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DIGITAL STORYTELLING IN STEM MATHEMATICS: COMMUNICATING ISLAMIC VALUES THROUGH PROBLEM-BASED LEARNING

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Abstract

This paper conceptualizes Digital Storytelling (DST) in Scince, Technology, Engeneering, Mathematic (STEM) Mathematics as a pedagogical model for strengthening students' mathematical problem-solving while enabling the communication of Islamic values honesty (ṣidq), responsibility (amānah), cooperation (taʿāwun), and perseverance (ṣabr) within problem-based learning (PBL). The concept paper argues that digital storytelling can function as a "narrative bridge" connecting STEM contexts, mathematical reasoning, and ethical reflection without turning mathematics lessons into moral instruction. The proposed framework positions storytelling as an integrative learning product developed across three cycles: (1) problem framing in authentic STEM situations, (2) modeling and solution development through collaborative mathematical inquiry, and (3) narrative synthesis, where learners produce short digital stories that explain assumptions, justify strategies, and reflect on value-informed decisions and societal impacts. To guide implementation and assessment, the paper outlines design principles for tasks, group roles, and teacher facilitation that promote accountable talk, respectful dialogue, and evidence-based reasoning. It also proposes an assessment approach combining mathematics performance indicators (representation, reasoning, accuracy, and validation) with value-oriented communication indicators (truthfulness in reporting results, responsibility in teamwork, cooperative discourse, and persistence through iterative revision). The paper concludes by highlighting practical implications for curriculum design, classroom assessment rubrics, and teacher professional development in value-integrated STEM education. Future empirical work is recommended to test the model across diverse contexts, compare it with conventional PBL, and examine how narrative features mediate students' engagement, reasoning quality, and value communication over time.

Keywords: *Digital storytelling; STEM mathematics education; Problem-based learning; Islamic values communication; Mathematical problem-solving*

Abstrak

Penelitian ini mengkonseptualisasikan *Digital Storytelling* (DST) dalam matematika STEM sebagai model pedagogis untuk memperkuat pemecahan masalah matematika siswa sambil memungkinkan komunikasi nilai-nilai Islam, kejujuran (*ṣidq*), tanggung jawab (*amānah*), kerja sama (*taʿāwun*), dan ketekunan (*ṣabr*) dalam pembelajaran berbasis masalah (PBL). Makalah konsep tersebut berpendapat bahwa mendongeng digital dapat berfungsi sebagai "jembatan naratif" yang menghubungkan konteks STEM, penalaran matematis, dan refleksi etis tanpa mengubah pelajaran matematika menjadi instruksi moral. Kerangka kerja yang diusulkan memposisikan mendongeng sebagai produk pembelajaran integratif yang dikembangkan dalam tiga siklus: (1) pembingkaian masalah dalam situasi STEM otentik, (2) pemodelan dan pengembangan solusi melalui penyelidikan matematis kolaboratif, dan (3) sintesis naratif, di mana peserta didik menghasilkan cerita digital pendek yang menjelaskan asumsi, membenarkan strategi, dan merefleksikan keputusan berdasarkan nilai dan dampak sosial. Untuk memandu implementasi dan penilaian, makalah ini menguraikan prinsip-prinsip desain untuk tugas, peran kelompok, dan

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fasilitasi guru yang mempromosikan pembicaraan yang akuntabel, dialog yang saling menghormati, dan penalaran berbasis bukti. Ini juga mengusulkan pendekatan penilaian yang menggabungkan indikator kinerja matematika (representasi, penalaran, akurasi, dan validasi) dengan indikator komunikasi berorientasi nilai (kebenaran dalam pelaporan hasil, tanggung jawab dalam kerja tim, wacana kooperatif, dan ketekunan melalui revisi berulang). Makalah ini menyimpulkan dengan menyoroti implikasi praktis untuk desain kurikulum, rubrik penilaian kelas, dan pengembangan profesional guru dalam pendidikan STEM yang terintegrasi nilai. Pekerjaan empiris di masa depan direkomendasikan untuk menguji model di berbagai konteks, membandingkannya dengan PBL konvensional, dan memeriksa bagaimana fitur naratif memediasi keterlibatan, kualitas penalaran, dan komunikasi nilai siswa dari waktu ke waktu.
Keywords: Penceritaan digital; Pendidikan matematika STEM; Pembelajaran berbasis masalah; Komunikasi nilai-nilai Islam; Pemecahan masalah matematika

1. Introduction

Digital storytelling is increasingly positioned as more than a "creative add-on" in mathematics classrooms; recent evidence suggests it can operate as a meaning-making process where learners externalize mathematical thinking, justify choices, and communicate significance to an audience. In university mathematics, a digital storytelling assessment task has been shown to help students articulate not only procedures but also the relevance of mathematics, because the narrative format pushes them to connect definitions, representations, and conclusions to situated contexts and personal or societal interpretations (Hernandez-Martinez & Keane, 2024). In school settings, digital storytelling has also been linked to stronger self-efficacy in mathematics learning, suggesting that story-based production can support confidence through visible progress, peer feedback, and ownership of mathematical explanations (Niemi & Niu, 2021). These findings align with a broader post-2020 shift in mathematics education research that treats digital media as a space where learners build mathematical identities and communicate reasoning multimodally, not merely consume content (Engelbrecht & Borba, 2024).

Placing digital storytelling inside STEM-oriented PBL strengthens this potential, because PBL already requires learners to frame problems, evaluate assumptions, and defend solutions under constraints. Contemporary work on PBL in STEM emphasizes problems embedded in rich real-world contexts, strategic metacognitive reasoning (Adinda et al., 2023), and collaboration driven by meaningful goals, making PBL a natural "engine" for the kinds of explanation and justification that storytelling demands (Smith et al., 2022). Similarly, integrated STEM education discussions in 2025 continue to highlight real-world problem solving (Adinda et al., 2023; Siregar et al., 2029) and cooperative work as pillars, while noting that classroom designs must clarify how inquiry (Siregar et al., 2019), design, and mathematical reasoning interact across disciplines (Portillo-Blanco et al., 2025). Within such environments, storytelling can function as a narrative bridge: it transforms a sequence of calculations into a communicative artifact that must make sense to others, thereby raising the bar for clarity, coherence, and evidential reasoning.

A key advantage of digital storytelling for STEM mathematics is its alignment with the communication demands of modeling. When students tackle authentic STEM tasks such as optimizing water use, budgeting energy consumption, or comparing design alternatives they must decide what variables matter, choose representations, test reasonableness, and interpret results. Digital storytelling requires these modeling moves to be narrated and justified, which can reduce "answer-first" habits and make assumptions visible for critique. Research on digital technology in mathematics education over the last five years notes that multimodality (including video) and evolving learning spaces can support new forms of explanation and collaboration, particularly when students are producing and sharing artifacts rather than only submitting written work (Engelbrecht & Borba, 2024). In this way, storytelling is not separate from mathematical rigor; it can increase rigor by demanding that mathematical representations be translated into accessible arguments.

The proposed three-cycle framework problem framing, collaborative modeling/solution development, and narrative synthesis fits well with how learning gains often emerge in technology-supported inquiry. For example, narrative-supported learning designs in digital environments have been associated with improvements in mathematical problem-solving competence, suggesting that "story structures" can scaffold how learners organize information, evaluate strategies, and communicate results (Dai et al., 2022). Conceptually, Cycle 1 (problem framing) positions students to identify the STEM context, constraints, stakeholders, and ethical tensions. Cycle 2 (modeling and solution development) focuses on mathematical representations, reasoning, validation, and iterative revision through group inquiry. Cycle 3 (narrative synthesis) requires teams to build a short digital story that explains decisions, compares alternatives, and communicates impact. Across cycles, the learning product is not only the solution but also a public explanation of why the solution is warranted.

Embedding Islamic values honesty (*ṣidq*), responsibility (*amānah*), cooperation (*taʿāwun*), and perseverance (*ṣabr*) becomes pedagogically plausible when values are treated as communication norms and decision-making commitments rather than as moral slogans. Honesty can be operationalized as truthfulness in reporting results, transparency about assumptions, and integrity in citing data sources or acknowledging limitations. Responsibility can be enacted through role accountability, timely contribution, and ethical attention to consequences when interpreting outcomes for real communities. Cooperation aligns naturally with PBL's collaborative inquiry demands (Smith et al., 2022) and perseverance maps onto iterative modeling cycles where early attempts often fail or require revision. Importantly, framing these values as learnable practices inside mathematical work avoids reducing mathematics to moral instruction; instead, values become criteria for how reasoning is conducted and communicated.

Recent research on ethics in mathematics education provides a strong conceptual anchor for this integration. The ethical reasoning in mathematics framework argues that equitable mathematics education benefits from tasks that surface dilemmas and require learners to reason about choices, consequences, and justification not merely compute (Register et al., 2021). This is highly compatible with STEM problems where trade-offs are unavoidable (e.g., cost vs. sustainability, efficiency vs. fairness). Digital storytelling can amplify ethical reasoning because it compels learners to narrate why certain assumptions were chosen, which trade-offs were accepted, and how a solution might affect others. In short, ethics becomes discussable because the story format invites explanation of stance, uncertainty, and impact, while mathematics provides the evidential backbone for those claims.

A complementary lens comes from values research in science education, where a scoping review emphasizes that acknowledging students' values can strengthen relationships, engagement, achievement, and wellbeing, yet values are often only indirectly addressed through adjacent constructs such as attitudes or identity (Hill et al., 2024). This matters for the current concept because it supports a design stance: values should be made explicitly communicable in learning activities, but in ways that remain authentic to disciplinary work. Digital storytelling offers a structured space for explicitness students can include brief reflective segments (e.g., why reporting accurately matters, how the team handled disagreement, what persistence looked like during revisions) while still centering mathematical reasoning.

The assessment approach therefore needs dual indicators: mathematics performance and value-oriented communication. On the mathematics side, performance indicators can include representational quality (appropriate variables, diagrams, equations), reasoning coherence (logical progression, justification), accuracy (correct computation and interpretation), and validation (checking assumptions, sensitivity, or reasonableness). On the value-communication side, indicators can be grounded in observable discourse and artifact features: honesty as transparent assumptions and truthful reporting; responsibility as equitable workload evidence and reliable task completion; cooperation as respectful dialogue and integration of ideas; perseverance as documented iteration and willingness to revise after critique. This kind of assessment logic is consistent with calls to treat digital artifacts as evidence of learning processes and communication competencies, not just final answers, particularly in technology-rich mathematics learning environments (Engelbrecht & Borba, 2024).

Implementation also benefits from attention to affect and engagement, because storytelling can change learners' emotional relationship with mathematics. A recent review of storytelling methods in mathematics learning points to connections between storytelling approaches and learner affect, including anxiety-related considerations, and calls for more work across settings and levels (Irmayanti et al., 2024). From a practical standpoint, teachers can design roles (e.g., modeler, verifier, narrator/editor, data steward) that distribute responsibility and make collaboration visible, while facilitation focuses on accountable talk, evidence-based critique, and ethical questioning during modeling choices. Professional development should therefore address both technical production (simple video/audio tools, accessibility) and pedagogical orchestration (how to prompt justification, how to assess multimodal artifacts fairly, and how to keep values integration authentic rather than performative).

Taken together, the conceptual model argues that digital storytelling can act as a narrative bridge in STEM mathematics PBL: it strengthens problem-solving by requiring communicable reasoning and supports values communication by making decision processes visible. The model is consistent with recent scholarship emphasizing real-world STEM problems, cooperative learning, and multimodal digital practices (Portillo-Blanco et al., 2025; Smith et al., 2022), while also aligning with emerging directions that explicitly link mathematics learning to ethical reasoning and values (Hill et al., 2024; Register et al., 2021). Future empirical studies from 2026 onward could test the framework through quasi-experimental comparisons with conventional PBL, longitudinal tracking of reasoning quality and communication norms, and analyses of how narrative features (voice, audience, plot structure, multimodal choices) mediate engagement, collaboration, and the clarity of mathematical justification over time.

2. Theoretical

Digital Storytelling as Multimodal Mathematical Communication

DST is increasingly theorized as a multimodal meaning-making practice in which learners combine narration, visuals, sound, and screen text to communicate disciplinary ideas. In mathematics, this matters because mathematical understanding is not only "having the right answer," but being able to represent, justify, and validate reasoning for an audience. Recent synthesis work in mathematics education shows DST is commonly associated with stronger engagement, reflective practice, and opportunities for learners to "humanize" abstract concepts through personally and socially meaningful narratives (Deslis et al., 2025). DST therefore fits a communication-oriented view of learning mathematics where students are positioned as explainers and decision-makers, not only as procedure-followers.

DST and Cognitive–Affective Support for Learning Mathematics

Theoretical accounts link DST to cognitive benefits through dual coding and multimedia learning assumptions: combining verbal explanation with visual representation can reduce ambiguity and make relationships in a model easier to grasp, especially when learners must design the story themselves. At the same time, DST can support affective conditions for learning, including interest and reduced anxiety, because storytelling invites creativity and personal voice. A recent review of storytelling in mathematics learning highlights that storytelling approaches are often discussed as making mathematics more enjoyable and accessible, with implications for anxiety reduction and positive learner experience (Irmayanti et al., 2025). In this sense, DST is not only a "product," but a learning environment that can make persistence and iterative refinement more likely because students feel ownership over the narrative they craft.

STEM Mathematics and the Centrality of Mathematical Modeling

When DST is embedded in STEM mathematics, the storyline can be structured around modeling: defining variables, setting assumptions, building representations, and checking solutions against constraints. Modeling-oriented instruction is widely framed as a bridge between school mathematics and real-world decision-making, because it requires students to interpret contexts, test ideas, and justify trade-offs. Empirical work on integrating modeling with STEM learning emphasizes that mathematical modeling tasks can strengthen students' capacity to coordinate representations, reason with constraints, and evaluate solution quality rather than only compute results (Register et al., 2021). DST can amplify these modeling practices because it pushes students to explain why an assumption was chosen and how a model's output should be interpreted for stakeholders.

Problem-Based Learning as the Instructional "Engine"

PBL is commonly used to structure integrated STEM learning because it starts from an authentic problem and organizes learning around inquiry cycles. A recent framework-building study proposed principles that characterize PBL in school-based STEM settings, highlighting flexible knowledge use, metacognitive reasoning, intrinsic-motivation collaboration, and problems embedded in rich contexts (Smith et al., 2022). These principles align closely with DST because a well-designed digital story can document (a) how a team framed the problem, (b) how strategies evolved through evidence and critique, and (c) how conclusions were validated. In other words, DST can serve as a narrative "trace" of PBL reasoning, making the learning process assessable not only the final numeric answer.

Collaborative Discourse and Value-Oriented Communication

Your concept paper emphasizes communication indicators (truthfulness in reporting results, responsibility in teamwork, cooperative discourse, persistence through revision). Theoretical grounding for these indicators can draw on research that treats classroom learning as interactional and relational: students learn through accountable talk, negotiation of meaning, and feedback. Communication-focused reviews in educational psychology argue that positive interpersonal communication behaviors (e.g., clarity, confirmation, care, and constructive dialogue) are linked to engagement and better learning conditions, especially when tasks are collaborative and demanding (Xie & Derakhshan, 2021). DST within PBL can intensify the need for such communication because teams must agree on what evidence counts, how to present claims responsibly, and how to credit contributions fairly.

Ethics, Integrity, and Fairness in Mathematics Education

Values integration in mathematics benefits from being framed as ethical practice embedded in disciplinary activity, rather than as external moral "add-ons." Recent empirical work on mathematics teachers' ethical decision-making shows that instructional choices often involve ethical tensions (fairness, harm, honesty, inclusion), and that virtue-oriented ideas (including honesty/integrity) can appear naturally in how teachers justify what is right to do in mathematics classrooms (Ozmantar et al., 2025). Complementing this, philosophical work in mathematics education argues that injustice can arise when students are positioned unfairly as knowers (e.g., whose explanations are believed, whose methods are valued), making ethics inseparable from participation and communication (Tanswell & Rittberg, 2020). DST can operationalize these insights by requiring students to account for claims, acknowledge uncertainty, and represent results transparently habits that mirror integrity (*ṣidq*) and responsibility (*amānah*) without turning mathematics into sermonizing.

Islamic Values as Communicative Practices Within Learning Activity

A practical way to theorize Islamic values (*ṣidq, amānah, taʿāwun, ṣabr*) in STEM mathematics is to treat them as observable communication practices within inquiry: reporting results honestly (*ṣidq*), meeting team commitments and roles (*amānah*), dialoguing cooperatively and sharing resources (*taʿāwun*), and persisting through revision and error analysis (*ṣabr*). This positioning is consistent with recent work on integrating Islamic values with science learning through digital and mobile learning designs, where values are embedded into learning processes and inquiry structures rather than appended as separate moral lessons (Fahyuni et al., 2020). Similarly, discussions of Islamic-based academic culture in educational contexts often frame character formation as emerging from routines, norms, and collaborative practices suggesting that "values communication" can be designed into task roles, reflection prompts, and peer-feedback structures rather than delivered as moral instruction.

Teacher Capacity, Design Knowledge, and Assessment Alignment

Implementing DST-in-PBL requires teacher capacity in task design, facilitation, and assessment. Teacher education research shows that when educators experience designing DST themselves, it can support developing professional identity and practical insight into integrating digital composing into instruction (Shinas & Wen, 2022). For assessment, recent DST-in-mathematics synthesis emphasizes the importance of rubrics that balance mathematical reasoning quality with multimodal communication quality, while also noting common challenges such as time, unequal access, and the need for explicit scaffolds (Deslis et al., 2025). Your proposed dual-indicator assessment approach (mathematics performance + value-oriented communication) fits this direction: it treats values as part of the epistemic work of explaining, justifying, and revising thereby aligning curriculum, pedagogy, and assessment.

3. Model Development

Model Purpose and Design Requirements

The proposed model is developed as a pedagogical and assessment-ready framework that integrates DST with PBL to strengthen mathematical problem-solving and make value-oriented communication observable in classroom activity. The model is motivated by recent findings that DST in mathematics can support reasoning, problem-solving, motivation, self-efficacy, collaboration, and reflective practice, while also posing practical challenges such as time, training, and unequal access (Deslis et al., 2025). It is also aligned with evidence that PBL in STEM benefits from clear principles of practice flexible knowledge use, metacognitive reasoning, collaboration, and problems embedded in rich contexts which must be explicit if teachers are to implement integrated approaches confidently (Smith et al., 2022). A second design requirement comes from the integrated STEM literature, which continues to report theoretical ambiguity and uneven implementation, with consensus forming around real-world problem contexts, inquiry/design cycles, and teamwork as core principles (Portillo-Blanco et al., 2024; Portillo-Blanco et al., 2025). The model therefore prioritizes (a) authentic STEM problem contexts, (b) mathematical modeling and validation, (c) accountable collaborative discourse, and (d) a structured narrative product that makes both reasoning and values communication assessable.

Core Design Principles

First, the model treats DST as mathematical communication, not decorative media work. DST is used to require learners to explain assumptions, justify strategies, validate outputs, and interpret consequences for stakeholders moves consistent with contemporary work emphasizing how digital technologies reshape mathematical learning spaces and expand forms of representation and argumentation (Engelbrecht & Borba, 2024). Second, the model positions mathematical activity within interdisciplinary STEM problem-solving while keeping mathematics epistemically central. This responds to persistent concerns that mathematics can become marginal or merely instrumental in STEM projects; recent discussions explicitly call for clearer articulation of how mathematics contributes to STEM-based problem solving and how STEM experiences enhance learning of mathematics (Dorier & Maass, 2023). Third, values integration is designed as norms of reasoning and communication rather than moral instruction. The framework draws on ethics-focused mathematics education research that argues ethical reasoning can be elicited through real-world tasks where students must justify choices and consider consequences, and where frameworks can support lesson design and analysis of students' ethical reasoning (Register et al., 2021; Siregar et al., 2020). Fourth, classroom interaction is treated as a key mechanism: positive and accountable interpersonal communication in instruction is associated with better engagement and learning conditions, especially in collaborative and demanding tasks (Xie & Derakhshan, 2021). Finally, teacher feasibility is built into the model through scaffolded roles, rubrics, and professional learning considerations, consistent with findings that teacher preparation and ongoing support are crucial for sustained DST integration (Shinas & Wen, 2022).

Model Architecture and Learning Product

The DST–STEM-Math-IVC model is organized around three iterative cycles that culminate in a single integrative learning product: a short digital story (3–6 minutes) that documents the problem context, the mathematical model, the solution pathway, and a reflective segment on value-informed decisions and impacts. The model assumes that a coherent learning product can function as a "narrative bridge" that links STEM context, mathematical reasoning, and ethical reflection while remaining discipline-respectful. This is consistent with research showing that DST assessment tasks can prompt learners to articulate the relevance of mathematics and to communicate reasoning more explicitly to an audience (Hernandez-Martinez & Keane, 2024). The product is not merely a performance artifact; it is designed as evidence for both mathematical proficiency and value-oriented communication.

Cycle 1: Problem Framing in Authentic STEM Contexts

Cycle 1 develops the problem space and establishes the ethical and practical constraints that will later require justification. Drawing on integrated STEM principles emphasizing real-world problems, inquiry, design, and teamwork (Portillo-Blanco et al., 2024), the teacher introduces an ill-structured scenario (e.g., reducing school water consumption, optimizing energy budgeting, planning waste reduction) and guides groups to formulate a problem statement, identify stakeholders, define measurable goals, and list constraints. This cycle explicitly introduces value-norm prompts as communication commitments: honesty (*ṣidq*) is operationalized as transparent claims and accurate data sourcing; responsibility (*amānah*) as role accountability and attention to consequences; cooperation (*taʿāwun*) as constructive discourse; and perseverance (*ṣabr*) as willingness to iterate after critique. These commitments are positioned as classroom norms that support fairness and integrity in knowledge-building, echoing mathematics education concerns about ethical orders in participation and credibility (Tanswell & Rittberg, 2020). The outcome of Cycle 1 is a group "problem brief" (one-page plan or storyboard slide) that will later become the opening segment of the digital story.

Cycle 2: Collaborative Modeling and Solution Development

Cycle 2 centers mathematical modeling, representation, and validation. Students collect or are provided with data, determine variables, create representations (tables, graphs, equations), build and test models, and compare alternative solutions. This cycle is designed to make mathematics epistemically visible within integrated STEM activity, consistent with calls to clarify the role of mathematics in interdisciplinary STEM learning (Dorier & Maass, 2023). The cycle also aligns with evidence that integrating inquiry and mathematical modeling can generate synergy across STEM domains when teachers intentionally coordinate practices and contextualization (Chindanya et al., 2024). Within groups, collaboration is structured through rotating roles (e.g., modeler, verifier, data steward, narrator/editor), which distributes responsibility and generates artifacts that document reasoning. Teacher facilitation prioritizes metacognitive prompts and validation routines consistent with PBL principles (Smith et al., 2022), such as asking students to justify assumptions, test sensitivity, check units and reasonableness, and explain why one solution is preferable under constraints. Perseverance (*ṣabr*) is operationalized through "revision checkpoints," where groups must respond to feedback and document at least one significant model improvement. The outcome of Cycle 2 is a validated solution set (model + results + justification notes) prepared to be narrated.

Cycle 3: Narrative Synthesis and Digital Story Production

Cycle 3 converts the reasoning pathway into a coherent narrative for an audience. DST research in mathematics indicates that digital story tasks can support reflective practice and communication of relevance, while also requiring scaffolding to manage production load (Deslis et al., 2025; Hernandez-Martinez & Keane, 2024). In this model, narrative synthesis follows a structured template: context and stakes (from Cycle 1), mathematical model and key representations (from Cycle 2), decision points (where assumptions or trade-offs were made), validation and limitations, and a concise reflection on societal impact and value-oriented communication. Values are included through evidence-based reflection rather than moral claims, for example: "We reported an outlier honestly and tested its impact," "We assigned tasks and met deadlines," "We resolved disagreement by checking evidence," and "We revised our model after identifying an unrealistic assumption." Teacher support focuses on clarity, attribution, accessibility (captions, readable visuals), and accuracy of mathematical claims. This reflects broader discussions that teacher capacity and design knowledge are essential for technology-rich instructional innovation (Engelbrecht & Borba, 2024; Shinas & Wen, 2022). The outcome of Cycle 3 is the final digital story plus a short companion appendix (citations, data sources, and key equations), which protects mathematical rigor while keeping the narrative accessible.

Teacher Facilitation, Discourse Norms, and Classroom Equity

Because the model relies on collaboration and public communication, teacher facilitation is treated as a design component rather than an implementation afterthought. The model adopts communication norms consistent with instructional communication research clarity, confirmation, constructive feedback, and respectful discourse as enabling conditions for collaborative inquiry (Xie & Derakhshan, 2021). Equity is addressed by structuring turn-taking, requiring evidence-based critique, and using rubrics that credit both mathematical contributions and communication labor, reducing the risk that only "technical" roles are valued. This responds to concerns that credibility and participation in mathematics can be shaped by implicit ethical orders and epistemic injustice (Tanswell & Rittberg, 2020). Teacher moves include (a) making evaluation criteria transparent early, (b) monitoring role rotation, (c) prompting quieter students with prepared sentence starters, and (d) using formative checkpoints that require groups to show work-in-progress rather than only final answers.

Assessment Model: Dual Indicators for Mathematics and Values Communication

Assessment is designed as a two-lens rubric with integrated evidence sources. The mathematics performance lens evaluates representation quality, reasoning coherence, accuracy, and validation. The value-oriented communication lens evaluates truthfulness/transparency (*ṣidq*), role accountability and consequence awareness (*amānah*), cooperative discourse quality (*taʿāwun*), and documented iteration/persistence (*ṣabr*). This structure is justified by ethics-oriented mathematics education research arguing that ethical reasoning can and should be elicited and analyzed within real-world mathematical tasks (Register et al., 2021) and by DST-in-mathematics synthesis emphasizing the need for clear rubric criteria that balance mathematical rigor with multimodal communication (Deslis et al., 2025). Evidence sources include the final story, the modeling appendix, peer feedback logs, and revision notes. The model recommends separating "production polish" from "mathematical truth" in scoring to avoid penalizing learners with weaker media skills or limited access, a practical concern noted in DST implementation challenges (Deslis et al., 2025).

Implementation Pathway and Professional Development

Implementation feasibility is supported through staged adoption: teachers can start with short "micro-stories" (1–2 minutes) before moving to full projects, and can use simple tools to avoid production overload. Teacher professional development should combine pedagogical orchestration (PBL facilitation, modeling prompts, discourse moves) with media pedagogy (storyboarding, accessibility, ethical citation). Research on preparing teacher candidates to implement DST suggests that structured experiences and reflection can build confidence and practical integration skills (Shinas & Wen, 2022). The model also recommends alignment with integrated STEM consensus principles real-world problems, inquiry/design, teamwork while explicitly protecting the mathematical learning goals to avoid STEM projects where mathematics becomes peripheral (Dorier & Maass, 2023; Portillo-Blanco et al., 2024). Finally, the model encourages empirical testing across contexts, including comparisons with conventional PBL and analysis of how narrative features mediate engagement and reasoning quality, reflecting ongoing calls for more robust, cross-context evidence in both DST and integrated STEM research (Deslis et al., 2025; Portillo-Blanco et al., 2025).

4. Conclusion

This concept paper proposes as a coherent pedagogical model that strengthens students' mathematical problem-solving while making the communication of Islamic values honesty (*ṣidq*), responsibility (*amānah*), cooperation (*taʿāwun*), and perseverance (*ṣabr*) visible within PBL. The central claim is that digital storytelling can operate as a "narrative bridge" that links authentic STEM contexts, rigorous mathematical reasoning, and ethical reflection without reducing mathematics instruction to moral messaging. By requiring students to explain assumptions, justify strategies, validate outcomes, and interpret consequences for real or simulated stakeholders, digital storytelling positions communication as an essential component of mathematical competence rather than an additional activity at the end of a lesson.

The proposed framework contributes a structured pathway for classroom enactment through three integrated cycles. The first cycle, problem framing, anchors learning in authentic STEM situations and supports students in clarifying goals, constraints, and stakeholder needs. The second cycle emphasizes collaborative modeling and solution development, where students build and test mathematical representations, evaluate reasonableness, and revise models through evidence-based critique. The third cycle, narrative synthesis, transforms the problem-solving process into a concise digital story that communicates the group's reasoning pathway and value-informed decision making. Together, these cycles produce a single integrative learning artifact that captures both mathematical thinking and ethical social considerations, thereby providing a practical basis for formative feedback and summative assessment.

A key contribution of the model is its dual-lens assessment approach. Mathematics performance indicators representation, reasoning, accuracy, and validation ensure that disciplinary rigor remains central. At the same time, value-oriented communication indicators truthfulness in reporting results, responsibility in teamwork, cooperative discourse, and persistence through iterative revision translate Islamic values into observable classroom practices. This operationalization matters because it allows values to be taught and assessed through students' discourse, collaboration, and modeling choices rather than through abstract declarations. In this way, Islamic values are embedded as norms of inquiry and communication that support high-quality STEM mathematics learning, not as separate moral lessons.

Practically, the framework highlights implications for curriculum design and teacher facilitation. Curriculum developers can design STEM problems that naturally invite modeling, trade-off analysis, and societal impact discussion, creating authentic opportunities for students to articulate both mathematical evidence and ethical reasoning. Teachers can support implementation by establishing clear group roles, structuring accountable talk, and providing scaffolds for storyboarding, data citation, and validation routines. The model also implies that professional development should address not only technical aspects of digital production but also pedagogical orchestration how to prompt justification, manage collaboration fairly, and assess multimodal artifacts in ways that prioritize mathematical integrity while recognizing communication labor.

Finally, this concept paper sets an agenda for future empirical research. The model should be tested across diverse school contexts, grade levels, and resource conditions to evaluate feasibility and equity. Comparative studies can examine how this approach performs relative to conventional PBL in improving problem-solving, reasoning quality, and learner engagement. Qualitative analyses can explore how narrative features voice, audience, plot structure, and multimodal choices shape the clarity of mathematical explanations and the explicitness of values communication. Over time, such evidence can refine the framework into validated design principles and robust rubrics, supporting teachers who seek to integrate STEM mathematics learning with value-oriented communication in meaningful, discipline-respecting ways.

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