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Leveraging on Pedagogical Potential of Scriptwriting in Mathematics Classroom among Prospective Teachers in Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria

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Abstract
This paper explores the pedagogical potential of scriptwriting in mathematics classroom, drawing insights centered around the concept of number line from prospective teachers. 30 prospective teachers enrolled in National Certificate of Education (NCE) II from Waziri Umaru Federal Polytechnic Birnin Kebbi, Kebbi State, Nigeria were used for this study. The study positions scriptwriting as a transformative instructional strategy that bridges abstract mathematical concepts with real-life applications through the Gradual Release of Responsibility (GRR) model using the phrases: "I do, we do, and you do" to deliberating the use of number line to generate multiplication table via skip-counting. The study highlights the purpose of scriptwriting in mathematics classroom, then uses the acronym "MATH S-C-R-I-P-T" to suggest a concise procedure for writing a mathematics dialogue, and also demonstrates a real-time assessment of a sample fictional dialogue involving two skeptical peers using the Knowledge Quartet (KQ) dimension contributory codes as an observation card. The findings feature scriptwriting as a reflective and diagnostic tool for cultivating creativity, critical thinking, communication and instructional design skills. Additionally, scriptwriting offers a dynamic approach to traditional instructions by engaging prospective teachers with a form of dramatized imaginary conversational exchange adequate for enhancing mathematical, and pedagogical content mastery of prospective teachers.

Keywords: Scriptwriting, Number line, Skip-counting, Pedagogy, Math-Script.

Introduction
In the evolving landscape of mathematics education, integration of creative teaching strategies has become central to fostering student's engagement. One such strategy gaining traction is the use of scriptwriting. Scriptwriting often referred to as lesson-play or teaching simulation (Kar, Ozturk, Ocal & Ozkaya, 2025) has been used as a valuable teaching strategy and a research tool in several contexts that enable teachers to rehearse pedagogical moves and reflect on their instructional decisions in an imaginative format (Zazkis, Sinclair & Liljedahl 2013; Zazkis & Zazkis, 2014). In this technique participants are asked to write imaginary interaction between a teacher and his students in form of a lesson-play, this expanded overtime to include classroom activities that describes dialogue between characters to resolve a problematic situation, a disagreement, a student error or inappropriate reasoning (Kar et al., 2025). Scriptwriting serves as a medium for assessing prospective teachers understanding, knowledge and teaching skills in mathematics classroom (Herbst & Milewski 2018; Kontorovich 2018; Dahl, Enge, Hensen & Valenta 2019; and Arnesen & Valenta, 2023). To this end, Dahl et al. (2019) considers scriptwriting suitable for prospective teaching experiences. Script writing is taking an idea and making it into a story that will be realized in action and dialogue (Frank 2006). Zazkis et al. (2013) sees scriptwriting as a tool for advancing prospective teachers' knowledge in mathematics, the researchers argued that the advancement is expected to grow through structured prompts (in this case the scripted dialogue) designed to address challenges in mathematics content and pedagogy. Scriptwriting is worthy of use in this research as it provides insights into participants pedagogical potentials. The study was guided by a research question asking; What insights about pedagogical knowledge can be gained from analyzing prospective teachers' script in Birnin Kebbi, Kebbi State, Nigeria?

Literature Review
Purpose of Scriptwriting in Mathematics Classroom
In line with the Zazkis & Zazkis (2014); Dahl et al (2019); Krecher & Zazkis (2024), scriptwriting seeks to influence mathematics classroom in the following manner:

1. Deepen students understanding as they struggle to break-down and resolve mathematics problems whilst confronting and correcting misconceptions

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2. Builds communication skills in an attempt to transform mathematics ideas into fictional story circles.
3. Envision student's creativity in their bid to creating meaningful learning experience.
4. Promotes pedagogical skills by offering avenue for simulating classroom realities.
5. Makes abstract mathematics concepts more relatable whilst confronting and correcting misconceptions
6. Serve as a means for assessing participants' pedagogical and mathematical content knowledge.

Procedure for Writing a Mathematics Script

The current study uses the acronym "MATH S-C-R-I-P-T" to suggests a framework that supports meaningful learning experience in mathematics classroom and guides the writing process of a creative and concise mathematics dialogue, these includes:

MATH: Make Abstract Thinking Human

Purpose: Use analogy, diagram or manipulative to connect Mathematics idea to everyday experience.

Example: Draw a simple line on a piece of paper; label from -5 to 6. Try adding 2 + 3; start at 2, count right 3 units to 5. For subtraction, like 4 – 6; start at 4, count left, 6 units to – 2. This demonstrates addition and subtraction of numbers in real life.

S: Select a concept

Purpose: Select a mathematics concept to be explored in line with curriculum whilst clearly emphasizing the behavioral objectives to be attained.

Example: Basic Arithmetic (Generate the multiplication table using the number line)

C: Create characters

Purpose: Assign roles to represent diverse viewpoints in line with the adopted script format. Dialogue between Skeptical peer, teacher – curious explainer, role play, etc.

Example: "*Abdu and Meri are two skeptical peers deliberating the use of number lines to generate the multiplication table.*"

R: Raise a conflict

Purpose: Introduce a challenge, argument, or disagreement that require mathematical reasoning to resolve.

Example: "*Abdu claims that multiplication table can be generated from the number line. But Meri disagrees and ask for a clear demonstration.*"

I: Investigate solutions

Purpose: Let characters explore, reason and solve the problems. Encourage them to explain their thinking in writing.

Example: "*Abdu: By skipping one place (forward jump) on the number line, multiplication table of 2* x *1 is generated.*"

P: Probe the procedure

Purpose: Use questions and justifications to guide the dialogue while integrating misconceptions and corrections to support deeper understanding.

Example: "*Meri: Why skip numbers instead of just move sequentially? Abdu: Skip-counting is the building block for multiplication (forward jumps) and division (revers jumps). E.g., for 2* x *3, we skip one place three times to land on 6.*"

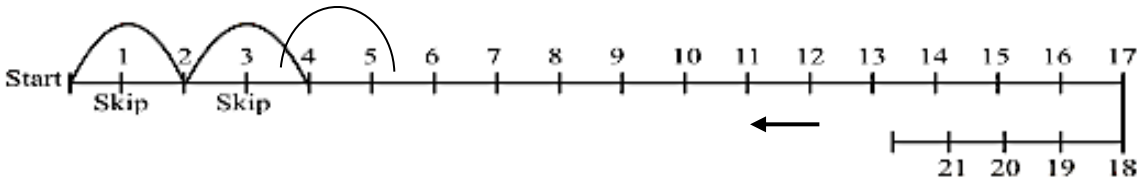

Figure 1: Number line showing skip-counting

Source: Sani, Sani, Abdullahi & Bayaro (2023)

T: Tie-up with reflection

Purpose: End with a clear reflection, insight or new question that reinforces the learning objective

Example: "*Meri: Wow, what happens if I want to generate five times table, how many numbers must I skip? Abdu: You skip four places on the number line, to generate the multiplication table of five.*"

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Review of Related Studies

Zazkis & Zazkis (2014) reveal that scriptwriting encourages active engagement, foster mathematical content knowledge and pedagogical skills of prospective teachers. Additionally, the authors advocate the use of scriptwriting to improve prospective teachers' pedagogical skills. Dahl et al. (2019) define lesson plays as scripted, imagined classroom conversation between a teacher his students. Their findings reveal that lesson plays foster prospective teachers conceptual understanding and professional knowledge for teaching mathematics. In another study Krecher & Zazkis (2024) suggests that scriptwriting promote deep reflection, reveal conceptual gaps and fosters pedagogical creativity. It could be deducted from the foregoing that a number of studies have investigated the use of scriptwriting in mathematics classrooms. Qualitative research design was employed to interpret content knowledge and pedagogical development of prospective teacher. The researchers analyze the content and structure of the scripted dialogue using thematic interpretations to identify pedagogical skill and the four-knowledge quartet to understand pedagogical development of each participant. Obviously, the literatures reviewed present the written scripts as a form of conversational exchange that involves at least two characters; dialogue between students, teacher-student interaction, and role-play. Benefits drawn from the content, structure, and characters of the scripted dialogue as well as the methodology of the reviewed literatures were used as a guide in the present study. However, the present study identifies and demonstrates in real-time the procedure for writing a mathematics script.

Theoretical Framework

Effective teaching is a dynamic interplay between instructional design and pedagogical content knowledge. In exploring the complexities of classroom dynamics, this study draws upon two complementary theoretical frameworks: The gradual release of responsibility model and the Knowledge quartet. Together, these, frameworks provide a robust lens for examining how to scaffold learning.

The Gradual Releases of Responsibility (GRR) Model

The study adopts the Gradual Release of Responsibility (GRR) model refined by Douglas Fisher and Nancy Frey to execute this study, which is deeply rooted in scaffolding theory developed by constructivists like of Lev Vygotsky and Jerome Bruner. To them, scaffolding describes how teachers support students just enough to help them succeed, then gradually remove the support as they become efficient. This gradual shift is designed to build learners confidence, competence, and independence in the classroom. The GRR model was coined using the phrases: "I do, we do, and you do" to describe how teacher can slowly shift the engagement of learning from the teacher to his students, can be integrated into scriptwriting through giving students chance to watch as passive observers and listeners (where teacher demonstrate how to do something), then working alongside the teacher with less support (where teacher and students do it together), and finally to the point of allowing student to work independently taking full ownership of the learning experience (student try it on their own).

The Knowledge Quartet Framework

The Knowledge Quartet (KQ), developed by Rowland, Huckstep Thwaites (2005) emanates from Shulman's (1986) concept of Pedagogical Content Knowledge (PCK), which emphasize the importance of blending content knowledge with effective pedagogical strategy (Dahl et al. 2019). The KQ extends PCK in practice by offering a robust practical tool for analyzing and developing mathematics teaching in real-time via teacher's knowledge, based on the belief that subject matter knowledge must be complemented with effective teaching strategies in mathematics classroom (Rowland et al. 2005). The KQ framework highlight how teachers utilize their knowledge in classroom through four interrelated dimensions: Foundation, Transformation, Connection, and Contingency). *Foundation dimension* denotes the prospective teacher's math knowledge, pedagogical awareness and understanding of the curriculum (i.e., knowledge acquired through educational training). *Transformation dimension* denotes ability to breakdown, modify, or convert foundational knowledge to meet the learners needs using examples, analogies, and demonstrations. *Connection dimension* highlights the ability to articulate logical relationship (prior-new, complex-simple or abstract-concrete) concerning the transformed knowledge through relationships and representations. *Contingency dimension* being the final, reflects prospective teachers' responsiveness to unexpected classroom events demanding revised explanation, this could be through questioning or while correcting student errors and misconceptions.

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The Sample Study

In this study, a sample script was presented to give an idea about how the data would be analyzed. The MATH-Script procedure was employed to consider conversation between two curious characters with respect to number line. To create a dialogue between the characters the script writers have to assume each role, and present or interact from the perspective of the diverse characters. The topic focused on generating the multiplication table through skip counting on the number line. In particular, the participants were introduced to the method of skip counting that is to say if "n" is a positive integer, we skip count (n – 1) times from left to right (forward skipping) starting at zero on the number line to illustrate the Multiplication of numbers. On the other hand, we can also skip (n – 1) times from right to left (reverse skipping) starting from a given number to illustrate the Division of numbers using the number line. It is worthy of note that "n" in the case of Division is the divisor. So, for 6 ÷ 2 "6" is called the dividend and "2" the divisor we have, (2 – 1) = 1. This means (reverse skipping) one place starting from "6". A script of dialogue between these two characters that include exchange of their viewpoints was prepared. Consider the examples, experience or patterns they both used to convince each other that led Abdu to his conclusion. The paper annotates the script and analyzed the argument between the characters using the knowledge quartet dimensions contributory codes observation rubric.

Abdu and Meri are two skeptical peers deliberating the use of number lines to generate the multiplication table. Abdu claims that multiplication table can be generated from the number line. But Meri disagrees.

I DO: Teacher demonstrate how to do something

1. Abdu: Claim multiplication table can be generated from a number line.
2. Meri: Can you give me an example?
3. Abdu: By skipping one place on the number line, multiplication table of 2 will be generated.
4. Meri: How is that possible, now that we don't have a number line chart?
5. Abdu: No problem, we can improvise and draw one together.
6. Meri: What do you mean by that, and why skipping instead of just moving sequentially along the number line?
7. Abdu: Skip-counting is the building block for multiplication (forward jumps) and division (revers jumps) e.g., for 2 x 3, we skip one place of size three to land on 6. So, sequential movements (to-and-fro) demonstrate addition or subtraction.
8. Meri: How do you mean, we skip one place of size three, and how does that even align with 2 x 3?
9. Abdu: Okay, how many jumps did you take, what is the size of the jump, and what does that lead you to?
10. Meri: I take one jump and skip three places, from zero to land on 4
11. Abdu: Oh no Meri...! by skipping one place three times (of size three), you are required to skip one place three times, from 0 you skip one place to rest on 2, skip one place again from 2 rest on 4, and skip one place again from four to finally land on 6 three jumps in total)
12. Meri: Wow, it appears to be so interesting and in line with 2 + 2 + 2 or two rows of three...!
13. Abdu: Really, oya tell me how does the array (two-rows of three) and (2 + 2 + 2) match skip-counting on the number line?
14. Meri: Two-rows of three items represents counting every item in row one and row two, 2 + 2 + 2 means adding 2 three times, which matches making three jumps of 2 units on the number line.
15. Abdu: Brilliant, how many numbers must I skip in order to generate the five times table on the number line?
16. Meri: You skip four places, if you want to construct the multiplication table of five.
17. Abdu: Astonishing, what if I want to construct the multiplication table of one?
18. Meri: I guess we don't skip any place; we just move around sequentially from place to place for the said number of times for 1-times table.
19. Abdu: Ahh, it works. I have noticed a pattern, while constructing the multiplication table, we are skipping one less than the element we are generating for (n – 1).

WE DO: Teacher and learners work on it together

20. Meri: Exactly…! you are on point Abdu, but I am curious whether this trick is true for Division.

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21. Abdu: Sorry Boss, I don't think the trick will work for division of numbers. Besides, how do we skip-count in the case of division?
22. Meri: I don't know, how about we skip-count in the opposite direction since multiplication is the reverse of division.
23. Abdu: Hmm… that's an interesting thought, Meri. I don't have that in mind today, but let's test 6 ÷ 2 and see even though it appears somewhat challenging. But then how do we resolve (n – 1) in this instance?
24. Meri: It is worthy of note that "n" in the case of Division is the divisor. So, for 6 ÷ 2 "6" is called the dividend and "2" the divisor we have, (2 – 1) = 1.
25. Abdu: Oh…, This means (reverse skipping) one-one places starting from "6".
26. Meri: Wonderful, this makes so much sense. For 6 ÷ 3 we skip 2 places and for 6 ÷ 6 skip 5 places all in reverse starting from the number "6" on the number line.
27. Abdu: Truly Meri; I'm now convinced that division of numbers can also be illustrated using the number line through skip counting.
28. Meri: Sure Abdu, I'm really glad that you challenged me when I first suggested that and I think it is safe to say that appropriate use of the number line eases multiplication and division.

YOU DO: Learners recreate it on their own (Assessment)

29. Teacher: Prepare a mathematics script between two skeptical peers to deliberate the use of addition and subtraction centered around the concept of number line.

The above task is a strong example of how prospective teachers can use creative methods like the scriptwriting to explore and express their knowledge of mathematics and pedagogical practice.

Table 1: The KQ Observation Rubric for Scriptwriting Assessment

Dimension	Contributory Codes	Evidence	Insight/Rating (S/W/N)
Foundation	Awareness of purpose	1, 26	Aims to build beyond rote Memorization(S)
	Adherence to textbook	3 – 26	Demonstrate awareness of curriculum and level appropriateness (W)
	Concentration to procedures	5	Emphasizes stepwise approach to problem solving(S)
	Overt display of subject knowledge	11, 19	Reflect clear understanding of mathematical procedure (S)
	Theoretical underpinning of pedagogy	24	Reflects understanding & development of numerals (S)
	Use of terminology	7, 18	Reflect understanding of mathematical vocabularies. (W)
	Identifying errors	8	Spotting reasoning or notation misuse for apt intervention (W)
Transformation	Communication	12, 14	Clear/accurate expression of mathematical ideas (S)
	Choice of examples	5, 13, 15, 18-22	Use of appropriate and purposeful examples to express math ideas (S)
	Choice of representation	12 – 14	Refers to effective use of different models to express a concept (S)
	Use of instructional materials	5, 7, 9, 12, 14, 22 16	Physical/digital tools used to deliver the chosen representation (S)
	Teacher/Learner demonstration (to explain a procedure)	5, 7, 9, 12, 14, 22	Clearly shows how to perform a procedure ()
Connection	Anticipation of complexity	4, 15, 19	Extent of application on related concepts, in this case division (S)
	Decision about sequencing	15 – 18	Logically order math content from simpler-complex ideas (S)
	Recognition of conceptual appropriateness	2, 10, 20, 22	Learner engagement in developing and validating ideas (S)

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Contingency	Making connection between procedures	9	Emphasizes steps, methods or how to solve problem (S)
	Making connection between concepts	13, 22, 26	Emphasizes idea, meaning or why procedures work (S)
	Teacher/learner insight during instruction	9, 22, 25	Ability to engage and build on student thinking (S)
	Responding to students' ideas	23, 27	Active listening to adapt & validate learner's contribution (S)
	Deviation from agenda	23	Ability to shift focus to address emergent learners needs (W)
	Responding to the unavailability of tools and resources	3	Flexibility to modify plans based on available materials (S)

Key: (S) Strong/Solid, (W) Weak, (N) Neutral/Not applicable
Source: Field work (2025)

Table 1 organizes scriptwriting assessment into four pedagogical dimensions, each includes *Contributory codes* for assessing specific aspects of prospective teachers' mathematics and pedagogical content knowledge, *Evidence* of observable indicators of performance that points towards a particular code, *Remark* paired with *Rating* to interpret quality of what each code assesses within its domain and how well the script mirrored each and every contributory code. We will now use the KQ dimension contributory codes observation rubric to analyze the dialogue between Abdu and Meri.

Methodology

Participants

30 prospective teachers who were enrolled in NCE II in Waziri Umaru Federal Polytechnic Birnin Kebbi were presented with a scenario in which two characters interacts with each other on addition and subtraction in an attempt to work on arithmetic strategies to find the sum and difference of two numbers using the number line. These prospective teachers are charged with the task of writing a script independently for 10 to 20 minutes-long discussion to be realized in a mathematics classroom, with each character attempting to convince the other of the validity of their diverse viewpoint. The discussion is supposed to be in line with the specific objectives drawn from Nigerian Educational Research and Development Council (NERDC) curricula for teaching addition and subtraction in Primary Two. The choice of this sample was influenced by factors such as time constraint, cost implication, and also the subject's convenience. It could be deducted from the forgoing that the pedagogical and mathematical content knowledge of all the prospective teachers involved in this task is expressed in the claims made by their assigned characters. The participants were further advised that the characters in their scripts might expose incorrect justification or claims, or inappropriate mathematical expressions, but this should be acknowledged and addressed in the study, draw clear distinction to differentiate between the language and argumentation that the script writers attributed to their characters. Particular information on how the task would be assessed known as the observation rubric is neither provided nor sought by participant.

Data Analysis

This study adopts the Rowland (2014) KQ dimension to analyze teaching quality of the scripted dialogue with respect to instructional design. For each dimension, there exist contributory codes to describe instances or actions in teaching where script writer's math and pedagogical knowledge manifest (Rowland 2014). The data analysis for this study was conducted in three steps. First, the 30 scripts were analyzed independently by the four researchers using the observation rubric for scriptwriting analysis, before coming together to compare and discuss an agreed upon interpretation of the contributory codes and yet again identify evidence of such actions in each participant's script. The observation rubric was certified for face, content, and construct validity before-hand by experts in mathematics education research, who recommends the notion (solid, weak, & not-applicable) suitable for rating the contributory codes.

Presentation of Results

The result of the data collected were presented according to insights concerning pedagogical knowledge focusing on the four KQ dimensions. The findings reveal a mix of what prospective teachers are doing well and areas they need to improve. The purpose of the data collected is not to provide a quantitative assessment of the script dialogue, but rather, serves as a tool to help recognize the specific aspects of prospective teachers' pedagogical insights that were captured in the script.

Foundation Dimension

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Table 2: Prospective Teachers' Scripts that Captures the Foundation Dimension

Contributory code	Strong	Weak	Not applicable
Awareness of purpose	26	03	1
Adherence to textbook	19	11	-
Concentration to procedures	25	05	-
Theoretical underpinning of pedagogy	23	07	-

Source: Field work 2025

Table 2 highlight insights into prospective teachers' pre-instructional knowledge such as awareness about curriculum use, teaching strategies, classroom responsiveness, and instructional design, all of which yielded positive results. A significant majority of the participants (n=26) demonstrated strong awareness of instructional purpose, indicating clarity in lesson objectives and intended learning outcomes. Similarly, 25 participants exhibited a strong concentration on procedural fluency in mathematics instruction. Moreover, 23 participants showed a solid grasp of the theoretical underpinnings of pedagogy, reflecting an understanding of educational principles guiding their instructional choices. However, adherence to textbooks was comparatively weaker, with only 19 participants rated strong and 11 rated weak. This suggests partial disconnect between instructional practices and curriculum materials, potentially

Transformation Dimension

Table 3: Prospective Teachers' Scripts that Captures the Transformation Dimension

Contributory code	Strong	Weak	Not applicable
Use of instructional materials	17	13	-
Teacher demonstration (to explain a procedure)	-	-	30

Source: Field work 2025

Table 3 shows a mix of strength and challenges on insights that addresses how teachers present mathematical ideas to life in classroom. It is evident that 17 participants utilized instructional materials effectively while 13 were rated weak, which highlights variability in the integration of visual and physical tools to support conceptual understanding. One major concern was that not a single prospective teacher demonstrates how to carry out mathematical procedure during his lessons. This means students may miss out on seeing step by step approach to problem solving, which is essential for scaffolding.

Connection Dimension

Table 4: Prospective Teachers' Scripts that Captures the Connection Dimension

Contributory code	Strong	Weak	Not applicable
Anticipation of complexity	10	15	5
Decision about sequencing	28	2	-

Source: Field work 2025

Table 4 also shows a mix of strength and challenges on insights that reflect how well prospective teachers link mathematical ideas, plan lesson sequence and anticipate students misconceptions. The result showed 28 participants demonstrating strong ability to organize their lessons, indicating a well-developed sense of instructional progression and coherence. However, only 10 participants were able to predict the kinds of difficulties students might encounter, clearly suggesting that many prospective teachers struggle to foresee potential students' misconceptions or areas of difficulty, which could hinder effective remediation.

Contingency Dimension

Table 5: Prospective Teachers' Scripts that Captures the Contingency Dimension

Contributory code	Strong	Weak	Not applicable
Responding to students' ideas	16	11	3
Deviation from agenda	23	7	-
Responding to the unavailability of tools and resources	21	9	-

Source: Field work 2025

Table 5 shows a mix of strength and challenges on how well prospective teachers addresses students ideas or unexpected classroom challenges. The result portrays strong instructional flexibility and situational awareness, with 23 participants adjusting their lesson plans to adapt meaningful students contributions and 21 participants improvising to teach with limited

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resources. However, responsiveness to students ideas inconsistent, pointing to the need for further strengthens teachers listening and use of students input to support instructions.

Conclusion

Overall, the findings suggest that many prospective teachers possess a strong grasp of how to plan lessons and guide students through step-by-step procedures. They are especially good at organizing content in a logical order and adjusting when things did not go as planned in the classroom. However, there are critical gaps in the areas of prospective teachers demonstration, anticipation of complexity, and the integration of students ideas into instruction. These areas are essential for fostering deep mathematical understanding and responsive teaching. To address these gaps, teacher training programs should place more emphasis on showing teachers how to model mathematical procedures, anticipate students misconceptions, and leverage effective use of textbooks and curriculum resources. Additionally, professional teacher development focus on enhancing teachers capacity to recognize and respond to students ideas as they emerge during instruction, thereby strengthening both their pedagogical knowledge for teaching and understanding of how students learn mathematics.

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