

Exemplification as a catalyst for equitable and reflective mathematics education

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Abstract

Purpose – This paper explores how elementary teachers conceptualized and enacted exemplification through learner-generated examples to support equitable mathematics instruction in an under-resourced, faith-based Caribbean school. It examines relationships among instructional practice, teacher identity and the integration of cultural and spiritual knowledge in mathematics teaching.

Design/methodology/approach – The study adopted a qualitative case study design grounded in Sociocultural Theory and Culturally Responsive Teaching. Six elementary teachers participated in a practice-based professional development initiative. Lesson plans, teacher reflections and a focus group discussion were analyzed thematically.

Findings – Learner-generated exemplification supported student agency, conceptual understanding and teachers' recognition of students' mathematical contributions when instructional tasks emphasized generation, variation and justification of examples. However, student hesitation, time constraints, and teacher discomfort were also evident, pointing to the emotional labor and tensions involved in enacting open-ended equity-oriented pedagogy.

Research limitations/implications – As a single, context-specific case study, the findings are not intended to be generalizable. Nevertheless, the study highlights the need for further research on exemplification, teacher learning and equity-oriented mathematics instruction in under-resourced and culturally diverse settings.

Originality/value – The findings suggest the importance of sustained, practice-based professional development that supports teachers in designing and facilitating learner-generated exemplification tasks that purposefully draw on students' cultural and spiritual resources. The study illustrates how culturally responsive mathematics instruction can affirm student voice, promote inclusion and advance educational equity in Caribbean and comparable Global South contexts. This paper contributes to the exemplification literature by foregrounding cultural, spiritual and emotional dimensions of equity-oriented mathematics teaching in a faith-based Caribbean context, an underrepresented setting in mathematics education research.

Keywords Equity in mathematics education, Caribbean education, Exemplification, Learner-generated examples, Culturally responsive mathematics teaching

Paper type Research article

Despite increasing advocacy for student-centered pedagogies in mathematics education, their enactment in under-resourced school contexts remains underexplored. In the Caribbean, regional and national policy frameworks, including the CARICOM Human Resource Development 2019–2030 Strategy (CARICOM, 2017), promote inclusive, culturally responsive instruction that emphasizes critical thinking, problem-solving and learner agency. Yet classroom implementation has been uneven, particularly in rural schools operating under material and professional constraints. In this study, under-resourced refers to school environments characterized by limited technological infrastructure, few professional learning opportunities and reliance on teacher improvisation and low-tech pedagogy. Many Caribbean schools operating under these conditions are also faith-based and culturally rich, grounded in strong community ties and spiritual traditions, yet such contexts remain underrepresented in empirical research on innovative mathematics pedagogies.

Exemplification, particularly learner-generated exemplification (LGE), offers a promising approach to advancing equity, conceptual understanding and student agency. Rather than positioning learners as passive recipients of worked examples, LGE invites students to construct, vary and refine examples, thereby deepening mathematical reasoning and expanding their example spaces (Watson & Mason, 2005; Zazkis & Leikin, 2007).



Research indicates that such example construction can support conceptual clarity, flexibility and creativity when appropriately scaffolded, though its effectiveness depends heavily on task design and teacher mediation (Sevimli, 2023). Implementing LGE also requires substantial shifts in instructional practice, classroom roles and professional identity (Adler & Pournara, 2023; Clarke & Hollingsworth, 2002), as teachers respond to unanticipated student thinking, relinquish control over lesson trajectories and manage the emotional labor associated with open-ended, dialogic pedagogy.

Although LGE has been shown to support mathematical reasoning and conceptual understanding, prior research has largely focused on secondary, tertiary, or well-resourced contexts (Watson & Mason, 2005; Zazkis & Leikin, 2007). Far less is known about how elementary teachers in under-resourced, faith-based settings conceptualize and enact LGE as part of sustained professional learning, or how institutional constraints and emotional demands shape this work (Sevimli, 2023). This gap is particularly consequential in the Caribbean, where policy frameworks, such as CARICOM (2017), call for equity-oriented, culturally responsive pedagogy but offer limited guidance for implementation in low-resource, faith-based schools.

The purpose of this qualitative case study is to examine how six elementary teachers in a single, under-resourced, faith-based Caribbean school conceptualize, implement and reflect on LGE as a strategy for equitable mathematics instruction within a practice-based professional development framework. A case study methodology is appropriate because it enables a close examination of the teachers' lived experiences, sense-making and instructional decision-making within a clearly bounded, real-world context (Yin, 2018). Rather than seeking statistical generalization, the study prioritizes analytic depth to explore how LGE is enacted and negotiated in practice, foregrounding teacher voice and classroom experience while illuminating its role as both an instructional approach and a catalyst for reflective practice and professional identity development.

Guided by Sociocultural Theory (SCT) and Culturally Responsive Teaching (CRT), this single-site qualitative case study is framed by the following questions:

- (1) How do elementary teachers conceptualize and implement LGE in mathematics instruction within a resource-constrained, faith-based school context?
- (2) What instructional shifts, reflective practices and changes in teacher identity emerge as teachers engage with LGE over time?
- (3) What pedagogical, emotional and contextual challenges do teachers encounter when implementing LGE, and how do they navigate these challenges?

These questions are intentionally bounded to generate situated, analytic insights rather than broad generalizations, consistent with the exploratory aims of qualitative case study research.

Literature review and theoretical foundation

This section explores LGE in mathematics education. It draws on SCT and CRT to examine how this strategy supports meaningful learning in under-resourced, faith-based school contexts.

Reframing LGE in mathematics education

LGE has gained prominence as a pedagogical strategy for promoting conceptual understanding, learner agency and mathematical reasoning. Within constructivist traditions, LGE invites students to produce examples that reflect their developing understanding of mathematical concepts, encouraging attention to structure, variation and justification (Cornock, 2021; Watson & Mason, 2005).

Watson and Mason (2005) conceptualize LGE not as a means of reinforcing known procedures, but as a generative mathematical activity that supports sense-making. From

this perspective, generating and varying examples enables learners to expand their *example spaces*—the sets of examples that they can construct and interpret—an idea further developed by [Zazkis and Leikin \(2007\)](#) as central to mathematical thinking and understanding.

Empirical research indicates that engagement in example construction can support flexible reasoning and conceptual clarity when tasks are deliberately framed and mediated by teachers ([Breen & O'Shea, 2019](#)). At the same time, findings are mixed. [Iannone, Inglis, Mejia-Ramos, Simpson, and Weber \(2011\)](#) found no consistent advantage of example generation over worked examples for proof production, underscoring that LGE is not inherently effective but depends on scaffolding and epistemic emphasis.

These considerations are particularly salient in under-resourced and culturally diverse classrooms, where standardized curricula often privilege procedural fluency and uniform assessment. Such conditions can create tension with the open-ended and contextually situated nature of LGE tasks, highlighting the need for pedagogical flexibility and responsive support if LGE is to foster equitable, conceptually rich mathematics learning.

LGE and culturally responsive pedagogy

CRT offers a critical lens for examining LGE in diverse and under-resourced educational contexts. CRT emphasizes validating students' cultural identities and lived experiences within the learning environment ([Gay, 2010](#); [Ladson-Billings, 1995](#)). In mathematics education, this perspective has been operationalized through frameworks that integrate students' community knowledge, linguistic practices and cultural narratives into mathematical tasks ([Aguirre, Zavala, & Katsh-Singer, 2024](#); [Zavala & Aguirre, 2024](#)).

LGE aligns with CRT when learners are encouraged to generate examples that reflect their cultural backgrounds, spiritual beliefs, or community practices. Such tasks reposition mathematics as a meaning-making activity rather than a purely procedural one, enabling students to connect abstract concepts to lived realities and affirming their identities as capable mathematical thinkers.

At the same time, research cautions that culturally responsive enactment is rarely straightforward. Teachers must balance curricular demands with cultural relevance and negotiate tensions between procedural rigor and epistemic inclusivity ([Abdulrahim & Orosco, 2020](#)). These tensions are particularly pronounced in faith-based schools, where spiritual values shape instructional practice but may not be recognized within standardized curriculum frameworks. This study addresses a gap in the literature by examining how teachers in under-resourced, faith-based Caribbean schools navigate these tensions through LGE, highlighting the potential of CRT-informed practice to support equity and meaningful mathematical engagement in contexts often overlooked by mainstream research.

Theoretical framework

This study is anchored in two interrelated theoretical perspectives—SCT and CRT. Together, these frameworks offer complementary insights into how LGE can support equitable and reflective mathematics instruction in under-resourced, faith-based educational contexts.

Sociocultural Theory. SCT, derived from the work of [Vygotsky \(1978\)](#), posits that learning is a socially mediated process shaped by cultural tools, language and interaction. Central to this theory is the concept of the Zone of Proximal Development (ZPD), which describes the space between what a learner can do independently and what they can achieve with appropriate guidance ([Vygotsky, 1978](#)). In mathematics education, this theory has been extended to emphasize mediated learning, scaffolding and dialogic interaction ([Cobb, 1994](#); [Kinard & Kozulin, 2012](#)).

In the context of LGE, teachers act as mediators who facilitate the co-construction of mathematical meaning through collaborative example generation. This study draws on sociocultural principles to analyze how teachers scaffold LGE tasks, foster mathematical

discourse and negotiate instructional change within their institutional and cultural contexts (Abakah, 2023; Lambright, 2024).

Culturally Responsive Teaching. CRT, as articulated by Gay (2010) and further developed by Aguirre et al. (2024), emphasizes the ethical imperative to affirm students' cultural identities and promote equity in the classroom. It advocates for inclusive instructional practices that are affirming and reflective of students' lived realities. In mathematics education, CRT has been operationalized through frameworks that emphasize identity affirmation, community relevance and critical consciousness (Ukpokodu, 2011; Zavala & Aguirre, 2024).

In faith-based schools, CRT includes integrating spiritual and community-based knowledge into mathematical tasks. This study uses CRT to interpret how teachers adapt LGE to promote equity, relevance and student agency in mathematics instruction. It also acknowledges the pedagogical tensions teachers face—balancing standardized curricular demands with culturally responsive practices, and procedural rigor with epistemic inclusivity (Abdulrahim & Orosco, 2020).

Synthesis and application. When combined, SCT and CRT offer a holistic view of LGE: One that values both the cognitive processes of learning and the cultural contexts in which learning occurs. Their synthesis provides a foundation for understanding how LGE can be implemented in ways that are both instructionally rigorous and culturally affirming, particularly in settings where pedagogical innovation must contend with limited resources, faith-based values and standardized expectations.

Integrating sociocultural and culturally responsive perspectives

By synthesizing SCT and CRT, this study advances a conceptual framework that positions LGE as both a cognitive and cultural practice. While prior research on LGE has largely emphasized cognitive processes such as variation, structure and example spaces, it has paid comparatively less attention to the cultural, institutional and emotional dimensions shaping classroom enactment. Integrating SCT and CRT enables a more nuanced understanding of how LGE is mediated through social interaction, cultural meaning-making and teacher judgment, particularly in contexts of material constraint.

This synthesis extends the literature by foregrounding how the affordances and limitations of LGE are shaped not only by task design but also by teachers' negotiation of curricular constraints, professional identity and commitments to affirming students' cultural and spiritual knowledge. In doing so, it contributes a context-sensitive lens for examining equity-oriented mathematics pedagogy in settings that remain underrepresented in mainstream research.

Methodology and methods

Research design

This study employed a qualitative case study design to examine how elementary teachers conceptualized, implemented and reflected on LGE within a resource-constrained, faith-based school context. This approach was selected to enable in-depth analysis of instructional practice and teacher sense-making in a real-world setting, aligning with the study's emphasis on meaning, context and professional learning rather than measurement or causal inference (Yin, 2018). Consistent with Yin's (2018) framework, the design prioritized analytic depth over statistical generalizability, yielding situated insights into how LGE operates within a bounded context shaped by material constraints and cultural factors.

Definition of the case and unit of analysis. The case in this study is defined as the collective implementation of LGE by elementary teachers in a single, under-resourced, faith-based Caribbean school, supported by a short-term, practice-based professional development initiative. The primary unit of analysis is teachers' instructional practice and professional learning related to LGE, examined through lesson plans, written reflections and a focus group discussion. While the school provides the institutional context shaping practice, analytic

attention centers on teachers' interpretations, enactments and reflections rather than institutional outcomes or student achievement.

This study constitutes an instrumental, embedded case study (Stake, 2010; Yin, 2018), designed to generate insight into LGE as a strategy for equitable mathematics instruction in culturally rich, resource-constrained contexts. Individual teachers function as embedded units within the broader case, allowing attention to variation while maintaining analytic coherence. The case is bounded by a single rural school in Dominica, six participating teachers across Kindergarten to Grade 6 (excluding Grade 1) and a two-month implementation period following a three-day professional development workshop. The principal, students and the non-participating seventh teacher are treated as part of the contextual setting rather than units of analysis.

Participants and sampling rationale

The study was conducted in a small, faith-based elementary school located in a rural Caribbean community shaped by agriculture, fishing and small-scale trade. The school enrolls approximately 120 students from Kindergarten to Grade 6 and is staffed by seven teachers and one principal. Economic and seasonal factors affect student attendance and access to resources. Faith is central to school life, with daily prayer and scripture integrated across the curriculum, including mathematics, where problem-solving often reflects values such as stewardship and fairness. Instruction occurs under material constraints, including limited technological infrastructure, minimal access to external professional development and reliance on printed materials, oral instruction and hands-on activities.

Purposive sampling was used to select both the sites and the participants. The school was chosen because it reflects structural conditions common to under-resourced, faith-based Caribbean schools, making it theoretically appropriate for examining LGE under constrained conditions. Six of the school's seven teachers volunteered: One declined due to professional obligations, leaving Grade 1 excluded. These exclusions were pragmatic rather than theoretical and form part of the case boundaries.

Participating teachers represented a range of experience and professional preparation, from early-career to more experienced educators. Five held formal teaching credentials (three associate degrees and two bachelor's degrees in elementary education), while one early-career teacher had not yet completed formal training. Across the group, prior exposure to exemplification was minimal, largely limited to procedural demonstrations. To protect anonymity within Dominica's small and closely connected educational community, detailed individual profiles are intentionally withheld, balancing ethical confidentiality with sufficient contextual detail for interpretive credibility.

Teachers' professional development

To support the integration of LGE in mathematics instruction, the six teachers participated in a three-day professional development (PD) workshop facilitated by the principal investigator. The sessions progressed from foundational concepts to classroom application, focusing on key mathematics processes, the principles of LGE and collaborative lesson design. Teachers engaged in interactive lectures, peer feedback and mock teaching, culminating in the development of LGE-based lesson plans. Table 1 summarizes the daily themes, focus areas and key outcomes.

Over the two months following the workshop, teachers submitted lesson plans to show how they incorporated LGE into math instruction. Their classroom experiences were further captured through written reflections and a focus group discussion, offering rich insights into their practices with LGE.

Data collection procedures

The study utilized three primary data sources: Lesson plans, teacher reflections and a focus group discussion. Lesson plans provided structured evidence of instructional intent and design.

Table 1. Summary of the themes, focus, and key outcomes of the PD sessions

Day	Theme	Focus and activities	Key outcomes
Day 1	Foundational Mathematics Processes	Explored seven key mathematics processes: communication, connection, visualization, problem-solving, mental math and estimation, reasoning, and technology. Activities included interactive lectures, group discussions, case studies, and Q&A sessions	Teachers demonstrated increased awareness of mathematics processes and expressed readiness to integrate them into instruction
Day 2	Introduction to Exemplification	Introduced exemplification as a strategy to enhance student engagement and understanding. Teachers engaged in guided discussions, collaborative prompt design, peer feedback, and reflective exercises	Teachers developed practical skills in designing exemplification prompts and articulated how the strategy could support diverse learners
Day 3	Application and Lesson Planning	Focused on applying exemplification in practice. Teachers created lesson plans, participated in peer review, and conducted mock teaching sessions. Feedback from peers and the facilitator supported the refinement and building of confidence	Teachers produced exemplification-based lesson plans and reported increased confidence in implementing the strategy in their classrooms

Source(s): The author’s own work

Initial plans developed during the PD workshop served as a baseline, while subsequent submissions captured ongoing integration. A total of 26 plans were collected, with each teacher contributing at least two. While formats of these plans varied, most included objectives, instructional steps, student activities and assessments. [Figure 1](#) exemplifies the typical structure of lesson plans. Plans were submitted electronically, anonymized and securely stored.

Following each LGE-integrated mathematics lesson, teachers submitted written reflections detailing instructional successes, challenges, student responses and planned adjustments. These reflections, along with corresponding lesson plans, were collected either via email or in person prior to the focus group session. To ensure confidentiality and ethical integrity, all submissions were anonymized using pseudonyms and securely stored in encrypted, password-protected folders accessible only to the principal investigator.

At the end of the two-month implementation period, all six teachers participated in a 90-min semi-structured focus group, facilitated by the principal investigator. The session was guided by open-ended questions, including the following:

- (1) *“How would you explain learners generating examples to a colleague?”*
- (2) *“How did your use of the strategy evolve over time?”*
- (3) *“What challenges did you face, and how did you address them?”*
- (4) *“How did your students respond to the strategy?”*

The discussion, audio-recorded and transcribed verbatim, provided a collaborative space for sharing experiences, validating insights and engaging in collective reflection.

Data analysis procedures

A thematic analysis was conducted across lesson plans, teacher reflections and the focus group transcript using NVivo 14, guided by [Braun and Clarke’s \(2006\)](#) six-phase framework. NVivo

Teacher E	
Date: March 6th, 2023	Grade: 3
Duration: 50 mins	School:
Subject: Mathematics	Topic: Measurement (Mass)
Objectives: Pupils will be able to:	
• Explain what is meant by Mass • Generate examples of items which can be measured using grams and kilograms.	
Mathematical Processes: Communication, Visualization, Technology, Connection	
Materials: Slides in Nearpod, items that measure 1 gram and 1 kilogram.	
Introduction: Teacher asks students, 'Do you think you would be able to lift a basket filled with about 20 pineapples?' Students talk about this and other items of varying Mass are presented and students talk about whether they would be able to lift these items.	
Transitional Statement: In today's lesson, we are going to look at measuring Mass and some of the units used to measure Mass.	
Development:	
Step 1: Teacher defines the term Mass explaining that Mass refers to the amount of matter in an object. Mass helps us to know how heavy or light an object is. Mass can be measured using several units. Some of these units include grams and kilograms. Teacher presents a paperclip (which has a mass of about 1 gram and another item which has a mass of about 1 kilogram. Students manipulate these items and then teacher asks students, "how many paperclips do you think you would need to make the mass of the other item?" Students brainstorm and share their ideas. 1000	
Step 2: Teacher then asks students to identify and draw 2 items that could be better measured using grams. Teacher then probes students about the items that they chose so they can demonstrate whether they have understood what Mass is and the estimated measurement of a gram. Teacher asks, "Why did you choose such an item? Why is grams a better unit of measurement for this item?"	
Step 3: Teacher instructs students to get two items that could be better measured using kilograms. Teacher reminds students that 1000 grams make 1 kilogram. Teacher probes students to check for understanding. Teacher asks, "Why would this item be better measured using kilograms instead of grams?"	
Step 4: Teacher then asks students to identify 2 items that have a mass (individually) of about 1 Kilogram. Students are led in a discussion about the items they chose and why they chose such items.	
Step 5: Teacher asks students, "Where have you seen items being measured in kilograms and grams?" Students share examples and teacher then asks students, "Why is it important to measure Mass accurately?" Students discuss.	
Conclusion: Content of the lesson is reviewed by students defining the term Mass and talking about what they learned about Mass through the generation of examples related to Mass.	
Evaluation: Students complete the following:	
1. Draw two items that could be measured using grams. 2. Draw two items that could be measured using kilograms.	
Draw 1 item that measures about 1 kilogram.	

Figure 1. A sample lesson plan. Source: Exemplar from the teachers' lesson plans

was used to support systematic data management, coding and visualization across multiple qualitative sources. All data were anonymized prior to analysis and organized by data type to facilitate structured comparison.

Analysis followed an inductive approach. The principal investigator conducted repeated readings of all datasets to develop familiarity and generate analytic memos documenting initial impressions, contextual observations and emerging ideas. Meaningful excerpts were then coded manually using descriptive labels that captured key instructional, emotional and contextual features. Coding was iterative, with earlier data revisited and codes refined, merged, or expanded as patterns became clearer.

Related codes were subsequently grouped into broader analytic categories and synthesized into overarching themes aligned with the study’s research questions. Themes were reviewed across data sources to ensure consistency and relevance, and illustrative excerpts were selected to reflect both shared patterns and variation. Throughout the process, analytic decisions were documented through memos and annotations to maintain a transparent audit trail. [Table 2](#) illustrates the coding framework used with the three datasets.

Triangulation and integration

To enhance credibility and depth, triangulation was applied across lesson plans, teacher reflections and focus group transcripts. NVivo’s matrix coding and cross-tabulation tools enabled systematic comparisons, revealing both convergence and divergence in themes such as student-generated examples, teacher confidence and instructional adaptation. Divergent findings were not treated as anomalies but explored through cross-case comparisons and analytic memos to uncover contextual influences shaping individual experiences.

Integration synthesized these insights into a coherent narrative aligned with the study’s research questions. Themes were refined to reflect their presence across multiple data types, and illustrative excerpts were selected to highlight diverse perspectives. NVivo’s concept-mapping tools supported the visualization of thematic relationships, facilitating a holistic understanding of how LGE shaped instructional practice and teacher learning.

Rather than seeking consensus, the analysis embraced variation as a reflection of the dynamic nature of pedagogical adaptation in under-resourced, culturally rich school settings. [Table 3](#) presents the triangulation framework.

Researcher reflexivity and trustworthiness

The principal investigator served as both the PD facilitator and the researcher, a position that enabled sustained engagement but also introduced the potential for bias. Consistent with [Lincoln and Guba’s \(1985\)](#) framework for qualitative trustworthiness, strategies were employed to support credibility, dependability and confirmability, including ongoing reflexive and analytic memo writing, triangulation across lesson plans, teacher reflections and focus group data, anonymization of all data prior to analysis and systematic documentation of analytic decisions to establish an audit trail ([Lincoln & Guba, 1985](#); [Tracy, 2010](#)).

Table 2. Sample coding structure used in thematic analysis across data sources

Excerpt	Data source	Initial code	Focused category	Theme
Identify and draw two items that could be better measured using grams	Lesson Plan	Student-generated examples	Prompting student-generated examples	Intentional Design for Student-Generated Examples
It is becoming a bit easier for me to allow my students to come up with their own examples. . .	Teacher Reflection	Teacher confidence	Growing teacher confidence	Evolving Teacher Identity and Confidence
The students almost become part of the teachers. . . you are guiding them. . .	Focus Group Transcript	Teacher as facilitator	Repositioning teacher role	Repositioning the Teacher as Facilitator
“What does the plus sign remind you of?” (linked to the cross of Christ)	Lesson Plan	Faith-based context	Integration of faith-based scenarios	Integration of Real-World and Faith-Based Contexts
I underestimated my children. . . I never expected that this was from that	Focus Group Transcript	Student creativity	Unearthing student potential	Recognition of Student Potential and Creativity
Source(s): The author’s own work				

Table 3. Triangulation and integration of themes across data sources

Theme	Lesson plans	Teacher reflections	Focus group	Integration summary
Intentional Design for Student-Generated Examples	Included prompts for students to create their own examples (e.g. measuring items using grams)	Described growing comfort with allowing students to generate examples	Discussed how students took ownership of learning through example creation	Theme confirmed across all sources, showing a shift toward student-centered instruction
Evolving Teacher Identity and Confidence	Progressive inclusion of open-ended tasks and student-led activities	Narratives highlighted increased confidence in facilitating student inquiry	Teachers expressed feeling more like facilitators than instructors	Consistent evidence of professional growth and role redefinition
Integration of Real-World and Faith-Based Contexts	Used contextual examples tied to local culture and Christian values	Reflected on the value of connecting math to students' lived experiences	Shared strategies for embedding moral and spiritual themes in lessons	Theme emerged strongly in lesson plans and was reinforced by reflective and dialogic data
Recognition of Student Potential and Creativity	Tasks encouraged exploration and multiple solution paths	Noted surprise at students' creativity and engagement	Teachers acknowledged underestimating students' capabilities	Theme highlighted across sources, emphasizing shifts in teacher expectations

Source(s): The author's own work

To further enhance credibility, member checking was conducted following initial thematic analysis. Teachers reviewed written summaries of emergent themes, along with illustrative excerpts from their contributions and were invited to confirm accuracy, clarify interpretations and provide additional context. Feedback was incorporated into subsequent analysis, supporting interpretive validity and ethical representation of participants' perspectives. In line with qualitative best practice, member checking functioned as a dialogic process rather than a mechanism for consensus (Creswell & Poth, 2018; Lincoln & Guba, 1985).

Results

The results section presents four interrelated themes derived from lesson plans, teacher reflections and focus groups, illustrating how LGE influenced instructional practice, teacher identity and student engagement. These themes align with SCT and CRT. Table 4 maps themes to research questions with supporting interpretive notes.

Although the study involved a small number of participants (six teachers) and instructional artifacts (26 lesson plans), the dataset was dense and multi-sourced, enabling robust cross-case and within-case analysis. Patterns associated with each theme recurred across multiple teachers, grade levels and data sources, including lesson plans, written reflections and the focus group discussion. Analytic sufficiency was reached when successive reviews yielded no substantively new dimensions of instructional practice or teacher response.

Theme 1: Intentional design for LGE

central instructional pattern evident across the dataset was teachers' intentional design of mathematics lessons that prompted students to generate their own mathematical examples. The lesson plans analyzed featured open-ended prompts requiring learners to construct, justify and reflect on examples, indicating an instructional commitment to LGE as a learner-centered practice rather than reliance on teacher-provided demonstrations.

Table 4. Linking research questions to emergent themes with interpretive notes

Research question	Emergent theme	Interpretive notes
How do elementary school teachers conceptualize and implement the strategy of exemplification in mathematics instruction?	Intentional Design for Student-Generated Examples	Teachers shifted from teacher-led demonstrations to student-generated examples, reflecting a conceptual and practical embrace of exemplification as a learner-centered strategy
	Integration of Real-World and Faith-Based Contexts	Teachers embedded cultural and spiritual references into math tasks, showing how exemplification was adapted to affirm students’ identities and make learning more relevant
What instructional shifts and reflective practices emerge as teachers engage with exemplification in resource-constrained, faith-based classrooms?	Evolving Teacher Identity and Confidence	Teachers redefined their roles from knowledge providers to facilitators, demonstrating increased confidence and reflective practice aligned with sociocultural learning principles
	Recognition of Student Potential and Creativity	Teachers began to recognize and value students’ creative capacities, reflecting a shift in expectations and deeper engagement with culturally responsive pedagogy
What challenges do teachers encounter when implementing exemplification, and what strategies do they use to navigate these challenges?	Evolving Teacher Identity and Confidence	Teachers initially expressed discomfort and uncertainty, but navigated these challenges through collaborative planning, reflection, and the gradual release of control to students
	Intentional Design for Student-Generated Examples	Strategic lesson planning and scaffolded prompts enabled teachers to overcome resource limitations and effectively support student inquiry
Source(s): The author’s own work		

Across grade levels, teachers positioned students as active contributors to mathematical meaning-making through task design. In a Grade 3 measurement lesson, students were asked to “identify and draw two items that could be better measured using grams” and justify their choices. In Kindergarten, learners generated “one pair of number bonds of 8” and later identified “three numbers that make 8,” illustrating how example generation was adapted to developmental level while maintaining a consistent emphasis on learner construction.

Lesson enactment revealed that designing for LGE involved practical constraints that shaped instructional decisions. Teachers reported that open-ended example generation sometimes disrupted lesson flow or exceeded students’ readiness, particularly within fixed curricular timeframes. One teacher noted, “I spent too long trying to get the students to come up with examples, and we did not finish the lesson,” highlighting tensions between open-ended inquiry and pacing demands. Other teachers observed student hesitation or reliance on confirmation, indicating the need for additional structure within tasks.

In response to these challenges, teachers adjusted lesson design by refining prompts, narrowing task parameters, incorporating peer collaboration and adding scaffolds to support student participation.

Theme 2: Evolving teacher identity and confidence

Teachers’ accounts of their engagement with LGE foregrounded facilitation of student inquiry rather than exclusive reliance on knowledge transmission, reflecting how they understood and

enacted their instructional roles during implementation. Lesson plans featured open-ended tasks, collaborative problem-solving and prompts that elicited student reasoning, aligning classroom practice with learner-centered pedagogy.

Teachers consistently described this instructional orientation as professionally demanding, emphasizing the emotional and cognitive labor required to sustain it. Reflections frequently referenced uncertainty, vulnerability and discomfort as they navigated unfamiliar pedagogical expectations. One teacher noted, “I was nervous. . . but I liked the energy in the classroom,” while another reflected, “I need to practice this teaching technique more. . . I hope my students will perform better,” highlighting that valuing LGE did not immediately translate into confidence.

Several teachers elaborated on this tension by likening their experiences to being repositioned from experts to novices. As one explained, “I felt like I was back at teacher training. . . having to think through what the children might do and how I would respond,” underscoring the combined cognitive and emotional demands of anticipating diverse student-generated examples while relinquishing control over lesson trajectories. These accounts reveal how emotional labor was embedded in teachers’ ongoing negotiation of authority, expertise and responsiveness.

Negative cases further illustrate that teachers’ engagement with LGE was not uniformly empowering. Teachers described moments when unexpected student responses disrupted instructional plans, creating doubt about how best to balance responsiveness, pacing and mathematical accuracy. One admitted, “I wasn’t sure how to respond when students gave unexpected examples, it threw me off,” noting occasional reversion to more directive approaches in such moments.

Despite these challenges, teachers did not frame discomfort as failure. Instead, uncertainty was described as an expected feature of working with open-ended pedagogy. Focus group discussions highlighted the patience and adaptability required when students assumed more central roles in knowledge construction. As one participant observed, “You have to think of all the different kinds of ways to turn to try to get the child to get the answer. . . and that is patience,” while another noted, “The students almost become part of the teachers. . . you are guiding them,” indicating an understanding of instructional authority as relational and situational rather than fixed.

Theme 3: Integration of real-world and faith-based contexts

Teachers’ engagement with LGE was closely intertwined with efforts to integrate real-world and faith-based contexts into mathematics instruction. Across lesson plans and reflections, teachers intentionally drew on students’ cultural, community and spiritual experiences to frame mathematical concepts, positioning LGE as a vehicle for culturally responsive pedagogy that rendered abstract ideas more meaningful and affirmed students’ identities within a faith-based learning environment.

Lesson plans revealed creative integrations of mathematical concepts with spiritual and moral themes familiar to students. In a Grade 3 addition lesson, students linked the plus sign to “the cross of Christ.” In a Grade 6 division lesson, equal sharing was framed through scripture, with a teacher noting that “God cautions us about sharing unequally. . . He wants us to be fair.” In Kindergarten, comparing spiders and insects led to the reflection that “spiders help protect us just as God protects us from evil every day.” These examples illustrate how teachers used learner-generated contexts to situate mathematics within students’ lived and spiritual realities.

Teachers reported perceiving heightened student engagement and understanding in lessons where such integration occurred. One reflected, “I enjoy using this method. . . I am able to see a deeper level of understanding from my students,” while another observed, “Students made real-life connections. . . they were excited to weigh their objects and talk about items they buy in kilograms.” These accounts suggest that culturally and spiritually grounded LGE served as a pedagogical bridge between formal mathematics and everyday meaning-making.

However, integration was neither seamless nor uniformly successful. Several teachers expressed uncertainty about how faith-based references might be perceived by external stakeholders. One admitted, “I was not sure if linking math to scripture would be seen as appropriate by external reviewers,” revealing tensions between culturally affirming practice and institutional accountability. Others noted that not all topics readily lent themselves to spiritual connections, resulting in uneven integration across grade levels and content areas. In such cases, teachers relied more heavily on real-world examples connected to commerce, measurement, or household practices.

Theme 4: Recognition of student potential and creativity

Teachers described LGE as reshaping how they attended to students’ mathematical ideas during lessons involving open-ended example generation, prompting closer attention to students’ choices, representations and explanations in instructional interactions. Classroom tasks provided students with opportunities to express their thinking through multiple representations and solution pathways, which teachers interpreted as evidence of creativity and sense-making. For example, in a Grade 6 fractions lesson, students used “fraction pies and fraction walls to generate and represent equivalent fractions,” while a Grade 2 statistics lesson invited learners to “collect, categorize, and interpret data about shoes and school bags.” In reflecting on these activities, teachers foregrounded students as active contributors to mathematical reasoning rather than as recipients of procedural instruction.

Teachers’ interpretations of these instructional moments were most visible in their reflections, which frequently expressed surprise and affirmation. One teacher noted, “I underestimated my children. . . I never expected that this was from that,” while another observed, “The students were excited to come up with as many examples as possible.” A particularly striking reflection illustrated how teachers recalibrated their attention to students’ contributions: “One child who does not normally get it was able to answer when the one who always talks did not. . . that was satisfying.” These accounts highlight how LGE shaped teachers’ perceptions of whose ideas counted in mathematical activity, rather than indicating changes in students’ underlying abilities.

At the same time, teachers described uneven student comfort with the demands of LGE, including hesitation and difficulty generating examples independently. These responses shaped how teachers interpreted student participation, leading them to employ strategies such as strategic pairing, sentence starters and explicit validation of partial or unconventional contributions. Focus group discussions illustrated how teachers made sense of this variability, reflecting both surprise and ongoing uncertainty about student readiness. As one teacher explained, “Sometimes we underestimate our children. . . we never expect that this was from that,” while another noted, “When you help them to create certain things from themselves. . . they can then transfer what they used to create to solve similar problems.” Taken together, these reflections underscore that teachers’ recognition of students’ potential was neither uniform nor predetermined but emerged through interpretive tension as they navigated uneven engagement, uncertainty and moments of insight.

Discussion and conclusion

This study examined how six elementary teachers in an under-resourced, faith-based Caribbean school conceptualized, implemented and reflected on LGE as a strategy for equitable mathematics instruction. Interpreted through SCT and CRT, the findings position LGE as a pedagogical catalyst that shaped instructional orientation and practice while simultaneously surfacing emotional, professional and institutional tensions. Rather than functioning as a seamless instructional solution, LGE emerged as a generative yet demanding practice whose effectiveness depended on responsive scaffolding, teacher judgment and sensitivity to contextual constraints.

LGE as generative mathematical practice

The findings affirm and extend [Watson and Mason's \(2005\)](#) conceptualization of LGE as a generative mathematical activity rather than procedural reinforcement. Teachers' task design emphasized opportunities for students to construct, vary and justify examples, orienting classroom activity toward sense-making and attention to mathematical structure. This emphasis aligns with research on example spaces, which foregrounds variation and boundary testing in conceptual understanding ([Zazkis & Leikin, 2007](#)), and with studies showing that example construction can support deeper reasoning when tasks are deliberately framed and mediated ([Breen & O'Shea, 2019](#)).

At the same time, uneven enactment across classrooms highlights the context-sensitive nature of LGE. Student hesitation, resistance to open-ended tasks and pacing constraints suggest that example generation alone does not ensure conceptual gain, aligning with [Iannone et al.'s \(2011\)](#) emphasis on the need for scaffolding and epistemic framing. This study extends that work by demonstrating contextual divergence: unlike the structured, proof-focused settings examined by [Iannone et al. \(2011\)](#), the challenges observed here were intertwined with material constraints, school norms and elementary learners' readiness for open-ended participation. In this under-resourced Caribbean context, LGE's effectiveness depended not only on cognitive scaffolding but on teachers' real-time negotiation of time, curriculum demands and student confidence, indicating that its generative potential is mediated by broader institutional and cultural conditions.

Sociocultural mediation and the teacher as facilitator

The pedagogical practices documented in this study are well explained through SCT, particularly [Vygotsky's \(1978\)](#) concept of the ZPD, in which learning is mediated through interaction, dialog and guided participation. Teachers' facilitative roles in LGE functioned as forms of sociocultural mediation, supporting collaborative inquiry and the co-construction of mathematical meaning in classroom interactions.

Importantly, this mediation extended to teachers' own professional learning. Teachers' uncertainty and experimentation are better understood not as instructional weakness, but as learning within a *professional* ZPD, where sense-making occurs through negotiation and reflection ([Lambright, 2024](#)). Sociocultural research on teacher development similarly emphasizes that inquiry-oriented practice involves iterative adjustment rather than immediate mastery ([Abakah, 2023](#)). Within this study, facilitation emerged through ongoing reflection and responsiveness to student thinking, highlighting professional learning as relational, non-linear and central to sustaining equitable mathematics instruction.

Emotional labor and teacher identity transformation

A central contribution of this study is its illumination of the emotional labor involved in implementing LGE. Teachers' reflections describe vulnerability, anxiety and self-doubt as they relinquished instructional control and navigated unpredictable student responses. These experiences align with [Kelchtermans' \(2019\)](#) characterization of emotional labor as intrinsic to teaching, particularly in reform contexts that challenge established norms of authority and expertise.

From a critical perspective, emotions are socially and institutionally produced rather than purely individual responses ([Zembylas & Schutz, 2016](#)). In this context, emotional labor was intensified by structural conditions such as rigid pacing expectations, assessment demands and limited planning time; pressures widely documented in research on teacher identity and resilience under reform ([Yin, Huang, & Lv, 2022](#)). Teachers' sense of professional confidence was described as emerging through sustained engagement with these emotional demands, positioning emotional labor as a central component of professional learning rather than an unintended byproduct.

This study reframes prior findings on example generation by situating them within the affective and professional dimensions of teaching. While [Iannone et al. \(2011\)](#) emphasize scaffolding as a matter of task structure and epistemic clarity, the present findings highlight a complementary, underexplored dimension: The emotional labor required to enact such scaffolding in resource-constrained contexts. Teachers' uncertainty, vulnerability and instructional disruption indicate that implementing LGE involves not only designing tasks but also managing the affective risks of relinquishing control and responding to unpredictable student thinking. Thus, the divergence from prior work lies not in questioning the importance of scaffolding but in showing that its enactment is inseparable from teachers' emotional and identity work, particularly where institutional supports are limited.

These findings underscore that equity-oriented pedagogies, such as LGE, require both affective and technical support, particularly in under-resourced educational settings, where, as noted in prior research, scaffolding demands are enacted through sustained emotional and professional labour.

CRT and faith-based integration

Teachers' integration of real-world and faith-based contexts into mathematics instruction reflects core principles of CRT, particularly the validation of students' identities, experiences and community knowledge ([Gay, 2010](#)). Through LGE, teachers embedded spiritual analogies and culturally meaningful scenarios into mathematical tasks, positioning mathematics as connected to students' lived realities and aligning practice with CRT emphases on identity affirmation and epistemic inclusion ([Aguirre et al., 2024](#)).

At the same time, teachers' concerns about external scrutiny and curricular legitimacy highlight a critical insight from CRT scholarship: Culturally responsive pedagogy requires institutional permission to be sustainable ([Abdulrahim & Orosco, 2020](#)). Research on mathematics learning as identity work similarly shows that when institutional expectations conflict with community-based knowledge, teachers must exercise ongoing professional judgment ([Soini et al., 2020](#)). In this study, LGE served as a site of such judgment, where teachers navigated the tension between cultural affirmation and accountability, underscoring that equity-oriented teaching involves negotiated practice rather than straightforward enactment.

Recognition of student potential and asset-based pedagogy

Teachers described LGE as prompting greater attention to students' mathematical ideas and contributions and challenging deficit-based assumptions about students' capabilities. In teachers' accounts, noticing student creativity and sense-making aligned with asset-based perspectives in mathematics education, which foreground students' intellectual resources rather than perceived shortcomings ([Charalambous, 2026](#)). Expressions of surprise at student contributions illustrate how procedural instruction can narrow what teachers attend to, whereas generative tasks broaden opportunities to recognize students as capable mathematical thinkers.

At the same time, teachers described this recognition as uneven and contingent on instructional support. Student hesitation, uncertainty, or reluctance to share ideas shaped how teachers interpreted participation and prompted deliberate scaffolding, reassurance and instructional adjustment. Research on mathematical agency similarly emphasizes that creativity and ownership require sustained support rather than episodic opportunities ([Boaler, 2016](#); [Louie, Adiredja, & Jessup, 2021](#)). Taken together, these findings position asset-based pedagogy not as a guaranteed outcome of LGE, but as an ongoing interpretive practice through which teachers exercise professional judgment to recognize and respond to students' mathematical participation.

Transferability to Global South contexts

Although this study is situated in a single Caribbean faith-based school, the professional and instructional tensions it highlights between learner-centered pedagogy and accountability, and

between cultural relevance and curricular rigidity, are characteristic of many education systems across the Global South. Comparative research documents similar challenges in implementing inquiry-oriented pedagogy within resource-constrained environments (Schweisfurth, 2021), while scholarship on postcolonial schooling emphasizes that pedagogical reform is mediated by historical, cultural and institutional forces rather than by universally applicable models (Crossley & Watson, 2018).

Rather than offering generalizable claims, this study contributes conceptual insights into how LGE is mediated through teacher judgment, emotional labour and institutional negotiation in culturally rich, under-resourced settings. It is these recurring processes, rather than specific practices or outcomes, that may resonate with educators and researchers working in faith-based and community-rooted schools across Sub-Saharan Africa, South Asia and Latin America, where similar structural conditions shape the possibilities and limits of equitable mathematics instruction.

Limitations

The findings of this study should be interpreted in light of several limitations. First, the single-site, short-duration design constrains the kinds of claims that can be made about the sustainability of instructional practices over time. The two-month implementation period captured early experimentation and adaptation rather than long-term consolidation, meaning the findings illuminate situated practices and sense-making rather than stable pedagogical outcomes.

Second, the absence of systematic student voice limits conclusions about learners' perspectives and experiences of LGE. While teachers' reflections provide important insight into instructional practice and professional learning, future studies incorporating student perspectives would deepen understanding of how LGE is experienced and interpreted by those most directly affected.

Third, the dual role of the researcher as PD facilitator introduces the possibility of proximity bias. Although this was mitigated through reflexive memoing, data triangulation and member checking, researcher positioning may have influenced participants' responses or interpretations. These limitations do not diminish the study's contribution; rather, they clarify the analytic boundaries within which the findings offer credible, contextually grounded insight.

Directions for future research

Future research should build directly on the pedagogical tensions and affordances identified in this study. Longitudinal inquiry represents a priority, as studies tracking teachers' use of LGE over extended periods could clarify whether early uncertainty and calibration become sustained instructional practice. Comparative research across faith-based and non-faith-based schools would further illuminate how institutional culture and accountability structures shape the enactment of LGE.

Additional research foregrounding student perspectives is also needed, particularly in under-resourced contexts. Examining how learners experience, interpret and respond to example-generation tasks would extend understanding of LGE's implications for mathematical identity and agency. Finally, realist and design-based methodologies could examine how LGE may be scaffolded within constrained curricular environments, offering practical guidance for supporting equity-oriented mathematics pedagogy across diverse Global South contexts.

Conclusion

This bounded qualitative case study shows that LGE, as described by teachers, functions not as a technical instructional technique but as a relational and intellectually demanding practice

that shapes teaching, learning and professional identity. When thoughtfully scaffolded, LGE supported student agency, challenged deficit-based assumptions and expanded opportunities for conceptual sense-making. However, these possibilities were negotiated through pedagogical risk-taking and ongoing engagement with curricular, institutional and cultural constraints.

By centering teacher voice within an under-resourced, faith-based Caribbean elementary school, the study extends LGE research by foregrounding the conditions under which its generative potential can, and cannot, be realized. The findings indicate that LGE is most productive when accompanied by responsive scaffolding, institutional flexibility and attention to the emotional dimensions of teaching. Although situated within a single site, these insights resonate with broader Global South contexts, underscoring that equity-oriented mathematics pedagogies require deliberate professional and institutional support to be enacted and sustained responsibly.

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