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Constructing a Love-Based Curriculum through an Ethnomathematics Approach: A Case Study of Madrasah Ibtidaiyah

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ABSTRACT

Purpose: This study explores how fifth-grade three-dimensional geometry learning can be connected with students' cultural experiences and human values through the formulation and implementation of a Love-Based Curriculum through an Ethnomathematics Approach (KBCE). **Methods:** This qualitative descriptive-interpretive case study was conducted in two Madrasah Ibtidaiyah in Banyumas Regency, Indonesia. The informants consisted of two fifth-grade mathematics teachers and two fifth-grade students selected through purposive sampling based on their involvement in three-dimensional geometry learning and KBCE implementation. Data were collected through in-depth interviews, classroom observations, and documentation. Analysis followed Miles, Huberman, and Saldaña's interactive model through data condensation, data display, and conclusion drawing, supported by source and technique triangulation. **Findings:** The initial findings indicated that three-dimensional geometry learning remained predominantly procedural, relying on textbook representations, formulas, and exercises, with limited systematic integration of local cultural resources and love values. The study formulated KBCE as an initial conceptual framework comprising four interconnected components: love-based values as the pedagogical foundation, ethnomathematics integration as a basis for mathematical concept construction, humanistic mathematics learning as the learning process, and holistic learning outcomes as the intended orientation. Its implementation utilized Banyumas traditional houses and kitchen utensils through five stages: local cultural exploration, mathematical concept identification, formal concept construction, collaboration and reflection, and internalization of love values. The findings indicate opportunities for students to engage with mathematical concepts through culturally meaningful objects and supportive classroom interactions. **Research Implications:** KBCE provides an initial reference for teachers to design culturally situated and value-oriented mathematics learning while allowing adaptation to different cultural and educational contexts. **Originality:** This study offers an initial conceptual contribution by positioning local culture as a foundation for mathematical concept construction and integrating love-based values within primary mathematics learning.

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INTRODUCTION

Mathematics learning in primary education holds a strategic position in developing students' logical, critical, creative, and systematic thinking abilities (Wang et al., 2025). Mathematical competence developed from the early stages of education serves as an important foundation for enabling students to understand various life phenomena rationally and structurally (Nanda & Rani, 2025). However, mathematics learning practices in Madrasah Ibtidaiyah (MI) still tend to emphasize conceptual mastery, procedural problem-solving, and academic achievement. This orientation often leads students to perceive mathematics as a collection of abstract rules and symbols that are disconnected from their lived experiences. The limited connection between mathematical concepts and real-life contexts has become one of the factors contributing to students' difficulties in developing a deeper understanding of mathematical concepts (Wisenöcker et al., 2024). Therefore, the need for more contextual mathematics learning has become increasingly important to ensure that mathematics is not merely understood as academic content (Kusnirova et al., 2026), but as knowledge that is closely connected to students' social and cultural environments.

Primary education has a responsibility not only to develop students' intellectual abilities but also to foster character and human values (Komalasari & Yakubu, 2023). The learning process at the primary level serves as an important space for shaping students' ways of thinking, attitudes, and relationships with their surrounding environment. The context of madrasah education has distinctive characteristics in which knowledge development and value formation are integrated simultaneously (Srinio et al., 2025). The concept of love-based education emphasizes that learning processes should establish positive relationships between teachers and students through empathy, care, appreciation, and respect for diversity. Love in education is not merely understood as an emotional attitude, but as a pedagogical principle that guides how learning is designed and implemented (Nurina & Setiyadi, 2025).

In this study, love-based curriculum is conceptualized through several pedagogical dimensions, including care for students' learning needs, respect for diverse perspectives, appreciation of students' contributions, supportive teacher-student interactions, and recognition of cultural diversity. These dimensions function as guiding principles in designing mathematics learning experiences rather than as separate character education components. However, the implementation of love values in mathematics learning remains relatively limited because previous studies have predominantly positioned mathematics as a cognitive domain and have not sufficiently integrated humanistic dimensions as part of the learning structure (Hendriana et al., 2022).

The ethnomathematics approach represents a relevant perspective for addressing the need for mathematics learning that is closer to students' lives (Shahidayanti et al., 2024). Ethnomathematics views mathematics as knowledge that develops through human activities within specific social and cultural contexts. Cultural activities, such as traditional games, artistic patterns, measurement practices, trading activities, and various daily practices, contain mathematical concepts that can be developed as learning resources. The use of cultural contexts in mathematics learning enables students to understand concepts through familiar experiences, making the process of mathematical abstraction more meaningful (Aroca & Fantinato, 2023; Prahmana, 2020). However, most ethnomathematics studies have primarily positioned culture as a contextual resource or instructional support to facilitate students' understanding of mathematical concepts. These studies have provided valuable contributions to contextual mathematics learning, but the role of culture as a foundation for constructing a broader mathematics learning framework that integrates cognitive, cultural, and human dimensions remains insufficiently explored. Therefore, further investigation is needed to examine how ethnomathematics can move beyond contextualization toward a more comprehensive orientation for mathematics curriculum development.

Previous studies indicate that ethnomathematics has not yet been widely positioned as an integral foundation for designing mathematics learning frameworks. Most studies have used local culture as a contextual entry point to support students' understanding of mathematical concepts, while the role of culture in shaping learning objectives, processes, and experiences remains relatively underexplored (Batiibwe, 2025; Rosa & Orey, 2020). Furthermore, although culturally responsive and humanistic approaches emphasize the importance of students' experiences, identity, and meaningful interactions (Copeland Solas & Kamalodeen, 2022; Hendriana et al., 2022), their integration with ethnomathematics and love-based pedagogical principles has received limited attention. This condition indicates the need for an integrated framework that connects cultural knowledge, mathematical understanding, and human values in primary mathematics education. This gap suggests the need for a framework that does not merely contextualize mathematical concepts through culture, but also integrates cultural knowledge, mathematical reasoning, and relational values within a coherent learning orientation.

Mathematics curriculum development also remains largely oriented toward achieving academic competencies rather than strengthening students' social values and humanity-oriented dimensions (Kamidah et al., 2023). The culturally responsive curriculum perspective highlights that students' cultural experiences play an essential role in developing learning engagement and academic identity (Zeng et al., 2025). This research gap indicates the limited exploration of how ethnomathematics can be integrated with love values as a pedagogical foundation for mathematics curriculum development in primary education.

The condition of mathematics learning in Madrasah Ibtidaiyah in Banyumas Regency provides a relevant context for developing the integration of local culture and human values in mathematics education. The cultural richness of Banyumas provides various social practices with mathematical potential, including traditional games, artistic patterns, craft activities, and community practices involving measurement and calculation. However, these local cultural potentials have not been fully utilized as mathematics learning resources because learning processes remain highly dependent on textbooks and formal learning materials (Fauzi et al., 2024). The limited integration of local culture indicates that the main challenge is not the availability of cultural learning resources, but the absence of a curriculum framework capable of systematically connecting culture, mathematics, and human values (Martadi & Sampurno, 2025). The development of a context-based curriculum concept is therefore essential to create mathematics learning that is more relevant to students' characteristics and experiences.

Theoretically, the integration of ethnomathematics, humanistic mathematics education, and love-based pedagogy provides a foundation for developing a more comprehensive mathematics learning framework. Ethnomathematics contributes an epistemological perspective by recognizing local cultural practices as sources of mathematical knowledge and meaningful learning experiences (Aroca & Fantinato, 2023; Rosa & Orey, 2020). Meanwhile, humanistic mathematics education emphasizes that mathematics learning should consider students' experiences, meanings, and personal relationships with mathematical knowledge rather than focusing solely on procedural achievement (Hendriana et al., 2022). Love-based pedagogy further strengthens this perspective by positioning care, respect, appreciation, and supportive relationships as essential elements in the learning process (Nurina & Setiyadi, 2025). The integration of these perspectives suggests that mathematics learning can be designed not only to develop conceptual understanding but also to foster cultural awareness and human values. Based on this theoretical connection, KBCE is positioned as a conceptual framework that integrates cultural knowledge, mathematical construction, and love-based learning orientations within primary mathematics education.

While ethnomathematics primarily emphasizes the relationship between mathematics and cultural practices, culturally responsive pedagogy focuses on students' cultural identity and participation, and humanistic mathematics education emphasizes meaningful mathematical experiences. KBCE extends these perspectives by integrating cultural knowledge, mathematical concept construction, and love-based relational values into a single conceptual framework for primary mathematics learning. Based on this theoretical perspective, the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) is proposed in this study as a conceptual framework that addresses the separation between mathematical knowledge, cultural experiences, and human values in primary mathematics learning. Unlike previous ethnomathematics studies that primarily position culture as a contextual resource for understanding mathematical concepts, KBCE positions local culture as a foundation for mathematical concept construction. Furthermore, KBCE integrates love-based pedagogical principles to ensure that mathematical learning develops not only students' cognitive understanding but also their appreciation, cooperation, care, and respect within learning interactions.

The KBCE model positions love values as a pedagogical foundation and ethnomathematics as an approach for constructing mathematical knowledge based on local cultural contexts. The integration of these two perspectives provides a new contribution because ethnomathematics is not merely used as a learning medium or contextual approach, but is developed as part of mathematics curriculum construction. Love values within the KBCE model function as an orientation for developing learning experiences that appreciate students, culture, and mathematical thinking processes. This concept provides an alternative approach to mathematics curriculum development that not only focuses on numeracy skills but also promotes character development, cultural identity, and social awareness among students.

The contribution of this study lies in formulating the Love-Based Curriculum through an Ethnomathematics Approach as a conceptual framework for developing mathematics learning in primary education. This study does not focus on testing the effectiveness of a curriculum product; rather, it seeks to understand learning conditions, formulate the conceptual construction of KBCE, and examine its implementation within authentic madrasah learning contexts. Therefore, this study aims to: (1) analyze the condition of mathematics learning in Madrasah Ibtidaiyah in Banyumas Regency from the perspectives of love values and local culture; (2) formulate the conceptual framework of a Love-Based Curriculum through an ethnomathematics approach in primary education; and (3) analyze the implementation of the Love-Based Curriculum through an Ethnomathematics Approach in mathematics learning at Madrasah Ibtidaiyah in Banyumas Regency.

METHOD

Research Design and Procedure

This study employed a qualitative descriptive-interpretive case study design to explore the construction and implementation of the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) in fifth-grade three-dimensional geometry learning. A case study approach was selected because the study aimed to understand a contemporary educational phenomenon within its authentic context, particularly how mathematical concepts, local cultural knowledge, and love-based values were integrated into mathematics learning practices.

The research was conducted from May to July 2026 in two Madrasah Ibtidaiyah (MI KSL and MI PTK) located in Banyumas Regency, Indonesia. The research process consisted of two sequential phases. The first phase involved analyzing the initial conditions of mathematics learning, including existing instructional practices, cultural integration, and teacher-student interactions. Findings from this phase were analyzed to construct the preliminary KBCE framework. The second phase involved implementing the preliminary KBCE framework in fifth-grade mathematics learning and analyzing how the framework operated within classroom practice.

The KBCE components and learning stages were therefore not generated from implementation data. Instead, they were formulated based on empirical evidence obtained during the initial-condition analysis. Data from the implementation phase were subsequently used to examine the manifestation of the framework in classroom activities and refine its conceptual description.

Research Setting and Participants

The study was conducted in two Madrasah Ibtidaiyah, namely MI KSL and MI PTK. The schools were selected purposively because they provided relevant contexts for investigating the relationship between mathematics learning, Banyumas local culture, and value-based education. Participants were selected through purposive sampling based on their direct involvement and contextual knowledge related to the research objectives. The study involved six key informants consisting of two school principals, two fifth-grade mathematics teachers, and two fifth-grade students. The school principals provided information regarding institutional support and the position of local culture and values within school practices. Mathematics teachers provided information regarding instructional planning, classroom implementation, and teacher-student interactions. Student participants provided perspectives regarding their learning experiences during KBCE implementation.

In addition to the key informants, classroom observations involved all students participating in the observed learning activities. Each participating class consisted of 28 fifth-grade students. The selection of participants was not intended to achieve statistical representation but to obtain information-rich perspectives relevant to the phenomenon under investigation. The adequacy of data was determined through the principle of informational sufficiency. Data collection was considered sufficient when additional interviews, observations, and documentary evidence no longer generated substantially new categories or interpretations related to mathematics learning conditions, ethnomathematics integration, love-based values, and KBCE implementation.

Data Collection

Data were collected through semi-structured interviews, classroom observations, and documentation analysis during May–July 2026. Semi-structured interviews were conducted with six key informants. Each school principal participated in two interview sessions, with each session lasting approximately 40 minutes. Each mathematics teacher participated in two interview sessions, with each session lasting approximately 45 minutes. Each student participated in one interview session lasting approximately 45 minutes.

The interview protocol was developed based on four dimensions: (1) mathematics learning conditions, (2) integration of local cultural contexts, (3) implementation of love-based values in classroom interactions, and (4) students' experiences in understanding three-dimensional geometry concepts. Classroom observations were conducted during five mathematics learning sessions. Each observation lasted approximately 70 minutes, equivalent to two learning periods. The observations focused on teacher facilitation, student engagement, exploration of Banyumas cultural objects, mathematical reasoning activities, collaborative learning processes, and interactions reflecting care, respect, appreciation, and cooperation.

Documentation analysis was conducted using teaching modules, student worksheets (LKPD), student learning products, photographs of learning activities, and documentation of Banyumas cultural objects. These documents were analyzed to complement interview and observation data and to examine the relationship between planned learning activities, mathematical concepts, cultural contexts, and value-oriented learning processes.

Data Analysis

Data analysis followed the interactive model proposed by Miles, Huberman, and Saldaña, consisting of data condensation, data display, and conclusion drawing. The analysis was conducted continuously throughout the research process. The coding procedure consisted of four stages. First, interview transcripts, observation notes, and documents were examined to identify initial codes related to mathematics learning, cultural resources, student experiences, and love-based interactions. Second, similar codes were grouped into categories representing recurring patterns across data sources. Third, categories were interpreted to develop themes describing relationships among mathematics, culture, and human values. Fourth, emerging themes were integrated into the conceptual components and learning stages of KBCE.

The initial analysis phase resulted in four conceptual components of KBCE: (1) love-based values foundation, (2) ethnomathematics integration, (3) humanistic mathematics learning process, and (4) holistic learning outcomes. These components were organized into five learning stages: local cultural exploration, mathematical concept identification, formal concept construction, collaboration and reflection, and internalization of love values. During the implementation analysis phase, classroom evidence was examined to determine how these components and stages appeared in actual learning practices. The purpose of this phase was not to create the framework retrospectively but to examine and refine the conceptual explanation of KBCE based on empirical classroom evidence.

Trustworthiness and Ethical Considerations

The credibility of the findings was established through source triangulation, technique triangulation, and analytical review. Source triangulation was conducted by comparing information obtained from school principals, teachers, and students. Technique triangulation was conducted by comparing interview data, classroom observations, and documentary evidence.

Analytical review was conducted through continuous examination of coding decisions, category development, and thematic interpretation to ensure that conclusions were consistently supported by empirical evidence. Research records, including interview transcripts, observation notes, and analytical documents, were maintained to improve transparency and traceability of the research process. Ethical procedures were maintained throughout the study. Permission was obtained from participating schools, informed consent was obtained from adult participants, and parental consent was obtained for student participation. Participant identities were protected through the use of institutional and participant codes.

RESULTS

1. The condition of mathematics learning in Madrasah Ibtidaiyah in Banyumas Regency from the perspectives of love values and local culture

The initial condition of mathematics learning in the participating Madrasah Ibtidaiyah (MI) indicated that mathematics instruction was still predominantly oriented toward procedural understanding. Classroom observations in both MI KSL and MI PTK showed that three-dimensional geometry learning was commonly conducted through teacher explanations, textbook-based examples, formula application, and structured exercises. Students were generally able to identify geometric shapes and apply measurement procedures introduced by teachers; however, opportunities to construct mathematical meaning through real-life contexts remained limited.

Observation records showed that students mainly interacted with two-dimensional representations, such as textbook illustrations, diagrams, and written formulas, when learning concepts of cubes, cuboids, cylinders, prisms, and cones. Students were able to complete exercises involving volume and geometric properties, but they rarely explored how these concepts appeared in objects within their surrounding environment. As recorded during classroom observation at MI KSL, students followed teacher explanations and completed formula-based tasks, while direct exploration of cultural objects related to three-dimensional geometry was not yet part of the regular learning process. Teacher interviews confirmed this condition. G1 explained that students often experienced difficulties when mathematical concepts were presented only through abstract representations:

> *"Students can usually follow the steps for calculating volume, but some of them still find it difficult to understand why the formula works because they rarely connect it with objects around them."* (G1, Interview, June 2026)

Similarly, G2 stated that contextual learning could support students' understanding, but integrating local cultural resources required additional preparation:

> *"Using local objects in mathematics learning is interesting because students are familiar with them. However, teachers need time to identify suitable objects and design activities that connect cultural characteristics with mathematical concepts."* (G2, Interview, June 2026)

The findings from the two schools showed similar patterns. Both MI KSL and MI PTK implemented mathematics learning that emphasized conceptual procedures and textbook-based activities. However, differences appeared in the availability and utilization of contextual resources. MI KSL had greater opportunities to connect mathematics learning with architectural elements of traditional Banyumas houses, while MI PTK had stronger potential for using household utensils as cultural objects containing geometric characteristics. Nevertheless, in both contexts, local cultural resources had not yet been systematically positioned as foundations for mathematical concept construction.

Documentation analysis supported these findings. Learning materials, including teaching modules and student worksheets, showed that mathematical representations were primarily presented through formal symbols, pictures, and formulas. Cultural objects from the Banyumas community, such as traditional houses and kitchen utensils, existed as part of students' daily experiences but had not been intentionally incorporated as mathematical learning resources.

From the perspective of love values, classroom observations indicated that supportive teacher-student relationships were already present in both schools. Teachers provided guidance when students experienced difficulties, encouraged students to participate, and created cooperative classroom interactions. For example, Observation Record 2 at MI PTK showed that the teacher provided individual assistance to students who had difficulties identifying geometric characteristics while encouraging peer discussion within groups.

Teacher perspectives also indicated the presence of caring practices in mathematics learning. G1 explained:

> *"When students have difficulties, the teacher needs to provide support and encourage them because each student has a different learning process."* (G1, Interview, June 2026)

Students also described positive learning interactions. S1 stated:

> *"The teacher helps us when we do not understand and gives us opportunities to discuss with friends."* (S1, Interview, June 2026)

Although these interactions reflected care, respect, and cooperation, the values had not yet been explicitly integrated into the structure of mathematics learning as pedagogical principles. They appeared mainly as general classroom behaviors rather than as intentional elements within mathematical knowledge construction.

Overall, the findings from interviews, observations, and documentation indicate that mathematics learning in the two Madrasah Ibtidaiyah had not fully integrated three interconnected dimensions: mathematical understanding, cultural experiences, and human values. Mathematics was primarily approached as a cognitive activity focused on procedures and calculations, while local cultural knowledge and relational values remained separate components within the learning process.

Therefore, the initial condition identified in this study provided an empirical foundation for constructing the Love-Based Curriculum through an Ethnomathematics Approach (KBCE). The findings suggest that local culture should not merely function as an additional contextual example but should be positioned as a source for constructing mathematical experiences. Furthermore, love-based values should be integrated as a pedagogical foundation that guides interaction, collaboration, and meaning-making processes in mathematics learning.

2. Formulation of the KBCE Design

The formulation of the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) was developed through a systematic interpretation of empirical evidence obtained from the initial-condition analysis phase. The construction process involved three interconnected data sources: semi-structured interviews with school principals, mathematics teachers, and students; classroom observations; and analysis of learning documents. The analysis revealed that mathematics learning, local cultural knowledge, and love-based values were not independent elements but represented interconnected dimensions that required integration within a coherent mathematics learning framework.

The construction of KBCE followed an inductive analytical process. Data obtained from interviews, observation records, and documentation were first examined through initial coding. The codes represented recurring empirical phenomena, including teacher support, students' learning difficulties, limited cultural integration, geometric characteristics of local objects, collaborative interaction, and caring classroom practices. These codes were subsequently grouped into broader categories and interpreted into themes representing relationships among mathematical knowledge, cultural experiences, and human values. For example, teacher interviews indicated that contextual learning was considered important but had not yet been systematically integrated into mathematics instruction. G1 explained:

> *"Students are more interested when mathematical concepts are connected with objects they know, but teachers still need guidance to design activities that connect cultural objects with mathematical concepts."* (G1, Interview, June 2026).

Similarly, classroom observations showed that students were able to recognize geometric forms from textbook representations, but they had limited opportunities to explore mathematical concepts through objects from their own cultural environment. Observation records indicated that students discussed geometric characteristics more actively when learning materials were connected with familiar objects. The relationship between empirical evidence, analytical categories, emerging themes, and KBCE components is presented in Table 2.

Table 2. Empirical Basis for the Construction of KBCE Framework

Analytical Phase	Data Sources	Initial Codes	Categories	Emerging Themes	KBCE Interpretation
Initial-condition analysis and preliminary construction	Interviews with principals, teachers, students; classroom observations; learning documents	Teacher support, learning difficulties, cultural familiarity, limited contextual	Existing mathematics practices, cultural resources, relational learning	Need for integration of mathematics, culture, and love-based values	Four conceptual components of KBCE

Analytical Phase	Data Sources	Initial Codes	Categories	Emerging Themes	KBCE Interpretation
		learning, caring interactions			
Cultural exploration analysis	Cultural documentation, learning materials, classroom evidence	Geometric characteristics of traditional houses and kitchen utensils	Cultural objects as mathematical resources	Culture as a foundation for mathematical exploration	Ethnomathematics integration
Learning interaction analysis	Classroom observations and student evidence	Exploration, identification, discussion, interpretation	Meaningful mathematical experiences	Mathematics constructed through experience and interpretation	Humanistic mathematics learning process
Value-oriented analysis	Interviews, observations, documentation	Care, respect, appreciation, cooperation	Cognitive, cultural, and relational dimensions	Integrated learning outcomes	Holistic learning outcomes
Implementation analysis	Five classroom sessions, teacher/student interviews, LKPD, student products, photographs	Cultural exploration, concept identification, formalization, collaboration, reflection, value internalization	Enacted learning processes	Movement from cultural experience toward mathematical and value-oriented learning	Confirmation and refinement of KBCE stages

Table 2 demonstrates that the KBCE framework was not constructed solely from theoretical assumptions but emerged from recurring patterns identified across multiple sources of empirical evidence. The analysis generated four interconnected conceptual components: (1) love-based values foundation, (2) ethnomathematics integration, (3) humanistic mathematics learning process, and (4) holistic learning outcomes. Figure 1 presents the relationship among these components and the five learning stages of KBCE.

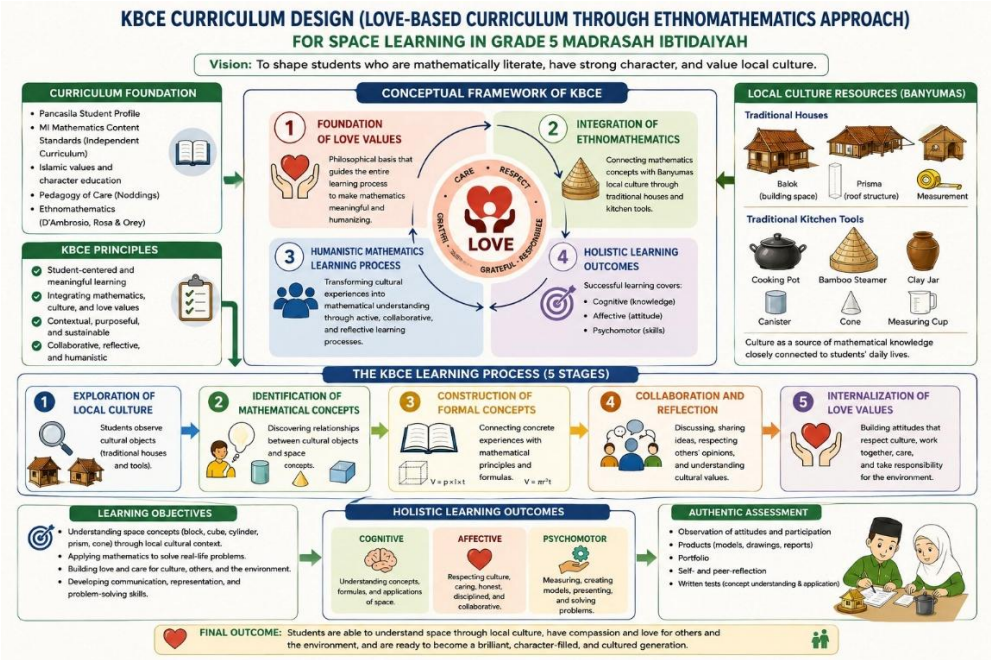


Figure 1. Formulation of the KBCE Conceptual Framework

The first component, the love-based values foundation, emerged from findings related to teacher-student relationships and classroom interactions. Observations showed that teachers provided assistance, encouragement, and emotional support when students experienced difficulties in understanding mathematical concepts. However, these practices initially appeared as general classroom behaviors rather than explicit principles embedded within mathematics learning design. Therefore, KBCE positions care, respect, appreciation, and cooperation as pedagogical foundations that influence how students participate, communicate, and construct mathematical understanding.

The second component, ethnomathematics integration, was derived from evidence regarding mathematical structures embedded within Banyumas cultural objects. Documentation and classroom exploration indicated that traditional houses and household utensils contained geometric characteristics relevant to three-dimensional geometry. Traditional houses provided opportunities for students to examine spatial structures, including cuboid and prism forms, while objects such as dandang, kukusan, and tempayan represented cylindrical and conical structures related to measurement and volume concepts. These findings positioned local cultural objects not merely as illustrations but as sources for mathematical concept construction.

The third component, the humanistic mathematics learning process, emerged from observations of students' activities when engaging with cultural contexts. Students were involved in identifying geometric characteristics, comparing forms, discussing interpretations, and connecting observations with formal mathematical concepts. This process demonstrated a transition from procedural learning toward meaningful mathematical construction, where students developed understanding through interaction with culturally relevant experiences.

The fourth component, holistic learning outcomes, was formulated from the integration of mathematical understanding, cultural awareness, and human values. The findings indicated that KBCE learning outcomes extended beyond conceptual knowledge by involving appreciation of local culture, communication, cooperation, and awareness of social relationships during learning activities. Based on these four components, the KBCE learning process was organized into five sequential stages. These stages represent the learning pathway identified from recurring patterns in classroom practices as : (1) Local cultural exploration: Students engage with Banyumas cultural objects as sources for mathematical investigation. (2) Mathematical concept identification: Students identify geometric characteristics, structures, and relationships contained within cultural objects. (3) Formal concept construction: Students connect their observations with formal mathematical concepts, including geometric properties, measurement, and volume formulas. (4) Collaboration and reflection: Students discuss findings, exchange interpretations, and construct understanding through collaborative activities. (5) Internalization of love values: Students reflect on the relationship between mathematics, culture, and human values through appreciation, respect, cooperation, and care.

The implementation analysis did not generate the KBCE components retrospectively. Instead, it served to examine how the preliminary framework operated in classroom practice and to refine the description of its learning stages. Therefore, KBCE represents a conceptual framework constructed from empirical analysis that integrates cultural knowledge, mathematical reasoning, and human values within primary mathematics education.

The Implementation of the Love-Based Curriculum through an Ethnomathematics Approach in Mathematics Learning at Madrasah Ibtidaiyah in Banyumas Regency

The implementation of the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) was analyzed based on classroom observations, semi-structured interviews with teachers and students, learning documentation, student worksheets (LKPD), and students' learning products. The implementation was conducted during fifth-grade three-dimensional geometry learning by integrating Banyumas local cultural contexts with love-based learning orientations.

The findings indicate that KBCE was implemented through five interconnected stages: (1) local cultural exploration, (2) mathematical concept identification, (3) formal concept construction, (4) collaboration and reflection, and (5) internalization of love values. These stages describe the process through which students moved from familiar cultural experiences toward formal mathematical understanding while developing appreciation, cooperation, and respect during learning activities.

1. Local Cultural Exploration

The implementation began with the stage of local cultural exploration, where students were introduced to Banyumas cultural objects as sources for mathematical investigation. Classroom observations showed that students examined traditional houses and household utensils to identify mathematical characteristics embedded within these objects. In MI KSL, students explored elements of traditional Banyumas houses, particularly spatial structures related to cuboid and prism concepts. Meanwhile, in MI PTK, students explored household utensils such as dandang, kukusan, and tempayan, which represented cylindrical and conical structures. Although the cultural objects used in both schools were different, both learning contexts provided opportunities for students to recognize that mathematical concepts exist within their everyday environment.

Observation records indicated that students demonstrated greater engagement when mathematics was introduced through objects that were familiar to them. Students were encouraged to observe, describe, compare, and discuss cultural objects before connecting them with formal mathematical concepts. A student explained:

> *"Before learning with these objects, I only thought they were ordinary things at home. After discussing them in mathematics class, I realized that their shapes are related to geometry."* (S1, Student Interview, June 2026)

This finding indicates that local cultural objects functioned as meaningful learning resources that connected students' daily experiences with mathematical exploration.

2. Mathematical Concept Identification

The second stage involved mathematical concept identification. Students were guided to recognize geometric characteristics contained within cultural objects, including shape, size, surface structure, edges, vertices, and spatial relationships. Classroom observations showed that students compared cultural objects with formal geometric representations. For example, students identified cylindrical characteristics in traditional kitchen utensils and related architectural structures of traditional houses to prism and cuboid concepts. Teacher interviews indicated that cultural contexts supported students in understanding abstract mathematical concepts because students could relate mathematical ideas to objects they already knew. A mathematics teacher stated:

> *"Students usually understand formulas, but sometimes they do not understand the meaning behind those formulas. When we use objects that they see every day, they can explain why an object has a certain shape and connect it with geometric concepts." (G1, Teacher Interview, June 2026)*

This finding shows that cultural objects functioned as a bridge between students' informal knowledge and formal mathematical understanding.

3. Formal Concept Construction

The third stage focused on transforming students' observations into formal mathematical knowledge. Teachers facilitated discussions that connected cultural exploration with mathematical concepts, including geometric properties, measurement, surface area, and volume. Classroom observations demonstrated that teachers did not begin learning activities by directly introducing formulas. Instead, students were encouraged to describe the characteristics of cultural objects and develop mathematical interpretations before connecting their observations with formal concepts.

Students' LKPD and learning products showed that students used cultural objects as references for constructing mathematical explanations. For example, students identified the relationship between cylindrical objects and volume concepts by examining the physical characteristics of household utensils. This process indicates that KBCE positioned students as active constructors of mathematical knowledge. Mathematical understanding developed through observation, interpretation, discussion, and formalization rather than through memorization of procedures alone.

4. Collaboration and Reflection

The fourth stage emphasized collaboration and reflection during mathematics learning. Students worked in groups to discuss findings, exchange interpretations, and develop mathematical explanations collaboratively. Observation records showed that students assisted peers, shared ideas, and discussed different perspectives when solving mathematical tasks. These interactions reflected love-based values, particularly cooperation, respect, appreciation, and care. Teachers also emphasized supportive interactions during group activities. Instead of focusing only on correct answers, teachers encouraged students to explain their reasoning and respect different approaches. A teacher explained:

> *"During group discussions, students become more confident because they can share their ideas. They also learn that mathematics is not only about getting the correct answer but also about listening and working together."* (G2, Teacher Interview, June 2026)

These findings indicate that love-based values were embedded within the learning process as relational principles that supported mathematical communication and collaboration.

5. Internalization of Love Values

The fifth stage involved internalizing love values through reflection on the relationship between mathematics, culture, and human experiences. Students were encouraged to reflect on how local cultural objects contained mathematical knowledge and how mathematics was connected with their community life. Reflection activities showed that students developed appreciation toward local culture while strengthening their understanding of mathematical concepts. A student stated:

> *"I feel that mathematics is closer to our lives because we can find mathematical shapes in objects around us. I also appreciate traditional objects because they have knowledge inside them."* (S2, Student Interview, June 2026)

This stage demonstrates that KBCE extends mathematics learning beyond cognitive understanding by integrating cultural awareness and human values.

6. Teacher Facilitation in KBCE Implementation

The implementation findings also revealed the important role of teachers as facilitators. Teachers were not only responsible for explaining mathematical concepts but also guided students in exploring cultural contexts, constructing mathematical arguments, facilitating discussions, and developing supportive classroom relationships.

Across MI KSL and MI PTK, teachers demonstrated similar facilitation patterns, including encouraging student participation, providing guidance, and connecting cultural observations with mathematical concepts. However, differences appeared in the selection of cultural resources according to each school context. MI KSL emphasized architectural cultural objects, while MI PTK focused more on household artifacts. These differences demonstrate that KBCE can be adapted to different cultural environments while maintaining its fundamental principles of cultural exploration, mathematical construction, and value-based interaction.

Overall, the implementation findings demonstrate that KBCE is not merely the use of cultural objects as contextual mathematics media. Instead, KBCE represents a conceptual framework that organizes mathematics learning through cultural exploration, mathematical concept construction, collaborative reflection, and internalization of love values. The implementation in the two Madrasah Ibtidaiyah shows that ethnomathematics provides the cultural foundation for mathematical exploration, while love-based values provide the relational conditions that support meaningful learning interactions. Therefore, KBCE positions mathematics learning as an integrated process involving mathematical reasoning, cultural understanding, and human relationships in primary education.

DISCUSSION

1. Repositioning Three-Dimensional Geometry Learning Through Contextual and Cultural Experiences

The findings of this study indicate that three-dimensional geometry learning in the participating Madrasah Ibtidaiyah was still largely influenced by a procedural orientation, where mathematical concepts were commonly introduced through textbook representations, formulas, and structured exercises. Such a condition does not necessarily indicate that procedural knowledge is inadequate; rather, it reflects a learning orientation in which students may encounter mathematical concepts primarily as formal procedures before developing connections with meaningful experiences. In geometry learning, this separation can create difficulties because students are required to understand abstract spatial relationships while having limited opportunities to construct meaning from objects and situations that are familiar to them. Previous studies have emphasized that meaningful mathematics learning requires connections between formal representations and students' lived experiences, allowing mathematical ideas to be interpreted as concepts rather than isolated procedures.

The distinction between procedural knowledge and conceptual understanding provides an important explanation for the learning condition identified in this study. Students may successfully apply formulas for calculating volume or identifying geometric properties, but they may experience difficulties when asked to recognize mathematical structures within everyday objects. This occurs because mathematical understanding involves more than the ability to manipulate symbols; it requires students to establish relationships among representations, experiences, and meanings. Therefore, learning environments that provide opportunities for students to explore concrete situations can support the transition from informal understanding toward formal mathematical reasoning (Setiyadi et al., 2026).

From this perspective, the limited integration of Banyumas cultural objects into mathematics learning represents not merely the absence of contextual examples but a missed opportunity to position culture as a source of mathematical knowledge. Ethnomathematics challenges the view that mathematics exists separately from social and cultural environments by emphasizing that mathematical ideas are embedded within human activities, practices, and cultural artifacts (Aroca & Fantinato, 2023; Rosa & Orey, 2020; Tortello et al., 2024). Therefore, the use of traditional houses and kitchen utensils in this study is theoretically significant because these objects functioned not only as illustrations of geometric concepts but also as starting points for students to identify, interpret, and construct mathematical meanings.

The integration of cultural contexts in mathematics learning can be understood through the mechanism of connecting students' existing knowledge with formal mathematical structures. When students encounter geometric forms through familiar objects, they begin learning from representations that already have meaning within their social environment. This process allows students to move from concrete experiences toward abstraction, which is particularly relevant in primary mathematics education where students are still developing connections between

physical representations and formal concepts. Ethnomathematics-based learning has been recognized as a way to strengthen the relationship between school mathematics and students' cultural experiences by making mathematical ideas more relevant and meaningful (Anwar & Ramadhani, 2025; Setiyadi, 2023; Umbara, 2021).

The findings also suggest that cultural integration should not be understood as simply adding local examples after mathematical concepts have been taught. Such an approach may maintain the separation between formal mathematics and cultural knowledge. Instead, culture can function as an epistemological foundation from which mathematical ideas are explored and constructed. In the context of this study, Banyumas cultural objects provided opportunities for students to identify three-dimensional forms, discuss their characteristics, and connect observations with formal geometric concepts. This orientation aligns with culturally relevant mathematics education, which emphasizes the importance of using students' cultural references as resources for developing mathematical knowledge while maintaining academic rigor (Dewi et al., 2025; Nurkholifah et al., 2025; Turmudi et al., 2021).

Furthermore, the findings contribute to the discussion of mathematics learning by showing that contextualization involves more than improving student interest. The deeper contribution lies in repositioning the relationship between students, mathematics, and their cultural environment. When students recognize mathematical ideas within objects that are part of their daily lives, mathematics becomes connected to their experiences and community knowledge. This perspective supports the view that mathematics is not only a formal symbolic system but also a human activity developed within particular social and cultural contexts (Ibrahim et al., 2025; Setiyadi et al., 2024).

Therefore, the initial learning condition identified in this study provides the rationale for developing KBCE. The need for KBCE does not arise merely from the absence of cultural materials or the need for more engaging activities, but from the need to reconnect three dimensions that are often separated in mathematics learning: mathematical concepts, cultural experiences, and human values. By positioning culture as a foundation for mathematical exploration and meaningful experiences, KBCE extends the role of contextual mathematics learning toward a more integrated orientation that connects mathematical understanding with students' cultural identities and learning experiences.

2. The KBCE Design as an Integration of Mathematics, Local Culture, and Love Values

The formulation of the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) in this study should be understood as a conceptual learning framework rather than a fully developed curriculum model or validated instructional product. Its contribution lies in organizing the relationship between mathematical content, local cultural knowledge, and love-based learning orientations within a structured learning process. The development of KBCE responds to a limitation identified in conventional mathematics learning, where mathematical concepts, students' cultural experiences, and relational values are often addressed as separate dimensions. By connecting these dimensions, KBCE provides an alternative perspective for designing mathematics learning that recognizes both the cognitive and human aspects of learning.

The four components of KBCE, namely the love-based values foundation, ethnomathematics integration, humanistic mathematics learning process, and holistic learning outcomes, represent interconnected dimensions rather than independent elements. The love-based values foundation provides the relational orientation that shapes classroom interactions, while ethnomathematics integration provides the cultural context through which mathematical concepts are explored. These two dimensions support a humanistic mathematics learning process that enables students to construct mathematical understanding through meaningful experiences. The resulting learning outcomes therefore include not only mathematical knowledge but also cultural appreciation, collaboration, and awareness of human values.

The positioning of love values as the foundation represents one of the distinctive contributions of KBCE. Previous applications of caring pedagogy have emphasized the importance of supportive relationships, responsiveness to students' needs, and recognition of students' perspectives in creating meaningful learning environments (Gunawardena & Wilson, 2021). However, in mathematics education, caring practices are often discussed as aspects of classroom climate rather than as elements integrated into the structure of mathematical learning. The KBCE framework extends this perspective by positioning care, respect, appreciation, and cooperation as principles that influence how mathematical activities are organized, how students interact, and how reflection is conducted during learning.

This distinction is theoretically important because a caring classroom environment does not automatically transform mathematics learning into a humanistic experience. The pedagogical mechanism occurs when values influence students' opportunities to participate, express mathematical ideas, discuss different interpretations, and engage in collaborative knowledge construction. In this sense, love values function not as additional character education content but as a relational foundation that shapes the process through which mathematical understanding is developed.

The ethnomathematics component provides the epistemological foundation of KBCE by positioning local culture as a source of mathematical knowledge. Previous ethnomathematics studies have demonstrated that cultural practices and artifacts can provide meaningful contexts for connecting mathematical concepts with students' lived experiences (Balabuch & Rasoarifetra, 2023; Luzano, 2025; Umbara, 2021). However, ethnomathematics is frequently applied as a contextual resource after mathematical concepts have been introduced. The KBCE framework extends this perspective by positioning local cultural objects as the starting point of mathematical exploration, where students first encounter mathematical ideas through culturally meaningful objects before moving toward formal mathematical representations. The use of cultural contexts in mathematics learning has been recognized as a way to make abstract mathematical concepts more meaningful by connecting them with students' social environments and experiences.

The Banyumas cultural context in this study illustrates how ethnomathematics can operate beyond the function of providing examples. Traditional houses and kitchen utensils are not merely illustrations of geometric concepts but represent cultural artifacts containing mathematical structures that students can investigate. Through this process, students are encouraged to recognize that mathematics is embedded within human activities and community practices. This perspective strengthens the argument that mathematical knowledge is not only constructed through formal schooling but also through interactions between individuals and their cultural environments (Bimantara, 2024; Rizkyh & Setiyadi, 2023; Saironi, 2022).

The five stages of KBCE further explain the pedagogical mechanism through which the integration of mathematics, culture, and love values occurs. Local cultural exploration functions as the experiential foundation where students encounter mathematical ideas through familiar objects. Mathematical concept identification enables students to recognize geometric characteristics within cultural contexts. Formal concept construction supports the transition from informal observation toward mathematical representation and reasoning. Collaboration and reflection create opportunities for students to negotiate meaning with peers, while internalization of love values connects mathematical learning with appreciation, cooperation, and cultural awareness.

This sequence distinguishes KBCE from approaches that simply attach cultural examples to conventional mathematics instruction. In KBCE, culture is not positioned as an additional activity after formal mathematical explanation but as the initial context through which mathematical understanding is developed. The framework therefore extends ethnomathematics from a contextual approach toward an integrated learning orientation that connects mathematical knowledge, cultural meaning, and classroom relationships.

The integration between ethnomathematics and love-based pedagogy also represents a theoretical contribution of KBCE. Ethnomathematics explains where mathematical meaning can be found, particularly within cultural practices and artifacts, while love-based pedagogy explains how mathematical meaning is constructed through human interaction. These two dimensions complement each other by connecting the epistemological dimension of mathematics with the relational dimension of learning. Therefore, KBCE contributes a framework that positions mathematics learning as a process involving knowledge construction, cultural interpretation, and human relationships.

From a practical perspective, KBCE provides guidance for teachers in designing mathematics learning that begins with culturally familiar contexts and gradually develops toward formal mathematical concepts. Teachers can identify local objects, practices, and community knowledge that correspond with mathematical topics while maintaining opportunities for discussion, collaboration, and reflection. In the context of Madrasah Ibtidaiyah, the framework provides a possible pathway for integrating mathematics education with local cultural awareness and values-based learning.

Overall, KBCE should be positioned as a conceptual learning framework that integrates mathematics, local culture, and love values rather than as a finalized curriculum model. Its contribution lies in providing an organizing structure for culturally situated and humanistic mathematics learning. Further research involving broader contexts, comparative designs, and systematic validation is needed to examine the applicability and effectiveness of KBCE across different educational settings.

3. KBCE Implementation and the Transformation of Mathematics Learning

The implementation of the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) illustrates how mathematics learning can be organized through the interaction of cultural experiences, mathematical reasoning, and human relationships. Rather than positioning KBCE as a replacement for formal mathematics instruction, the implementation demonstrates how cultural contexts and love-based values can provide a pathway for students to engage with mathematical concepts through meaningful learning experiences. The findings indicate that KBCE implementation was characterized by a movement from students' encounters with familiar cultural objects toward the construction of formal three-dimensional geometry concepts.

The learning process observed in this study reflects an important principle in primary mathematics education, namely that students develop mathematical understanding through connections between concrete experiences and abstract representations. In conventional geometry learning, students may encounter formulas and symbolic representations before understanding the meaning of the concepts they represent. KBCE reverses this sequence by beginning with cultural objects that students recognize in their daily lives and gradually guiding them toward mathematical abstraction. This process is consistent with research emphasizing that meaningful mathematics learning occurs when students are able to connect new mathematical ideas with existing experiences and representations (Setianingsih, 2024).

The use of Banyumas cultural objects as learning resources represents a significant characteristic of KBCE implementation. Traditional houses and kitchen utensils were not introduced merely as additional examples after mathematical concepts had been explained. Instead, these objects functioned as starting points for students to observe, identify, and discuss mathematical characteristics. This approach reflects the central principle of ethnomathematics, which views mathematical knowledge as embedded within cultural practices and human activities (Aroca & Fantinato, 2023; Rosa & Orey, 2020). Through this process, students were encouraged to recognize that mathematics exists within their social and cultural environments rather than only within textbooks and classroom exercises.

The implementation findings also reveal a shift in the role of the teacher during mathematics learning. Within KBCE, teachers functioned not only as providers of mathematical information but also as facilitators who guided students in observing objects, asking questions, comparing geometric characteristics, and constructing mathematical explanations. This role is consistent with humanistic approaches to mathematics education, which emphasize the importance of students' participation, interpretation, and meaning-making processes rather than focusing solely on correct procedures (Hendriana et al., 2022). The teacher's role becomes particularly important because cultural contexts alone do not automatically create meaningful learning; teachers need to facilitate connections between cultural observations and formal mathematical concepts.

Another important characteristic of KBCE implementation is the integration of love values within classroom interactions. The findings indicate that care, respect, appreciation, and cooperation were manifested through collaborative discussions, opportunities to express ideas, and supportive responses among teachers and students. This aspect distinguishes KBCE from approaches that focus only on contextualizing mathematical content. While ethnomathematics provides the cultural foundation for mathematical exploration, love-based pedagogy provides the relational conditions that support students' participation and confidence during learning. Previous studies on pedagogy of care emphasize that supportive relationships contribute to learning environments where students feel recognized, respected, and encouraged to participate actively (Gunawardena & Wilson, 2021).

The collaborative dimension of KBCE is also theoretically important because mathematical understanding is not developed only through individual cognitive processes but also through social interaction. During implementation, students were provided opportunities to discuss interpretations, compare observations, and construct explanations together. Such activities support the development of mathematical reasoning because students are required to articulate their thinking, respond to alternative perspectives, and refine their understanding through interaction. This finding aligns with perspectives on mathematics learning that view communication and collaboration as important elements in constructing mathematical meaning (Sari et al., 2023).

The implementation of the five KBCE stages provides a structured mechanism that connects cultural experiences with mathematical understanding. The stage of local cultural exploration allows students to encounter mathematical ideas through familiar objects. Mathematical concept identification supports recognition of geometric characteristics, while formal concept construction enables students to connect observations with mathematical representations and principles. Collaboration and reflection provide opportunities to develop shared understanding, while internalization of love values connects mathematical learning with appreciation, cooperation, and cultural awareness. Through this sequence, KBCE integrates cognitive, cultural, and relational dimensions within a single learning process.

However, the findings should be interpreted as characteristics observed during KBCE implementation rather than evidence of causal effectiveness. The present study was conducted within a limited qualitative case context involving two Madrasah Ibtidaiyah in Banyumas Regency, and it was not designed to compare KBCE with other instructional approaches. Therefore, the observed student participation, reasoning activities, and learning experiences provide an initial understanding of how KBCE operates in practice, but they do not demonstrate that KBCE alone produced these outcomes. Further studies using comparative or longitudinal designs are required to examine the broader effectiveness and sustainability of the framework.

From a theoretical perspective, the implementation findings strengthen the position of KBCE as a conceptual framework that extends ethnomathematics beyond cultural contextualization. Ethnomathematics explains the relationship between mathematics and cultural knowledge, while love-based pedagogy explains the relational conditions through which learning takes place. KBCE integrates these dimensions by organizing them within a

structured learning process that connects cultural exploration, mathematical construction, and human values. Thus, the contribution of KBCE lies in providing a framework for understanding mathematics learning as an activity that involves knowledge construction, cultural interpretation, and meaningful human interaction.

CONCLUSION

This study demonstrates that the integration of mathematics, local culture, and love values provides an initial direction for rethinking three-dimensional geometry learning in Madrasah Ibtidaiyah. The findings indicate that mathematics learning in the studied contexts was still predominantly oriented toward procedural understanding, with limited systematic integration of cultural experiences and human values. In response to this condition, the study formulated the Love-Based Curriculum through an Ethnomathematics Approach (KBCE) as an initial conceptual framework that connects mathematical concepts, Banyumas cultural resources, and love-based learning orientations. The framework consists of four interconnected components: a love-based values foundation, ethnomathematics integration, a humanistic mathematics learning process, and holistic learning outcomes, which are organized through five learning stages: local cultural exploration, mathematical concept identification, formal concept construction, collaboration and reflection, and internalization of love values.

The implementation findings from the two Madrasah Ibtidaiyah indicate that KBCE can be applied within a specific cultural and educational context by connecting local cultural objects, three-dimensional geometry concepts, and collaborative learning interactions. These findings should be interpreted as observed characteristics of KBCE implementation rather than evidence of causal effectiveness. From a practical perspective, KBCE provides an initial reference for teachers in designing mathematics learning that incorporates local cultural resources and love-based interactions; however, its application requires adaptation to different cultural and educational contexts. This study contributes an exploratory conceptual framework that integrates ethnomathematics, humanistic mathematics education, and love-based pedagogy in primary mathematics learning. Given that the study was conducted in two Madrasah Ibtidaiyah in Banyumas Regency, further research involving broader contexts, comparative designs, expert validation, and longitudinal investigations is required to examine the refinement, applicability, and sustainability of KBCE in diverse educational settings.

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AUTHOR CONTRIBUTION STATEMENT

DS contributed to the formulation of the research concept, the development of the research design, data investigation and curation, and the writing of the initial draft of the manuscript. **PN** contributed to the formal analysis and validation of the data, the critical review and editing of the manuscript's content, and the overall supervision of the research.

AI DISCLOSURE STATEMENT

The authors used ChatGPT (OpenAI) in a limited capacity during the preparation of this manuscript, primarily to improve language use, clarify the presentation of ideas, and refine the academic style of the writing. Following its use, the manuscript was carefully reviewed and revised by the authors to ensure the accuracy, appropriateness, and clarity of the content. The authors take full responsibility for the content of the published work.

ChatGPT was not involved in the research design, data collection or analysis, interpretation of the findings, decision to publish, or development of the scientific substance of the manuscript. All scientific ideas, academic judgments, interpretations, and final responsibility for the content of this manuscript rest entirely with the authors.

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