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Recontextualizing Realistic Mathematics Education Based on Islamic *Duduk Mufakat* for Students' Problem Solving

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Abstract

This study examines the integration of local cultural and religious values into mathematics learning through the recontextualization of Realistic Mathematics Education (RME) with the Acehnese cultural practice of *duduk mufakat* (consensus-based deliberation) at the elementary school level. The study focuses on how culturally grounded deliberative practices shape classroom interaction patterns and influence students' mathematical reasoning processes. The research employed a qualitative, design-based research approach involving 28 elementary school students. Data were collected through classroom observations, analysis of students' work, and interviews, and were analyzed descriptively using the theoretical frameworks of RME and culturally responsive teaching. The findings indicate that the practice of *duduk mufakat*, rooted in Aceh's cultural context, functions as an interactional structure that guides the exchange of ideas, the comparison of strategies, and the collective verification of mathematical solutions. Repeated group discussions encouraged students to transition from informal representations toward more systematic reasoning, particularly when identifying patterns, generalizing procedures, and jointly checking solution outcomes. The deliberative process also strengthened reflection, as students evaluated alternative strategies and revised solutions based on group consensus supported by mathematical justification. These dynamics contributed to more structured reasoning, communication, and deeper engagement in problem-solving activities. The study confirms that integrating culturally grounded deliberative practices into RME can support meaningful mathematics learning by organizing communication and collaboration patterns that are responsive to students' cultural contexts.

Keywords: Realistic Mathematics Education, Duduk Mufakat, Problem Solving.

Abstrak

Penelitian ini mengkaji integrasi nilai budaya dan religius lokal dalam pembelajaran matematika melalui rekontekstualisasi Realistic Mathematics Education (RME) dengan praktik budaya Aceh duduk mufakat (musyawarah berbasis konsensus) pada jenjang sekolah dasar. Studi ini berfokus pada bagaimana praktik deliberatif berbasis budaya membentuk pola interaksi kelas dan memengaruhi proses penalaran matematis siswa. Penelitian menggunakan pendekatan kualitatif berbasis Design-Based Research yang melibatkan 28 siswa sekolah dasar. Data dikumpulkan melalui observasi pembelajaran, analisis hasil kerja siswa, dan wawancara, kemudian dianalisis secara deskriptif menggunakan kerangka teori RME dan pembelajaran responsif budaya.Hasil penelitian menunjukkan bahwa praktik duduk mufakat berfungsi sebagai struktur interaksi yang mengarahkan pertukaran ide, perbandingan strategi, dan verifikasi solusi matematis secara kolektif. Diskusi kelompok yang berlangsung berulang mendorong siswa beralih dari representasi informal menuju penalaran yang lebih

sistematis, terutama ketika mengidentifikasi pola, melakukan generalisasi prosedur, dan melakukan pengecekan bersama terhadap hasil penyelesaian. Proses deliberatif juga memperkuat refleksi, karena siswa mengevaluasi alternatif strategi dan merevisi solusi berdasarkan kesepakatan kelompok yang didukung alasan matematis. Dinamika ini berkontribusi pada komunikasi penalaran yang lebih terstruktur dan keterlibatan yang lebih mendalam dalam aktivitas pemecahan masalah. Temuan penelitian menegaskan bahwa integrasi praktik deliberatif berbasis budaya dalam RME berpotensi mendukung pembelajaran matematika yang bermakna melalui pengaturan pola komunikasi dan kolaborasi yang responsif terhadap konteks budaya siswa.

***Kata Kunci**: Realistic Mathematics Education, Duduk Mufakat, Pemecahan Masalah*

INTRODUCTION

Problem-solving ability is a core competency of 21st-century mathematics education and a primary indicator of elementary students' numeracy literacy. This is because problem solving requires students to integrate conceptual understanding, logical reasoning, and the ability to apply mathematics in real-life situations (Habil, Nastiti, & Sulistyowati, 2025; Habsah, Putri, Farda, & Sa'idah, 2024; Pradana, Noer, & Sutiarso, 2025; Rahmadi, Wahyu, & Oktari, 2024; Siregar, Fauzan, Yerizon, & Syafriandi, 2025). Findings from various international studies, such as PISA and TIMSS, indicate that students' low problem-solving ability is not only related to their mastery of mathematical concepts but is also influenced by instructional approaches that lack contextual relevance and are not rooted in students' socio-cultural realities (Nurul Zahrotul Jannah & Rahma Ramadhani, 2025)(Prahmana, 2022). This condition indicates that abstract and procedurally oriented mathematics instruction has not sbeen able to optimally develop numeracy literacy. Therefore, mathematics needs to be understood as a meaningful activity that is connected to students' lived experiences and cultural backgrounds.

Realistic Mathematics Education (RME) is an approach that has been consistently proven effective in developing students' mathematical problem-solving abilities (Pujiastuti, Prahmana, & Evans, 2025);(Rocha & Babo, 2024). This approach is strongly justified as it emphasizes the use of real-world contexts, the process of progressive mathematization, social interaction, and students' active roles in constructing mathematical knowledge (Zetriuslita dkk., 2025);(Fredriksen, 2021). Research findings indicate that RME contributes significantly to the improvement of elementary students' conceptual understanding, critical thinking skills, and the quality of their problem-solving processes (Qouder, Fouze, & Amit, 2025);(Fitriani, Hayati, Sugeng, Srimuliyati, & Herman, 2022);(Anjarwati, Adiwahyono, Adawiya, Ariyani, & Susilowati, 2025). The contexts employed are often limited to everyday situations without representing students' local cultural values and practices. Consequently, RME requires recontextualization to become more relevant to learners' socio-cultural backgrounds.

Recent studies indicate a growing emphasis on integrating local culture into mathematics instruction through ethnomathematics and culturally responsive teaching approaches (Hayati, Syahputra, & Surya, 2024). This approach is grounded in the view that culture does not merely function as a contextual background but also shapes students' values, interaction patterns, and ways of thinking (Abidin, Fatawi, & Kausar, 2025; Adiyono, Patimah, Malik, & Abdurrohim, 2025; Aldogiher, Halim, El-Deeb, Maree, & Kamel, 2025; Asrori dkk., 2025; Aulia, Kusrini, & Daud, 2025). Research findings reveal that cultural integration can enhance students' engagement and the meaningfulness of mathematics learning (Habsah dkk., 2024; Martanti, Nurkaenah, & Sholikhin, 2026; Putri, Dwiningrum, Retnawati, Begimbetova, & Salem, 2025; Rislan, Abdullah, & Ramzy, 2025). However, most studies have focused primarily on cultural artifacts, such as traditional games or artistic motifs, while cultural values as social practices remain relatively underexplored. In fact, socio-cultural practices play a crucial role in shaping how students engage in dialogue and solve problems collectively (Rizal, Hidayat, & Anwar,

2025). This indicates a clear opportunity for further development in culturally based mathematics education research.

One cultural value that is closely aligned with the principles of Realistic Mathematics Education (RME) is the tradition of *duduk mufakat* practiced within Acehnese society, which historically and sociologically cannot be separated from Islamic values. In the Acehnese context, socio-cultural practices, including deliberation in collective decision-making, represent manifestations of religious teachings that have been internalized in everyday community life (Hanafiah, 2021). Therefore, the integration of cultural and religious values in learning does not constitute the addition of external elements, but rather reflects the authentic social reality of students, which is consistent with the fundamental principles of RME itself. The *duduk mufakat* tradition provides a strong rationale for integration because it emphasizes egalitarian dialogue, exchange of arguments, collaborative problem seeking, and the achievement of collective agreement, all of which are aligned with key characteristics of RME such as mathematical discussion, negotiation of meaning, and socially constructed knowledge. Furthermore, the practice of *duduk mufakat* reflects the internalization of Islamic values derived from the principle of *shūrā* (deliberation) in the Qur'an, thereby offering an ethical and normative foundation for interaction within the learning process (Ahwan & Karfida, 2025; Arizona, Rokhmat, Ramdani, Gunawan, & Sukarso, 2025; Ismawati, 2023; Pangastuti, Suyudi, Bahtiar, Erfansyah, & Abdullah, 2025; Sabarudin, Ayyubi, Rohmatulloh, & Indriyani, 2023; Sabililhaq, Dina, Khatami, & Suryanudin, 2024). Consequently, linking culture, religiosity, and mathematics learning becomes relevant for fostering meaningful and contextual numeracy literacy, particularly in societies with strong socio-religious identities such as Aceh (Ar dkk., 2025; Murza, Ar, & Usman, 2025; Suryati, Mulyani, & Shadiqin, 2026). However, empirical studies that systematically integrate these cultural-religious values into the stages of RME remain very limited. Therefore, there is a need to develop a learning model that explicitly connects RME with cultural and religious values within a coherent conceptual framework.

The research gap lies in the absence of a conceptual and implementable model that structurally integrates Islamic values embedded in the *duduk mufakat* tradition into RME-based mathematics instruction. This integration is important because social interaction in RME is often understood merely as general discussion without considering the value system that regulates the ethics of argumentation and collective decision-making. In fact, the quality of mathematical discussion is determined not only by the intensity of communication but also by epistemic norms that guide students in expressing, evaluating, and revising ideas. In this context, Islamic deliberative ethics—such as mutual respect for opinions, collective responsibility, and the pursuit of fair solutions—have the potential to enhance problem-solving quality through increased confidence in argumentation, openness to strategy revision, and reflective engagement in reaching rational consensus. Thus, cultural-religious values can be understood as epistemic mediators that directly influence the quality of students' reasoning and mathematical problem-solving processes, rather than merely serving as a learning context.Review findings indicate that Islamic values such as *shūrā*, justice, and wisdom have the potential to strengthen the quality of students' mathematical reasoning and communication. Based on this rationale, the present study aims to recontextualize RME through the *duduk mufakat* cultural tradition of Acehnese society and to examine its contribution to the development of elementary students' mathematical problem-solving abilities. It is expected that this study will enrich the theoretical and practical discourse on culturally and Islamic values based RME.

METHOD

This study employed a qualitative approach within a Design-Based Research framework to develop and examine a consensus values–based Realistic Mathematics Education learning model grounded in the cultural tradition of *duduk mufakat* in elementary mathematics instruction. The selection of DBR was based on the research objective, which focuses on designing a pedagogical innovation, implementing it within an authentic classroom context, and iteratively evaluating and refining the model until it achieves both theoretical validity and practical effectiveness. In this study, the *duduk mufakat* tradition was not merely positioned as a cultural context but as an epistemic and pedagogical framework that shapes social interaction, mathematical argumentation, and students' collective reasoning processes during learning.

The research was conducted at UPTD SD Negeri 4 Bireuen, Bireuen Regency, Aceh, during the first semester of the 2024/2025 academic year. The participants consisted of 28 elementary school students selected through purposive sampling based on criteria related to cultural exposure and social experiences relevant to deliberative practices in daily life. The selection criteria included: (1) students originating from Acehnese family and community environments that still practice deliberation or *duduk mufakat* in social decision-making, (2) students who use the Acehnese language as a means of daily communication at home or within the community, and (3) students who have prior experience participating in group discussions in classroom settings. These criteria were established to ensure that participants possessed sufficient cultural and linguistic proximity so that the integration of *duduk mufakat* values in learning could be observed authentically. The research process followed the main stages of Design-Based Research namely: (1) needs analysis and context exploration, (2) design of the *duduk mufakat*–based RME model, (3) implementation and limited classroom trials, and (4) reflection and revision of the model based on empirical findings. Learning activities focused on solving contextual mathematical problems emphasizing problem-solving skills, particularly in geometry and measurement topics closely related to students' daily experiences. The learning design was based on the core principles of RME, including the use of realistic contexts, exploration of students' strategies, interactive discussions, and reflection, enriched with *duduk mufakat* practices as a mechanism for collaborative decision-making and shared mathematical understanding.

Data were collected through classroom observations, semi-structured interviews, analysis of students' written work, and documentation of the learning process during each implementation cycle. The researcher served as the primary instrument (human instrument), supported by observation protocols and interview guidelines that had undergone expert validation. Data credibility was ensured through source and technique triangulation, as well as member checking. Data analysis followed the interactive model of Miles, Huberman, and Saldaña, including data reduction, data display, and conclusion drawing and verification, with particular emphasis on examining the relationships among the model design, implementation processes, and the development of students' mathematical problem-solving abilities. The results of the analysis were used as a basis for reflection to refine the model in subsequent iterations until a conceptual and implementable learning model was achieved.

RESULTS AND DISCUSSION

Findings

Recontextualization of the RME Approach Based on the *Duduk Mufakat* Cultural Tradition

The findings indicate that the Realistic Mathematics Education (RME) approach can be effectively recontextualized through the integration of Islamic *duduk mufakat* cultural values at each stage of the learning process. This recontextualization is reflected in the use of contextual problems closely related to students' social lives, as well as in the strengthening of deliberative processes grounded in Islamic values such as justice, togetherness, and mutual respect for differing opinions during group discussions (Redmond, Shubert, Scales, Williams, & Syvertsen, 2025). Students were not only required to arrive at mathematical solutions but were also encouraged to reach agreement on problem-solving strategies through dialogue, collective deliberation, and shared responsibility, reflecting the Islamic principle of *shūrā*.

Classroom observations revealed that the *duduk mufakat* values served as the primary framework for group interaction. Each student was given an equal and respectful opportunity to express their ideas, while final decisions were reached through collective consensus without individual domination. This process fostered a participatory, inclusive, and ethical learning environment, aligning with the students' socio-cultural characteristics and religious values within the elementary school context (Utari, Putri, Zulkardi, & Hapizah, 2024).

Observations of the 28 students indicate that the recontextualization of the Realistic Mathematics Education (RME) approach based on the *duduk mufakat* cultural tradition was consistently implemented across all stages of instruction. Descriptively, 24 of the 28 students (85.7%) were actively engaged in group discussions that emphasized deliberation (*musyawarah*) in determining problem-solving strategies. Meanwhile, 4 students (14.3%) showed limited participation, particularly in the initial stages of discussion, yet still followed the group's decisions.

Observational data further reveal that 21 students (75%) explicitly expressed ideas or alternative strategies during group discussions, while 7 students (25%) acted as active listeners who provided agreement or reinforcement of their peers' ideas. All groups (100%) reached collective consensus (*mufakat*) before presenting their problem-solving results, with no evidence of dominance by any single individual in the decision-making process.

From the problem-solving process perspective, 22 students (78.6%) did not immediately focus on the final answer but first discussed and compared several solution strategies. This finding indicates that the *duduk mufakat* value functions as an interactional framework that promotes mathematical dialogue at the stage of horizontal mathematization, when students still rely on informal, context-based representations. Furthermore, 20 students (71.4%) demonstrated the ability to accept and revise their initial strategies after considering their peers' opinions, indicating the occurrence of meaning negotiation that contributes to the transition toward vertical mathematization or more formal representations. This process was observed in one group of students while solving a contextual problem related to the area of plane figures. At the initial stage, students calculated the area by counting unit squares in the diagram. Through *duduk mufakat* discussions, different strategies were compared, until one student proposed using the length × width formula as a more efficient approach. After considering the mathematical arguments and reasoning presented, the group reached a consensus to adopt the formula, resulting in a shift from a concrete strategy toward a formal symbolic representation. These findings suggest that *duduk mufakat* practices not only facilitate social interaction but also function as an epistemic mechanism that supports the cognitive shift from informal to formal mathematization as described in the RME approach.Qualitatively and descriptively, these findings show that the *duduk mufakat* cultural tradition was not merely

present as a normative value but was internalized within mathematics classroom practices.(Suyono, Minarti, & Wiraningsih, 2023) The recontextualization of RME through group deliberation (*musyawarah*) created a participatory, inclusive, and collaborative learning environment, aligning with the socio-cultural characteristics of elementary school students.

Realistic Mathematics Learning Processes in a Deliberative Atmosphere

The realistic mathematics learning process conducted in a deliberative atmosphere demonstrated a high level of implementation across most of the observed aspects. A total of 23 students (82.1%) were involved in learning activities that reflected the complete implementation of the main stages of Realistic Mathematics Education (RME), including the presentation of contextual problems, strategy exploration, group discussion, and reflection. This engagement was evident not only in quantitative participation but also in the quality of interactions that reflected the principles of *shūrā* and *adab* during mathematical reasoning processes. For example, in a group discussion on determining the area of a rectangle based on the context of a school garden, the following dialogue occurred:

Student A: "*We could count the squares one by one, but that might take a long time*." Student B: "*I think we can use length times width because the shape is a rectangle*." Student C: "*That's a good idea, but let's check first to make sure the results are the same*." Student A: "*Okay, let's compare them first. If they match, then that method is faster*."

This dialogue illustrates mutual respect for opinions, rational evaluation of strategies, and willingness to consider others' ideas before making a decision, reflecting deliberative practices within the learning process.

Active student engagement in strategy exploration through group deliberation was also dominant, with 23 students (82.1%) participating in discussions to construct shared understanding. However, five students (17.9%) tended to act as active listeners, indicating variation in participation levels within group interactions. Nevertheless, the role of active listeners still contributed to meaning negotiation, as these students followed the flow of arguments within the group before responding.

From a problem-solving perspective, 21 students (75.0%) were able to propose more than one alternative solution strategy, while 22 students (78.6%) compared strategies before reaching group consensus. This comparison process was evident when students considered the efficiency of counting unit squares versus applying a formal formula, eventually reaching consensus based on the most logical mathematical reasoning. Furthermore, 21 student groups (75.0%) successfully resolved differences in strategies through collective consensus, confirming that consensus values functioned as a mechanism for mathematical decision-making during learning.

Intergroup interaction also showed reasonably strong quality, with 20 students (71.4%) responding to other groups' presentations, either by asking questions or proposing alternative solutions. For instance, during a presentation on measuring the perimeter of plane figures, a student from another group asked, "Why did you add all the sides? Is there a faster way?" This question triggered further discussion, demonstrating openness to evaluating ideas and engaging in collective reflection. Meanwhile, the teacher's role as a facilitator was consistently observed, with 23 students (82.1%) experiencing learning situations in which the teacher did not directly determine the final answer but instead guided students' thinking processes. This aligns with the core principle of RME, which emphasizes active knowledge construction through social interaction and reflection.

Overall, these findings indicate that mathematics learning within a deliberative, consensus-based atmosphere not only supports the implementation of RME stages but also strengthens the quality of social interaction, meaning negotiation, and collective mathematical decision-making through discursive practices reflecting the values of *shūrā* and *adab*.

Student Engagement and Participation in Problem Solving

The research findings indicate that students' engagement and participation in the mathematics learning process increased significantly when instruction was conducted within a deliberative atmosphere grounded in the principle of duduk mufakat (consensus-based discussion). Most students demonstrated active involvement during the problem-solving process, both through expressing ideas, responding to peers' opinions, and participating in group decision-making regarding solution strategies. This engagement was reflected not only in the frequency of participation but also in the quality of interactions, which indicated a shift in students' learning attitudes. Students who had previously tended to be passive began to show greater confidence in speaking and arguing when discussions took place in an environment that positioned all group members as equals. This finding suggests that the implementation of duduk mufakat values functions as a social framework that creates an inclusive and participatory learning environment.

This increase in participation is closely related to the internalization of shūrā values, which emphasize openness, fairness, and respect for every opinion. In classroom practice, students were not only given opportunities to express ideas but were also encouraged to listen to and consider others' perspectives before reaching a collective agreement. This process fostered dialogic and reflective interactions, enabling students to feel that they had a meaningful role in the group's mathematical decision-making. Such an atmosphere of equality appeared to reduce the fear of making mistakes, which had previously been a barrier to participation for some students.

Observational findings were supported by interview data showing that students felt more comfortable and confident expressing their opinions when discussions were conducted in a deliberative setting. One student stated, "*When learning is like this, I am brave enough to speak because my friends do not immediately say I am wrong.*" Another student expressed, *"If there are different opinions, we look for the most correct answer together, so we are not embarrassed*." These statements indicate that a discussion environment that values individual contributions creates psychological safety, allowing students to be more open in expressing their mathematical thinking. This condition also reflects the application of adab in deliberation, namely mutual respect, maintaining harmonious social interaction, and avoiding judgments that belittle others' opinions.

In addition to increasing students' willingness to participate, the deliberative atmosphere also contributed to the quality of students' mathematical understanding. Several students reported that group discussions helped them better understand problems because they could hear multiple solution strategies. One student explained, "When a friend explains the method, I understand better than when I only listen to the teacher." This suggests that peer interaction serves as a medium for knowledge construction through the exchange of ideas and argumentation. This process aligns with the principles of social constructivism in mathematics learning, in which understanding is formed through negotiation of meaning and collective reflection.

Student engagement was also reflected in the increased intensity of responsive interactions during discussions. Students not only expressed ideas but also responded to, reinforced, or questioned their peers' opinions. This interaction pattern indicates the development of healthy mathematical discourse norms, in which differences of opinion are viewed as part of the process of finding better solutions. In several groups, students were

observed helping each other correct computational errors without generating interpersonal conflict, demonstrating a collective responsibility for achieving shared understanding. The consensus value embedded in duduk mufakat appears to function as a social mechanism that encourages cooperation and a shared sense of responsibility for group learning outcomes.

Overall, these findings suggest that integrating duduk mufakat values into RME learning not only increases student participation quantitatively but also strengthens the quality of cognitive, social, and emotional engagement in the mathematics problem-solving process. A deliberative atmosphere grounded in Islamic values creates a learning environment that is safe, respectful of differences, and supportive of collective responsibility, thereby enabling students to become more confident in argumentation and more open to revising their understanding. Thus, cultural-religious values function not only as a learning context but also as an epistemic mechanism that supports the collaborative construction of mathematical knowledge.

Development of Students' Mathematical Problem-Solving Abilities

ased on the analysis of students' work, classroom observation notes, and interview data, it was found that students' mathematical problem-solving ability showed clear development throughout the learning process conducted within a deliberative atmosphere grounded in the cultural practice of *duduk mufakat* (consensus-based discussion). This development was reflected in several key aspects, including the ability to understand problems, design solution strategies, implement procedures systematically, and explain the mathematical reasoning underlying the solutions produced.

At the stage of problem understanding, changes were evident in how students identified essential information before beginning calculations. In the initial observations, some students tended to perform arithmetic operations immediately without analyzing the problem context. However, after participating in learning activities structured around group deliberation, students became accustomed to reading the problem collaboratively and discussing what was known and what was being asked. For example, the following exchange was documented within one group:

Student A: "*We know the length is 12 cm and the width is 8 cm, but what is asked is the area of the shaded part.*" Student B: "*That means we should find the total area first, then subtract the empty part.*" Student C: "*Yes, don't calculate yet. Let's understand the problem first.*"

This fragment demonstrates the development of analytical problem-understanding skills, where students consciously identified relevant information before determining a solution strategy. The process reflects increased metacognitive awareness emerging through group interaction.

At the stage of designing solution strategies, students began to demonstrate the ability to select more logical approaches through collaborative discussion. In one discussion concerning composite shapes, a debate emerged that illustrated collective mathematical reasoning:

Student D: "*If we divide it into two rectangles, it will be easier to calculate.*" Student E: "*But the shapes are not all the same. Using subtraction might be more accurate.*" Student F: "*How about we try both methods first, then see whether the results are the same*?"

This discussion shows that students did not passively accept a single strategy but compared alternative solutions through mathematical argumentation. Such negotiation reflects the practice of *shūrā* within the mathematics learning context, where decisions are reached through collective consideration rather than individual dominance.

Development was also evident at the stage of implementing solution strategies. Analysis of students' worksheets indicated that their procedures became more systematic compared to the period before the learning intervention. Students began using visual representations such as redrawing shapes, labeling dimensions, and performing step-by-step calculations in a more

structured manner. This finding was reinforced by observations of peer correction during calculations:

Student G: "*Try checking again, we made a mistake when adding.*"
Student H: "*Oh yes, it should be 96, not 86.*"
Student G: "*That means the final answer changes. Let's rewrite it correctly.*"

This interaction indicates the emergence of collective responsibility for solution accuracy, developed through collaborative work.

The reflection stage also demonstrated important progress in students' problem-solving ability. After completing tasks, groups jointly evaluated whether their strategies were appropriate. During one reflection session, a student stated: "*Our method actually worked, but it was too long. The other group's method was faster because they divided it directly into two parts.*"

This statement reflects evaluative ability and awareness of strategy efficiency, which are key indicators of higher-level mathematical problem solving.

Students' oral mathematical communication skills also improved significantly. At the beginning of the learning process, students tended to provide short answers without explaining their reasoning. However, through repeated deliberative discussions, students began to explain solution steps more coherently and logically. For instance, during a group presentation:

> "We calculated the total area first using the length times width formula, then subtracted the part that was not included. We chose this method because it was easier than dividing it into many small parts."

This explanation demonstrates more structured mathematical argumentation while also reflecting polite communication attitudes consistent with the value of *adab* (ethical conduct) in expressing opinions.

Interview results further strengthened these findings. One student stated:

> "When we discuss like this, I understand better because my friends explain the method slowly. If I only listen to the teacher, sometimes I'm still confused."

Another student explained: "*Deliberation makes us not afraid of being wrong. If we are wrong, we fix it together. So I am more confident trying my own method.*"

These statements indicate that the development of problem-solving ability was influenced not only by cognitive practice but also by the psychological safety created through a collaborative learning environment.

Overall, the findings demonstrate that integrating deliberative values into mathematics learning contributes to the comprehensive development of students' problem-solving ability. This development includes improvements in problem analysis, strategy design, procedural implementation, solution reflection, and mathematical argumentation. Islamic values such as *shūrā* (consultation) and *ta'āwun* (cooperation) function as social mechanisms that encourage reflective interaction, collaboration, and collective responsibility. Consequently, mathematics learning serves not only to develop cognitive competence but also to foster students' intellectual and social character in a balanced manner.

Teachers' and Students' Responses to RME Learning Based on Duduk Mufakat

The findings indicate that both teachers and students responded positively to the implementation of Realistic Mathematics Education (RME) integrated with the *duduk mufakat* practice. These responses were reflected not only in their acceptance of the instructional approach, but also in changes in perceptions regarding the mathematics learning process, social relationships in the classroom, and the roles of teachers and students during instruction.

From the students' perspective, learning within a deliberative atmosphere was perceived as more comfortable, enjoyable, and supportive of their understanding of mathematical concepts.

Students felt they had space to express their opinions without fear of being judged wrong, since decisions were not determined unilaterally but reached through collective agreement. One student stated: "*Learning like this is more enjoyable because we can talk with friends first. If we are wrong, we are not scolded, but corrected together.*"

This statement suggests that the deliberative environment created psychological safety that supported students' willingness to participate. Another student emphasized that group discussion helped them understand concepts that were previously difficult:

> "When friends explain using their own methods, I understand faster. Sometimes friends' explanations are easier to understand than directly from the book."

This indicates that peer interaction functioned as a medium for knowledge construction through the exchange of diverse representations and strategies, consistent with the principles of social constructivism within RME.

Furthermore, several students reported that the deliberation process helped them appreciate others' opinions and learn cooperation in solving problems. One student explained: "*If there are different opinions, we do not immediately say it is wrong. We try first to see which one is correct. So we learn to respect each other.*"

This statement reflects the internalization of *shūrā* and *adab* values in classroom interaction, where students not only learned mathematics but also developed social attitudes such as respect for others' perspectives and collective responsibility for group outcomes.

From the teacher's perspective, responses to the implementation were also generally positive, although some challenges were identified. The teacher observed that students became more active and confident in expressing ideas compared to previous teacher-centered instruction. In an interview, the teacher stated:

"*I see students who were usually quiet starting to speak up. They are more active in asking questions and discussing when given opportunities for deliberation.*"

The teacher also believed that this approach helped students develop deeper conceptual understanding because they discovered solution strategies through discussion. The teacher explained: "*When students find their own methods through discussion, their understanding is stronger. They do not just memorize formulas, but know why the formula is used.*"

However, the teacher acknowledged several challenges, particularly related to time management and group discussion dynamics. The deliberation process required more time than lecture-based methods, especially when students were still adapting to collaborative learning patterns. The teacher noted: "*At first it required more time because students were not used to discussing. But after several meetings, the process became smoother.*"

In addition, the teacher emphasized that the facilitator role required greater preparation in designing contextual problems and guiding discussions without dominating them. This finding indicates that implementing RME based on *duduk mufakat* not only affected students but also transformed the teacher's pedagogical practice toward a more reflective and participatory approach.

Positive responses from both teachers and students were also evident in their perceptions of the cultural-religious values integrated into the learning process. The teacher considered the deliberation practice aligned with character education goals in the school, making mathematics learning simultaneously a medium for attitude formation. The teacher stated: "*Deliberation is actually already part of our culture. When applied in mathematics, students not only learn calculations but also learn to respect others.*"

Meanwhile, students felt that learning became more meaningful because it was connected to everyday values. One student commented: "*We do not only learn mathematics, but also learn how to cooperate and listen to friends.*"

Overall, the responses from teachers and students indicate that RME learning based on *duduk mufakat* was well received and provided a more meaningful learning experience. The approach not only improved conceptual understanding of mathematics but also strengthened social interaction, self-confidence, cooperation, and collective responsibility. These findings confirm that integrating pedagogical approaches with cultural-religious values can create a more humanistic and participatory learning environment that simultaneously supports students' cognitive and character development.

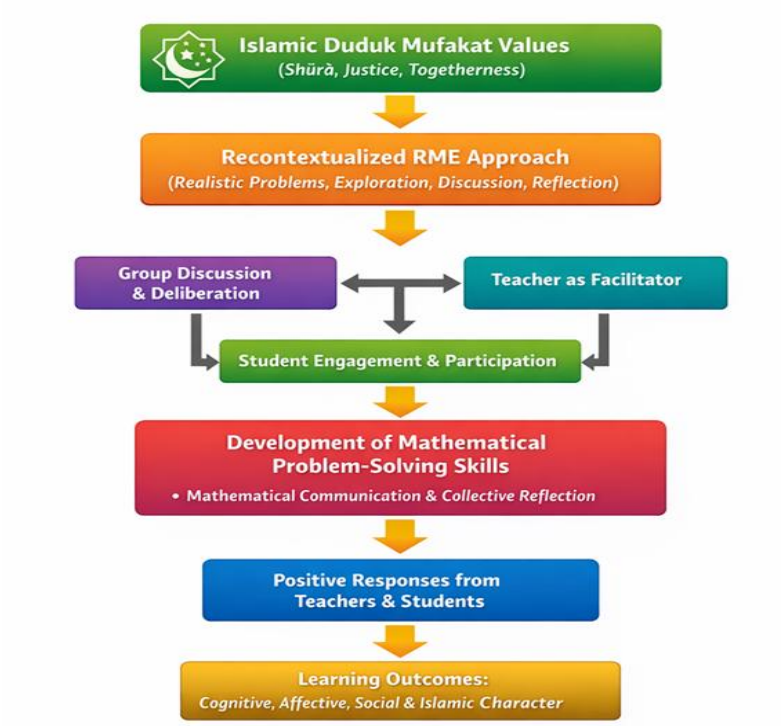

Figure 1. The Relationship between RME and Duduk Mufakat Cultural Values

Discussion

The findings of this study indicate that the recontextualization of Realistic Mathematics Education (RME) based on the duduk mufakat cultural tradition makes a tangible contribution to the development of elementary students' mathematical problem-solving abilities, not only at the stage of understanding contextual problems but also in the progression toward formal mathematical representations. The improvement in students' abilities did not stop at successfully finding solutions grounded in real-life situations; rather, it was reflected in shifts in their thinking from concrete strategies toward symbolic abstraction. These findings are consistent with the perspective of Hans Freudenthal, who emphasized that mathematics is a human activity that develops through progressive mathematization, moving from informal experiences toward formal structures.

Evidence of vertical mathematization in this study can be observed in the analysis of students' worksheets on the topic of area measurement. In the initial stage, most students used a strategy of counting individual unit squares in a rectangular garden diagram. However, through group discussions grounded in deliberation (musyawarah), students began to identify patterns and generalize the counting process into multiplication operations. One worksheet demonstrated a gradual progression from counting 24 squares individually, to organizing them into 6 rows and 4 columns, and finally expressing the formal representation $A = l \times w$. This transformation occurred after group deliberation rather than solely as a result of teacher intervention.

Fragments of group dialogue illustrate how abstraction emerged through consensus supported by mathematical reasoning. One student noted that counting one by one was time-consuming, while another suggested that the total number of squares could be obtained by multiplying the number of rows by the number of columns. The group then agreed to use multiplication because it produced the same result but was more efficient. When the teacher asked for justification, the students explained that the total number of squares remained the same, confirming the correctness of the method. This dialogue demonstrates that consensus within the duduk mufakat process functioned as a mechanism for mathematical validation grounded in quantitative reasoning rather than mere social agreement.

The function of duduk mufakat as a verification tool was also evident in a geometry task on perimeter. When discrepancies appeared in calculation results, students did not immediately accept a particular answer; instead, they proposed a collective rechecking process by summing all sides again. This shared verification practice indicates that cultural consensus was used to test mathematical correctness. Thus, the deliberative cultural practice did not merely shape social interaction but also strengthened rational justification processes in mathematics.

Student interviews further reinforced these findings. Several students reported that they did not immediately understand the use of formulas until they discussed them with peers. One student explained that when a classmate demonstrated multiplication, they realized that calculating area was essentially repeated addition. This statement suggests that social interaction functioned as a bridge toward mathematical abstraction. In other words, vertical mathematization occurred through collective meaning negotiation rather than through direct procedural transmission from teacher to students.

Nevertheless, the study also revealed an important limitation. The indicator related to students' responses to other groups' presentations showed the lowest performance compared to other indicators. Classroom observations and interviews indicated that some students felt uncomfortable criticizing their peers' ideas directly due to concerns about hurting others' feelings (Asy'Ari dkk., 2025; Daulay, Haidir, & Firmansyah, 2024). Norms of politeness embedded in the duduk mufakat culture tended to emphasize social harmony, meaning that intellectual conflict did not always emerge spontaneously. Yet cognitive conflict is a crucial component in mathematics learning for deepening conceptual understanding. This finding suggests that deliberative cultural practices may have an ambivalent effect: on the one hand, they support collaboration and psychological safety, but on the other hand, they may reduce the intensity of critical debate if not pedagogically facilitated.

The teacher's role therefore became crucial in addressing this limitation. In this study, the teacher used non-confrontational open-ended questions, such as asking whether alternative strategies were possible or whether different reasoning existed, allowing students to express critique without violating group politeness norms (Prayogi, Prasetya, Marina, Setiawan, & Ishak, 2025). This strategy gradually increased argumentative participation and helped maintain a balance between social harmony and productive cognitive conflict (Erawadi & Setiadi, 2024; Harahap, 2024; Widiawati & Firman, 2025).

From a theoretical perspective, this study does not position Realistic Mathematics Education as an ideological framework but rather as a universal pedagogical approach that can be recontextualized according to local cultural values (Broto, Kristiyanto, Nurkamto, & Yudanto, 2026; Ma`arif, Sebgag, Syamsi, & Alai, 2025; Rozanita, Usman, & Azzukhrufi, 2026). The main contribution of this research lies in extending the understanding that culture does not merely function as a source of contextual learning situations but also as a normative framework influencing the validation processes of mathematical knowledge. In this study, *duduk mufakat* operated as a collective mechanism for evaluating strategies, comparing arguments, and agreeing upon formal representations based on mathematical reasoning.

However, this research remains limited to relatively concrete mathematical topics, such as measurement and basic geometry. Therefore, further studies are needed in more abstract domains, such as algebra, to examine the extent to which culturally grounded deliberative practices can support transitions toward more complex symbolic formalism. Such investigations are important for determining the boundaries of the duduk mufakat model's effectiveness in promoting advanced vertical mathematization.

Overall, the findings suggest that integrating deliberative cultural practices into mathematics instruction has significant potential to support students' conceptual understanding, problem-solving abilities, and processes of mathematical abstraction, provided that teachers actively facilitate a balance between social consensus and constructive cognitive conflict.

CONCLUSION

The findings of this study indicate that the recontextualization of Realistic Mathematics Education (RME) based on the Acehnese cultural practice of *duduk mufakat* reveals a learning process that is participatory, reflective, and structured within elementary students' mathematical experiences. The deliberative practice emphasizing togetherness, mutual respect, and collective rational consideration encourages students' engagement in understanding problems, designing strategies, and discussing as well as revising solutions collaboratively. These findings enrich the understanding of culture as a mediator of learning interaction by demonstrating that *duduk mufakat* shapes patterns of communication, cooperation, and mathematical reasoning during the problem-solving process. Classroom observations also indicate that norms of maintaining group harmony sometimes made students hesitant to express criticism directly, highlighting the importance of the teacher's role in facilitating dialogue that respects differences while encouraging critical argumentation. Practically, teachers need to design discussion activities that provide opportunities for students to explain mathematical reasoning, compare strategies, and conduct collective verification, so that deliberative cultural practices can function as a means of strengthening conceptual understanding rather than merely serving as group work activities.

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