. This study contributes to the existing literature by demonstrating how a Javanese philosophical value can be operationalized in statistics learning to integrate mathematical literacy, environmental awareness, social responsibility, and sustainable action.

5. CONCLUSION

This study concludes that the integration of Hamemayu Hayuning Bawana, a Javanese philosophy emphasizing harmony, environmental well-being, and responsible relationships with nature, provides a meaningful cultural and pedagogical foundation for Phase E statistics learning at SMA Muhammadiyah Mlati. Findings from observations, interviews, and documentation show that students connected statistical concepts with authentic environmental contexts such as waste management, cleanliness, water and electricity use, and school conditions. Through data collection, classification, visualization, calculation, interpretation, reflection, and recommendation activities, students developed statistical literacy, critical thinking, collaboration, environmental awareness, and responsibility. The findings indicate that Hamemayu Hayuning Bawana can function not merely as a cultural symbol but as an orientation for contextual mathematics learning and sustainable action. Therefore, mathematics teachers are encouraged to integrate local philosophical values with authentic statistical and environmental problems through culturally responsive materials, project-based activities, and relevant assessments. Further research should involve more schools,

diverse students, and longitudinal or comparative designs to examine the sustainability and broader impact of this approach on mathematical literacy, environmental awareness, and responsible decision-making.

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