Theorizing Learning Gaps in High School Mathematics

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ABSTRACT

Background and Objectives: Despite mathematics being globally recognized as essential for academic success and the development of lifelong skills, Filipino high school students consistently perform poorly in national and international mathematics assessments. This chronic underperformance is especially visible in public schools and reflects deep-rooted issues beyond mere academic deficits. While most studies have focused on achievement scores and curriculum mandates, few have examined the local, lived realities that contribute to students' non-attainment of expected mathematical competencies. To address this gap, the present study aimed to explain why students in Philippine public high schools fail to attain expected mathematics competencies by constructing a grounded, systemic-ecological model that uncovers the complex web of systemic, instructional, and affective factors contributing to mathematics learning gaps.

Methodology: The study employed a qualitative grounded theory design, following the constructivist tradition of Charmaz (2014), to capture emergent patterns in participants' narratives. Data were gathered from 10 purposively selected individuals (students, mathematics teachers, and school administrators) from a rural public high school in the northern Philippines. Using semi-structured interviews conducted in Filipino, the study elicited insights into participants' experiences with the curriculum, instruction, learning resources, student motivation, and assessment. Transcripts were translated and analyzed using grounded theory coding procedures: initial coding, focused coding, constant comparison, memo writing, and theoretical integration. Saturation was reached through iterative coding and cross-group analysis.

Main Results: The analysis yielded twelve interrelated thematic categories: (F1) Perceived relevance in real Life, (F2) Curriculum overload and fragmentation, (F3) Time constraints and interrupted class schedules, (F4) Foundational gaps and remedial needs, (F5) Teaching strategies and instructional clarity, (F6) Classroom engagement, (F7) Attitude toward mathematics, (F8) Student motivation, (F9) Access to traditional resources, (F10) Access to online platforms and videos, (F11) Use and misuse of technology, and (F12) Assessment formats and feedback processes. These categories were synthesized into a Systemic-Ecological Model of Mathematics Learning Gaps, which maps the interaction of factors across Bronfenbrenner's ecological levels: microsystem (e.g., teaching strategies), mesosystem (e.g., curriculum continuity), exosystem (e.g.,

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availability of resources), and macrosystem (e.g., educational policy and societal pressures).
Discussions: The findings demonstrate that underachievement in mathematics arises from the convergence of curricular disconnection, limited instructional time, fragmented content delivery, and students' emotional and cognitive responses to these constraints. Rather than being attributable to student or teacher failure alone, learning gaps result from systemic incoherence and insufficient contextual adaptation. Students' declining motivation, foundational weaknesses, and disengagement are closely tied to how math is taught, assessed, and made relevant in real life.
Conclusions: This study proposes a model that redefines mathematics learning gaps as products of ecological and systemic interactions rather than individual shortcomings. The proposed model underscores the need for coherent, inclusive, and context-sensitive reforms in curriculum, pedagogy, teacher development, and educational policy, particularly in under-resourced public schools. It contributes a localized and empirically grounded framework that can inform long-term solutions to improve mathematics achievement in the Philippine basic education system.

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Introduction

Mathematics education plays a pivotal role in developing students' problem solving, logical reasoning, and quantitative literacy, competencies deemed essential for both academic progression and daily life (Huinker et al., 2020). As societies increasingly rely on data-driven decision-making, technological fluency, and financial independence, the significance of mathematical competence has expanded beyond the classroom and into the broader arenas of civic participation, workforce readiness, and lifelong learning (Organisation for Economic Co-operation and Development [OECD], 2019). Despite this global consensus, mathematics remains one of the most challenging subjects for students, particularly at the secondary level. Persistent underachievement in mathematics is a well-documented concern in the Philippines and elsewhere, leading to widespread calls for systemic reforms in curriculum, pedagogy, and assessment (Bernardo et al., 2022).

International large-scale assessments such as the Programme for International Student Assessment (PISA) have consistently placed Filipino learners among the lowest-performing in mathematics. In the 2018 PISA cycle, Filipino 15-year-olds ranked last among 79 participating countries in mathematical literacy, with over 80% failing to reach even the minimum level of proficiency (OECD, 2019). Four years later, the 2022 PISA results showed no statistically significant improvement, with the Philippines posting an average mathematics score of 355—only two points higher than the 2018 score of 353, and still well below the OECD average (OECD, 2023). This stagnation underscores persistent systemic challenges, despite reforms and interventions in basic education. The minimal gains reflect deeply rooted issues in Philippine basic education (Frianeza et al., 2024). These concerns were further validated by national assessments such as the National Achievement Test (NAT), which have shown consistently low mathematics performance across grade levels and regions, indicating that the learning crisis in mathematics remains both unresolved and widespread (Ojastro et al., 2025).

While quantitative data reveal a disturbing trend of underperformance, they provide limited insight into the complex and interrelated factors that shape students' learning trajectories. Recent research has emphasized the need for more localized, qualitative, and theory-informed inquiries that delve into students' lived experiences and the contextual challenges that hinder their attainment of expected learning competencies (Montebon, 2024). In the Philippine context, the Department of Education (DepEd) has adopted the Most Essential Learning Competencies (MELCs) framework to streamline content delivery and focus instruction. However, questions persist regarding the extent to which these competencies are realistically attainable, equitably delivered, and meaningfully assessed in varied school settings, particularly in rural or resource-limited areas (Gaddi, 2024).

The high school years are particularly critical in shaping mathematical thinking. It is during this period that students transition from concrete to abstract reasoning and encounter foundational concepts in algebra, geometry, statistics, and trigonometry. However, literature suggests that many students struggle to make sense of these topics, often perceiving them as disconnected from real life and overly procedural (Boaler, 2016). The disconnect between academic mathematics and its practical applications has been shown to negatively influence student motivation, confidence, and engagement (Dowker et al., 2016). This phenomenon, sometimes referred to as mathematics alienation," can result in long-term disengagement and underachievement, particularly among students with low self-efficacy or limited access to support systems (Bandura, 1997).

Several scholars have pointed to the pivotal role of curriculum design in either facilitating or hindering students' mastery of mathematics. The K to 12 Basic Education Curriculum in the Philippines, which employs a spiral progression approach, has been criticized for promoting content overload and conceptual fragmentation. Orale and Uy (2018) argues that while the spiral model was intended to reinforce learning across grade levels, its implementation has often led to superficial coverage and cognitive overload. Students are introduced to multiple strands of mathematics within the same academic year, such as algebra, geometry, and statistics, without adequate depth or continuity. Moreover, the sequencing of topics does not always reflect logical progressions, leaving gaps in foundational understanding and retention.

Compounding this curricular issue is the perennial problem of instructional time and learning interruptions. In recent years, Philippine schools have faced increasing disruptions due to natural disasters, political events, and the COVID-19 pandemic. These have resulted in lost class days, shortened school hours, and a reliance on modular or remote learning modalities that are often ill-suited for mathematics instruction (Mullen et al., 2021). Research shows that time-on-task is a critical predictor of learning outcomes, particularly in content-heavy subjects like mathematics (Carroll, 1963). When instructional time is constrained, teachers are often forced to rush through lessons, skip essential topics, or rely on superficial assessments—further exacerbating learning gaps and inequities.

Beyond structural and curricular concerns, pedagogical practices remain central to student achievement in mathematics. Studies have shown that effective math instruction requires not only content expertise but also the ability to make abstract ideas accessible, culturally relevant, and emotionally safe for diverse learners (Abdulrahim & Orosco, 2019; Vale & Barbosa, 2023). In practice, however, many teachers struggle to balance content coverage with the need for differentiated instruction, formative assessment, and student-centered learning. This is especially true in overcrowded classrooms or in contexts where resources and professional development opportunities are limited.

Another layer of complexity stems from student-level factors, particularly their attitudes toward mathematics, motivational states, and prior learning experiences. Mathematics anxiety, for instance, has been consistently linked to avoidance behaviors, reduced working memory, and poor academic performance (Dowker et al., 2016). Students who perceive math as inherently difficult or irrelevant are less likely to invest time and effort in mastering the subject. Similarly, students with weak foundational knowledge in earlier grades often experience compounding difficulties in high school, where topics become increasingly abstract and cumulative (Fuchs & Vaughn, 2012). Without targeted interventions and emotionally supportive classroom environments, these students may fall into cycles of disengagement and academic failure.

In response to these multidimensional challenges, researchers and policymakers alike have called for a more systemic and theory-informed approach to understanding and addressing mathematics underachievement. Theoretical frameworks such as Bronfenbrenner's (1979) ecological systems theory and Bandura's (1997) model of self-efficacy offer valuable lenses through which to examine how individual, instructional, institutional, and sociocultural factors interact to influence learning outcomes. At the same time, there is a need to develop grounded, context-sensitive models that reflect the realities of mathematics education in specific localities, particularly those that serve underprivileged, multilingual, and rural student populations.

Against this backdrop, the present study aims to explain why students in Philippine public high schools fail to attain expected mathematics competencies by constructing a grounded, systemic-ecological model derived from the perspectives of students, teachers, and administrators. While most studies focus on statistical trends or isolated classroom interventions, this study adopts a broader systems-oriented perspective that draws on qualitative insights from students, teachers, and administrators. The aim is not merely to identify surface-level challenges, but to illuminate the deeper, interlocking mechanisms that shape mathematics learning in context. In doing so, the study hopes to contribute to both the scholarly literature on mathematics education and the practical discourse on curriculum development, teacher preparation, and equity-driven reforms.

Method

This study employed a qualitative research design with a constructivist-interpretivist orientation to explain why students in Philippine public high schools fail to attain expected mathematics competencies by constructing a grounded, systemic-ecological model derived from the perspectives of students, teachers, and administrators. Given the study's goal of uncovering systemic, pedagogical, and contextual factors from the perspectives of key stakeholders, a qualitative approach was most appropriate for capturing rich, situated meanings and complex human experiences (Merriam & Tisdell, 2016). Rooted in grounded theory and ecological systems thinking, the study aimed not merely to describe surface-level barriers to learning but to construct an integrated framework that explains how various interrelated influences contribute to students' mathematical struggles.

Research Design

This inquiry was designed as a multiple case study embedded within a broader grounded theory framework (Charmaz, 2014). Multiple case studies allow for cross-case analysis and triangulation across different stakeholder groups (students, teachers, and school administrators) while grounded theory provided the analytical structure for deriving a context-sensitive explanatory model. The use of grounded theory, particularly in its constructivist form, was justified by the aim of building theory from participants' own interpretations and situated realities rather than testing pre-existing hypotheses (Charmaz, 2014).

Research Setting and Participants

The study was conducted in a public high school located in a rural municipality in the province of Isabela, Philippines. The school was purposively selected based on its low performance in the National Achievement Test for Mathematics and its designation as a recipient of DepEd remedial interventions. Such a setting offered a fertile ground for exploring mathematics learning gaps in a real-world, resource-constrained environment.

Participants were selected using purposive maximum variation sampling to ensure a broad range of perspectives (Palinkas et al., 2015). A total of ten participants were involved: five Grade 10 students, three mathematics teachers, and two school administrators (master teacher and head teacher). Student participants included both high-achieving and struggling learners to capture the diversity of experiences and challenges. Teacher participants included junior high school mathematics instructors with at least five years of teaching experience, while the administrator group comprised individuals directly involved in curriculum implementation and school leadership.

Data Collection Methods

The primary method of data collection was semi-structured interviews, conducted individually with each participant group. Interviews allowed for both consistency across key questions and flexibility to probe deeper into emerging themes (Kvale & Brinkmann, 2015). Separate but thematically aligned interview protocols were developed for students, teachers, and administrators. These protocols were pilot-tested in a nearby school for clarity and relevance, and revised accordingly. Data collection was carried out over a six-week period between September and October 2024.

Student interviews explored perceived relevance of mathematics, learning difficulties, motivation, access to learning resources, and classroom experiences. Teacher and administrator interviews covered curriculum design, instructional strategies, assessment practices, classroom challenges, and professional support systems. Each interview lasted between 45 to 60 minutes and was conducted in a mix of Filipino and English, depending on the participants' preference. Interviews were audio-recorded with permission and transcribed verbatim.

To enhance credibility and methodological triangulation, classroom artifacts (e.g., lesson plans, activity sheets, assessment samples) and policy documents (e.g., MELCs, DepEd curriculum guides) were also reviewed and integrated during data analysis. While classroom observations were considered, they were deferred due to logistical limitations and pandemic-related restrictions in the local school system.

Data Analysis Procedures

Data analysis followed Charmaz's (2014) constructivist grounded theory procedures: initial coding, focused coding, axial coding, and theoretical coding. MAXQDA software was used to organize, code, and visualize data. Initial line-by-line coding was used to stay close to the data and identify recurring patterns in participants' language and meanings. Focused coding grouped these codes into more significant categories, while axial coding allowed for exploring relationships between categories. Finally, theoretical coding integrated the categories into a coherent explanatory framework—the Systemic-Ecological Model of Mathematics Learning Gaps.

Throughout the analysis, constant comparative methods were employed to compare data within and across stakeholder groups and to ensure internal consistency in category development. Memo writing was used to document emerging insights, code reflections, and conceptual linkages. Member checking was also conducted by returning synthesized interpretations to selected participants for validation and clarification to strengthen the credibility and trustworthiness of findings.

Trustworthiness and Rigor

To ensure the trustworthiness and rigor of the study, several strategies addressing credibility, dependability, confirmability, and transferability were employed. Credibility was enhanced through triangulation of multiple data sources (students, teachers, and administrators) and methods (interviews and document reviews), as well as prolonged engagement within the research site during the six-week data collection period. This sustained presence allowed the researcher to build rapport with participants and gain a deeper understanding of the school context. Member checking was conducted by sharing synthesized interpretations and thematic summaries with selected participants to validate the accuracy of the findings and interpretations. Dependability was addressed through maintaining a detailed audit trail, including interview transcripts, coding outputs, memos, and analytic decisions, allowing for external scrutiny of the research process. To enhance confirmability, the primary researcher engaged in reflexive journaling throughout the study to document assumptions, positionalities, and decision-making processes. Finally, transferability was supported by providing thick descriptions of the research context, participant characteristics, and setting, enabling readers to determine the applicability of the findings to similar educational environments (Merriam & Tisdell, 2016).

Ethical Considerations

Ethical integrity was prioritized throughout the research process. Participants were informed of the study's purpose, data use, and their rights, including anonymity and confidentiality. Audio recordings and transcripts were stored in password-protected digital folders accessible only to the researchers. All identifying information was removed from quotes presented in the final report. Care was also taken to present student voices with dignity, avoiding deficit framing or stigmatization. While challenges were reported, the discussion emphasized systemic rather than individual shortcomings.

Findings

Relevance in Real Life

Students repeatedly acknowledged that mathematics had practical relevance, especially for daily financial activities like budgeting, fare payments, or buying goods. These recognitions, however, were generally limited to basic arithmetic applications. Once topics became more abstract (e.g., trigonometry or polynomials), many struggled to see their connection to everyday life:

> Student A: "Yes Ma'am, almost naman ma'am naiinvolve 'yung math sa buhay natin! Katulad ng pagbayad ng pamasahe, pagbili ng miryenda, pagbili ng pang lunch mga ganun ma'am *(Yes ma'am, almost all the time math is involved in our daily lives! Like paying for fare, buying snacks, lunch—things like that, ma'am).*"
>
> Student B: Halimbawa po ma'am nakakatulong sa pagcompute ma'am ng mga dapat cocomputin mam tulad ng mga nagagastos namin sa pang-araw-araw *(For example, ma'am, it helps us compute our daily expenses)."*

Despite these practical acknowledgments, some students hesitated or failed to see the real-world application of certain mathematical topics:

Student C:“ Parang wala po akong maisip *(I can't think of anything)."*

Student D: "Meron naman po ma'am 'yung iba. Pero 'yung iba hindi ko maiconnect sa totoong buhay *(Some lessons, yes. But others, I can't relate them to real life)."*

Teachers and administrators also expressed that while curricular goals intended relevance, their implementation often leaned toward the idealistic rather than practical:

Admin C: "Based sa MELCs, oo naman, meron naman relevant sa buhay ng mga estudyante, kaya lang napaka-ideal lang ng mga hinihinging output *(According to the MELCs, yes, the content is relevant to students' lives, but the expected outputs are too idealistic)."*

This reveals that while there is inherent potential for mathematics to be relevant, students require clearer real-life context, and teachers need to bridge academic abstraction with applied learning experiences.

Curriculum Overload and Fragmentation

The concern of curriculum overload was strongly voiced across all participant groups. Students expressed frustration over the volume of content, the repetitiveness of certain lessons, and the simultaneous teaching of disparate topics within a single grade level:

Student A: "Sobrang dami, nag-ooverlap na po 'yung competencies na nakalagay ma'am *(There are too many; the competencies overlap)."*

Student B: "Masyadong marami ma'am… Hindi naming naaattain lahat ng competencies *(There are just too many, ma'am… We're unable to master all the competencies)."*

Teachers described the lack of conceptual continuity as the primary flaw of the current spiral curriculum, which covers multiple content areas per quarter (e.g., algebra, geometry, trigonometry):

Teacher D: "Ngayon kasi iba-iba. Spiral kasi ngayon, walang continuity. *(Right now it's all mixed up. The spiral approach lacks continuity.)"*

Teacher C: "Grade 8 ang pinakamahirap kasi walang continuation mula sa Grade 7. *(Grade 8 is the hardest because there's no continuation from Grade 7.)"*

Master teachers and administrators echoed that the competencies are not only excessive, but also poorly sequenced, making progression difficult:

Master Teacher D: "Against ako sa spiral… Retention ng learning, very low." *(I'm against the spiral. The students' learning retention is very low.)*

Admin C: "Sa curriculum ng mathematics, sobrang taas ng standard... hindi nakaka-align sa ability ng bata." *(The standards in math are too high… they don't align with the ability of most students.)*

These statements reveal a consensus: less is more when it comes to content coverage. A focused and logically progressing curriculum could foster better mastery and reduce anxiety among learners.

Time Constraints and Interrupted Class Schedules

Students and teachers both highlighted the lack of instructional time as a major impediment to learning. Time was consumed not only by the overloaded curriculum but also by unexpected cancellations and non-academic activities:

Student A: "Kunti lang 'yung time namin ma'am… minsan may mga bagyo, ulan… minsan may mga activities sa school. *(We don't have much time, ma'am… sometimes there are storms or school activities.)"*

Student C: "Ngayon po eh parang hindi siya enough, naghahabol na po kami. *(Now, it seems time isn't enough—we're trying to catch up.)*"

Teachers confirmed the same struggle, explaining how content is either rushed or skipped altogether:

Master Teacher D: "Kulang talaga sa oras. Talagang hindi mamamaster ng mga bata ang mga competencies. *(There really isn't enough time. Students won't master the competencies this way.)"*

Teacher D: "Hindi ko natatapos 'yung naka-allot na competencies sa isang quarter. *(I can't finish all the competencies for the quarter.)"*

Saturday classes, shortened periods, and crammed catch-up schedules led to incomplete instruction, which in turn contributed to learning loss:

Master Teacher D: "Kahit gusto kong dagdagan ng examples, hindi na kasya sa oras. *(Even if I want to add more examples, there's not enough time.)"*

The findings suggest the need to extend math contact time or streamline content per quarter to allow for deeper processing and stronger retention.

Foundational Gaps and Remedial Needs

A recurring concern was the gaps in students' foundational math knowledge. Students admitted difficulty recalling previous lessons, and teachers shared that even basic arithmetic operations like signed numbers and fractions were not mastered:

Student D: "Hindi ko po maalala 'yung mga properties or laws po na need i-apply sa isang problem. *(I can't remember the properties or laws that I need to apply to solve a problem.)"*

Teacher C: "Kapag may negative times negative, nagkakamali pa rin sila. *(When it comes to negative times negative, they still get it wrong.)*"

Teachers pointed out that time had to be diverted to review elementary topics, leaving less room to teach the intended high school content:

Teacher E:	"Kaya parang magba-backread ka muna… para makasunod sila. *(So I end up going back to basics… so they can keep up.)*"
Teacher E:	"Kung hindi mo na alam mag plus, minus... wala na. Mawawala na ang interest nila. *(If you don't know how to add or subtract… you'll lose interest immediately.)"*

This challenge was not merely academic but motivational. Students who consistently struggled with basics often disengaged entirely, reinforcing a cycle of academic frustration and emotional withdrawal.

Teaching Strategies and Instructional Clarity

Students expressed a strong preference for teachers who used clear, step-by-step explanations, provided multiple examples, and allowed for visual and contextual reinforcement. Fast-paced lessons, on the other hand, were often perceived as stressful or confusing:

Student A:	"Maiintindihan ko po ang lesson namin sa mathematics kung 'yung teacher ay hindi masyadong mabilis magturo. *(I can understand our math lesson if the teacher doesn't teach too fast.)"*
Student B:	"Mas gusto ko po na nagdidiscuss muna si ma'am, para masusundan ko 'yung step by step. *(I prefer it when the teacher explains everything step by step.)"*

Students also appreciated the use of modeling, where teachers solved examples on the board before students attempted similar problems:

Student A:	"Una po gusto ko munang pinapanood 'yung teacher kung paano i-solve 'yung problem… para alam ko 'yung step-by-step. *(First, I like watching the teacher solve the problem… so I understand the step-by-step process.)"*

From the teacher's perspective, deductive strategies (starting with concept and examples) were emphasized over lengthy introductions:

Teacher D:	"Kung inductive ka, wag ka ng paligoy-ligoy pa. Sa mathematics, dapat diretso sa concept. *(If you're using inductive teaching, don't beat around the bush. In math, you need to go straight to the concept.)"*

Many teachers also applied differentiation informally, by pairing advanced students with those struggling:

Master Teacher D:	"Tinatandem ko 'yung magagaling sa mga hindi nakakasunod… parang peer tutoring. *(I pair the high performers with those who can't follow… kind of like peer tutoring.)"*

However, some teachers admitted that lack of time, fatigue, or workload sometimes limited the effectiveness of their instructional strategies:

Master Teacher D:	"Minsan 'yung assessment mas mataas pa kaysa sa tinuro… kasi hindi na rin ako nakagawa ng ibang examples. *(Sometimes the assessments are more difficult than what I taught… because I didn't have time to create more examples.)"*

Classroom Engagement

Classroom engagement surfaced as a critical theme influencing students' comprehension, motivation, and retention in mathematics. Students consistently emphasized that how lessons are delivered significantly affects their interest and ability to stay focused.

For many, interactive strategies, such as peer learning, hands-on problem solving, and games, made lessons more memorable and enjoyable:

Student A:	"Gusto ko ma'am more examples para mas ma-practice po kami sa pag-solve… kasi pag narerepeat 'yung mga practices, mas na ma-master po namin. *(I want more examples so we can practice solving… because when practices are repeated, we master the topic better.)"*
Student B:	"Mas gusto ko po is 'yung nagpapa-activity through games… mas nage-engage po kami pag ganun. *(I prefer when the teacher gives activities through games… we get more engaged that way.)"*
Student D:	"Kapag may pa-activity si teacher, lalo 'yung through games, nage-engage po talaga kami. *(When our teacher gives us games or fun activities, we really engage.)"*

Students also highlighted that group activities encouraged collaborative learning and helped them support peers who were falling behind:

Student A:	"Gusto ko rin ma'am 'yung by group para 'yung iba ma'am na hindi nakakasunod eh maisama sa mga nakakasunod. Pwede po silang maturuan. *(I also like group work so those who can't keep up can be included and helped by others.)*"

Teachers confirmed this, citing peer-led discussions and structured groupings as useful tools for addressing mixed abilities in class:

Teacher D:	"Nag-aassign ako ng mga magagaling na estudyante na turuan 'yung mga hindi pa nakakasunod… tapos 'yung advanced siya 'yung pinagtuturo ko sa harap ulit. *(I assign top students to help those who can't follow… and sometimes let them teach in front again.)"*

However, not all teachers favored group work equally. Concerns were raised about unequal participation within groups:

Teacher D: “Kapag group work, iisa lang ang gumagawa… ‘yung iba wala nang ginagawa. *(In group work, only one person does the task… the others don’t contribute.)*”

On the whole, students valued teachers who fostered a supportive, participatory, and responsive classroom environment, where questions were welcomed, and effort was recognized:

Student C: “Comfortable po ako sa classroom namin… lahat cooperative. Pero minsan po talaga may hindi interesado sa subject. *(I’m comfortable in our classroom… everyone is cooperative. But sometimes, some students aren’t interested.)”*

Attitude Toward Mathematics

Attitudes toward mathematics ranged from mild interest to strong anxiety and emotional resistance. Many students openly admitted that math was a subject they found difficult and emotionally taxing:

Student A: “Sa totoo lang ma’am, halos nakalimutan ko na lahat… ibig sabihin ma’am, short span ‘yung retention ko. *(To be honest, ma’am, I’ve forgotten almost everything… it means I only retain math for a short span.)”*

Student C: “Hindi po ako masyadong confident… minsan po tinatamad ako makinig. *(I’m not very confident… sometimes I don’t feel like listening.)*”

Student D: “Una po ay mahina po ako sa foundation ng mathematics… hindi ko po maalala ‘yung mga properties or laws. *(First of all, I have a weak foundation in math… I can’t remember the properties or laws.)*”

Several factors influenced these negative attitudes, including teacher approach, pace of instruction, and previous learning failures. For instance, some students expressed resentment when teachers assumed prior knowledge they did not have:

Student D: “Ina-assume ng teacher na alam na namin lahat ng principle or foundation sa math… kaya minsan hindi po namin alam kung saan nanggagaling ‘yung sagot. *(The teacher assumes we already know the principles… so we don’t understand where the answers come from.)”*

Teachers and administrators acknowledged that emotion and confidence played a significant role in how students approached math learning:

Teacher C: “Mostly mga estudyante hate nila ang mathematics… pero kung minsan kasi teacher factor din. *(Most students hate math… but sometimes, it’s because of the teacher too.)*”

Some teachers recounted how positive relationships and teaching enthusiasm helped shift student attitudes:

Teacher D (quoting a student):	"Kung ikaw naging teacher ko, siguro I have learned to love math. *(If you were my teacher, I probably would have learned to love math.)*

The theme strongly suggests that mathematical attitudes are not fixed but are instead sensitive to classroom climate, instructional style, and self-perception of ability.

Student Motivation

Motivation emerged as a dynamic and fragile element of student learning. Many students expressed a conditional motivation that was dependent on emotional state, perceived task difficulty, and support mechanisms in the environment:

Student B:	"Minsan kasi ma'am natatamad akong mag-aral ma'am… minsan kasi ma'am moody ako. *(Sometimes I feel lazy to study, ma'am… sometimes I'm just moody.)"*
Student D:	"Minsan po wala po talaga ako sa mood… pero iniisip ko, kailangan ko talaga itong ipasa para maka-move up. *(Sometimes I'm really not in the mood… but I remind myself I have to pass so I can move up.)"*

However, when students were provided with engaging, relatable, and interactive experiences, their motivation improved significantly:

Student B (on game-based assessments):	"Mas nakakatulong sa akin kapag ganun ma'am… mas nage-enjoy ako. *(It helps me more when it's like that, ma'am… I enjoy it more.)"*
Student C:	"Exciting part ng pag-aaral 'yung mga quizzes… para ma-challenge ko 'yung sarili ko. *(Quizzes are the exciting part of learning… they challenge me.)"*

Teachers, however, shared concerns about lack of intrinsic motivation, especially among students with weak foundations:

Teacher E:	"Very shallow 'yung retention nila… kapag hindi nila naintindihan sa umpisa, nawawala na 'yung interest… Hindi nila naiintindihan ang plus, minus… doon na mismo nawawala ang interest nilang makinig. *(Their retention is very shallow… if they don't understand it from the start, they lose interest. If they don't understand addition and subtraction, they lose interest in listening altogether.)"*

Teachers also described external distractions such as online gaming and social media as detrimental to sustained motivation. At the same time, they saw technology and AI tools as double-edged swords:

Master Teacher D: "Mas madali silang mag-browse… pero 'yung retention nila, wala eh. Learning is followed by forgetting. *(It's easier for them to browse… but they don't retain anything. Learning is followed by forgetting.)*"

Thus, student motivation in mathematics is shaped by a mix of academic self-efficacy, interest level, emotional regulation, and external learning supports.

Access to Traditional Resources

Traditional resources remained the baseline tools for learning mathematics among students and teachers, though their accessibility and sufficiency varied significantly across contexts. These resources included printed books, modules, notebooks, and direct teacher instruction. Students commonly cited these as their primary tools:

Student B: "Sa book ma'am minsan… tapos po sa lecture po ni teacher nagtatanong po ako kung saan po ang resources niya. *(Sometimes I use the book, ma'am… and I ask my teacher about her lecture resources.)"*

Student D: "Meron po mga modules at libro po… Usually po kapag natatapos na po 'yung topic doon po kami nagkakaroon ng exercises or drills po… minsan po nagpapa-assignment kapag hindi kinaya ng time naming sa klase. *(We have modules and books, ma'am… Usually after the topic, we do exercises or drills… and sometimes assignments when we run out of time.)"*

However, teachers lamented the inadequacy and inconsistency of traditional materials. In some cases, the textbooks were outdated, or grade-level appropriate materials were missing altogether:

Teacher E: "Hindi sapat kasi until last year, wala pa 'yung mga textbook na intended for Grade 7. *(It's not enough because until last year, there were still no textbooks for Grade 7.)"*

Master Teacher D: "Yung mga resources dito sa division… sa totoo lang, mas gusto ko 'yung nakuha ko sa ibang division. *(The resources in our division… honestly, I prefer those I got from another division.)"*

Teachers often had to supplement traditional resources with self-made worksheets or borrowed materials:

Teacher E: "Sa teaching mathematics, hindi naman mahirap gumawa ng sariling problems… as long as it is aligned sa standard. *(In teaching math, it's not hard to make your own problems… as long as they are aligned with the standards.)"*

In essence, traditional resources—while foundational—were perceived as insufficient, inconsistent, and not always aligned with updated curricular demands. The gap between what is provided by the institution and what teachers and students actually need forced educators to constantly innovate or improvise.

Access to Online Platforms and Videos

The use of online platforms, educational videos, and digital applications was frequently cited by both students and teachers as a critical learning enabler, especially when traditional resources were lacking or outdated. Students often turned to platforms like YouTube and Google Search to reinforce their understanding of complex mathematical topics:

Student A:	"Minsan nanonood ako sa YouTube pag may topic akong gustong aralin. *(Sometimes I watch YouTube when there's a topic I want to study.)*"
Student B:	"Usually ma'am nag-YouTube po ako tapos Google po ma'am. *(Usually, ma'am, I watch YouTube and use Google.)"*
Student D:	"Kapag may internet, nanonood po ako ng educational video about sa topic po naming sa math. *(When I have internet, I watch educational videos about our math topic.)"*

Teachers also found online tools useful, particularly interactive platforms such as Kahoot or PowerPoint-based quizzes, which made mathematics more engaging for students:

Student D:	"Doon po kami nag-qui-quiz… kasi po through games po ang activities at pataasan po ng points. Mas nageengage po ang karamihan kung may pa-activities si teacher na ganun. *(We take quizzes there… because it's through games and point rankings. Most of us engage better when the teacher gives those kinds of activities.)*
Teacher C:	"Pinapanood ko 'yung downloaded video... tapos in-eexplain ko ulit para mas ma-process nila. *(I play downloaded videos and then explain again so they can process it better.)"*
Master Teacher D:	"Kaya kung gusto mo mag-sacrifice na teacher, magpa-spot ka, pero one hour lang. *(So, if you want to make a sacrifice as a teacher, you'll need to find a hotspot—but it only lasts for an hour.)"*

Despite their usefulness, teachers and students also noted barriers to full integration of digital tools—most notably internet connectivity and data availability:

Teacher D:	"Bihira, kasi 'yung iba walang internet. *(Rarely—because some students don't have internet access.)*"
Master Teacher D:	"Wala silang load doon… kasi kung sa cellphone, pasok naman na sila lahat. May smartphones na sila… sa load lang ang kulang. *(They don't have mobile data… most have smartphones now, but they lack prepaid load.)"*

Even with these constraints, digital platforms were described as effective in scaffolding learning, especially when the content aligned with MELCs and the language was accessible:

Teacher C: "Naka-specific 'yung mga lesson sa videos. Tapos by competency siya. *(The videos are specific to lessons. And they follow the competency.)"*

The growing reliance on online platforms and videos reflects a transformational shift in how learners engage with mathematics outside the classroom. However, it also emphasizes the need for infrastructure, training, and curation to maximize their pedagogical value.

Use and Misuse of Technology

Participants shared mixed views on the dual nature of technology in mathematics education. On one hand, appropriate use of gadgets, apps, calculators, and AI-enhanced tools facilitated faster computation, independent review, and resource access. On the other, unregulated or excessive reliance on technology led to distraction, disengagement, and shallow understanding. Students recognized technology's role in computation and review:

Student A: "Medyo po nakakatulong… katulad po ng pagnagka-calculator ako ma'am, mas mabilis kong nalalaman ang sagot kaysa sa manual. *(It kind of helps… for example, when I use the calculator, I get the answers faster than solving manually.)"*

Student B: "Usually ma'am nag-YouTube po ako tapos Google po ma'am." *(Usually, I use YouTube and Google, ma'am.)*

Student D: "Nanonood po ako ng educational video about sa topic po naming sa math. *(I watch educational videos related to our math topics.)"*

Several teachers shared that technology helped enhance presentations, clarify lessons, and maintain student engagement:

Teacher C: "Pinapanood ko 'yung downloaded video… tapos ine-explain ko ulit para mas ma-process nila. *(I play the downloaded video, then explain it again to help them process it better.)*"

Master Teacher D "Nagpa-download ako ng apps sa cellphone nila para mas maengage sila." *(I asked them to download apps on their phones so they could be more engaged.)*

However, teachers were cautious about students relying too much on AI or digital tools, especially when they failed to internalize concepts:

Teacher D: "Nagde-depende na lang sila sa AI… pag tinanong mo, hindi naman nila mapaliwanag 'yung sagot. *(They just depend on AI… when you ask them to explain, they can't.)*"

Master Teacher D: "Hindi na sila seryoso sa pag-memorize ng lessons… isang click lang, isang Google lang. *(They're no longer serious about memorizing lessons… just one click, one Google search.)"*

Teachers also raised concern over technology being more associated with leisure than learning among students:

Teacher E: "Parang hindi ko pa nakikita sa mga estudyante 'yung paggamit nila ng AI… basta ang nakikita ko lang ay ML. *(I haven't really seen them using AI for school… mostly, I just see them playing Mobile Legends.)"*

From the administrative view, integrating technology is promising—but only if paired with curricular clarity and consistent teacher guidance:

Master Teacher D: "Maganda 'yung AI… pero kung ang purpose ay para lang may maisulat ka, hindi maganda. *(AI is helpful… but if the only purpose is to just produce something, that's not ideal.)*"

The theme reinforces the notion that technology is a powerful tool, but its impact depends on how students are taught to use it. Without structure, it can become a barrier rather than a bridge to deep mathematical understanding.

Assessment Formats and Feedback Processes

Assessment emerged as a vital part of the learning experience—either as a motivational tool or a source of confusion and discouragement, depending on its design and execution. Students responded positively to diverse, engaging, and timely assessments, especially when they included games, group work, and clear feedback:

Student A: "Kung math po, meron po sanang board work, meron pong paper and pencil, tapos meron po 'yung may laro-laro para mas maengage kami. *(For math, I hope there's board work, paper-and-pencil, and games to keep us engaged.)*"

Student B: "Gusto ko po is 'yung nagpapa-activity through games… tapos after po nun ma'am mag-individual na kuha ng assessment. *(I prefer it when there are game-based activities, and then we do individual assessments afterward.)"*

Students liked quizzes and performance tasks when they were aligned with lessons, included variety, and allowed them to demonstrate their learning in multiple ways:

Student C: "Para siyang exciting part ng pag-aaral po 'yung mga quizzes… para ma-challenge 'yung sarili ko. *(Quizzes are the exciting part of studying… they challenge me.)"*

Teachers shared the same view—assessments must be varied, contextualized, and manageable, not just in difficulty but in timing and purpose:

Teacher D: "Usually multiple choices ang pinapagawa ko. Tapos may boardwork, individual activity, drills, group work minsan. *(I usually give multiple-choice tests. Then boardwork, individual activity, drills, sometimes group work.)*

Teacher C: "May quiz notebook sila. Lahat ng exercises, performance tasks doon… iba 'yung quizzes nila, iba 'yung lecture. *(They have a quiz notebook. All exercises and tasks go there… quizzes are separate from lectures.)"*

Students appreciated assessments that allowed collaboration, such as peer teaching or random selection of presenters, which ensured everyone understood the solution process:

Teacher C: "Yung mga magagaling sa grupo… sila yung nagiging parang little teacher namin… pero hindi sila ang magre-represent. Ako ang mamimili. *(The bright ones in the group act as our little teachers… but they don't present, I choose who does.)"*

However, both students and teachers lamented that feedback was sometimes inconsistent or inaccessible, especially for students who didn't actively seek it out:

Teacher D: "Oo ma'am, sa mga pumupunta lang. *(Yes ma'am, but only for those who approach me.)"*

In some cases, assessment expectations exceeded what was taught, leaving students confused or disheartened:

Master Teacher D: "Assessment mas mataas pa kaysa sa tinuro… kasi hindi na rin ako nakagawa ng ibang example. *(The assessment was harder than what was taught… because I didn't have time to create more examples.)"*

Finally, teachers expressed the need for alignment of assessment with instruction and suggested that contextualizing assessments to match teaching pace and depth would improve learning outcomes.

Discussion

The complexity of mathematics learning in high school lies not only in the subject's inherent abstractness but in the layered realities of curriculum design, teaching practices, learner characteristics, and systemic supports. This study, grounded in voices of students, teachers, and administrators, unveils a constellation of interrelated factors that obstruct students' attainment of expected mathematical competencies. These factors, while diverse in form, converge on a critical insight: success in mathematics hinges on how well schools balance cognitive rigor with pedagogical relevance, emotional support, contextual accessibility, and systemic alignment.

One of the most urgent implications of this study relates to the dissonance between the intended curriculum and learners' perceived reality. Mathematics in the curriculum is designed to develop both abstract reasoning and problem-solving applicable to daily life. However, the findings suggest that for most learners, real-world relevance is confined to rudimentary applications. The inability to link abstract topics to lived experiences reflects a broader global issue wherein curricular design favors theoretical completeness over contextual adaptability (Boaler, 2016). Research on culturally responsive mathematics stresses the importance of embedding instruction in students' social and cultural contexts to make learning meaningful

(Abdulrahim & Orosco, 2019). In the Philippine setting, where learners come from diverse linguistic, economic, and regional backgrounds, failure to contextualize mathematics may result in disengagement and resistance.

Beyond content relevance, the structure of the mathematics curriculum itself demands serious reconsideration. The spiral progression approach, though theoretically beneficial for reinforcement and continuity, often results in fragmentation and superficial coverage (Orale & Uy, 2018). Students encounter multiple strands (e.g., algebra, geometry, statistics) within the same quarter, with limited depth in each. This overload, paired with poor vertical alignment, mirrors what Schmidt et al. (2005) refer to as curricular incoherence, which hampers cognitive integration and long-term retention. In international contexts, streamlined curricula focusing on fewer but more coherent topics per grade level have been shown to support deeper learning and better performance in mathematics (OECD, 2025). Philippine education policymakers must evaluate whether the current scope-and-sequence promotes true mathematical understanding or merely compliance with breadth-oriented standards.

The problem is further compounded by inadequate instructional time and unpredictable disruptions, which undermine even the most dedicated teaching efforts. As Carroll's (1963) time-on-task theory reminds us, learning is a function of time allocated and time engaged. The loss of instructional time due to typhoons, non-academic activities, and curricular overload severely limits student exposure to core concepts. In such contexts, teachers are forced to rush, skip, or superficially discuss lessons, which leads to cumulative learning deficits. Effective learning requires not only allocated time but protected time (i.e., regular, uninterrupted periods dedicated to core subjects such as mathematics). For rural and disaster-prone regions in the Philippines, implementing buffer schedules or modular pacing guides may help safeguard math learning continuity.

The discussion must also confront the persistent issue of foundational gaps among students. The fact that many high school learners struggle with operations involving fractions, signed numbers, or basic properties reveals systemic failures in earlier grade levels. These foundational deficits are not just academic concerns—they are deeply motivational. According to Bandura’s (1997) theory of self-efficacy, repeated failure in tasks perceived as basic erodes learners’ confidence, leading to disengagement and learned helplessness. What is needed is not merely remediation, but structured, tiered support systems that differentiate instruction and allow for catch-up without stigma. Approaches such as Response to Intervention (RTI), successfully adopted in various countries, can serve as models for early identification and support (Fuchs & Vaughn, 2012).

Instructional strategies surfaced as both an enabler and a barrier to learning. Students consistently preferred clear, step-by-step modeling, visual supports, and scaffolded instruction—practices well-aligned with cognitive load theory (Sweller et al., 2020). Conversely, rushed pacing, assumed knowledge, and misaligned assessments caused frustration and confusion. While many teachers applied informal differentiation techniques such as peer tutoring, these are not systematic or sustainable in large, under-resourced classrooms. Teacher training must therefore evolve from content-heavy in-service models to pedagogy-focused professional learning communities that emphasize adaptive, student-centered instruction. This includes equipping teachers with tools to assess readiness, design inclusive tasks, and provide formative feedback that guides rather than merely grades.

Closely tied to instruction is the theme of classroom engagement, which emerged as both a prerequisite and consequence of successful mathematics learning. Students who were actively engaged through problem-solving, collaborative work, and game-based learning reported higher motivation and better retention. This supports Fredricks et al.’s (2004) tripartite model of engagement, which emphasizes behavioral (visible participation and sustained effort), emotional (interests, enjoyment, sense of belonging), and cognitive (strategic, self-regulated learning) dimensions. However, engagement is not accidental; it must be intentionally designed. While teachers showed creativity in using games, groups, and visuals, the lack of resources and time often limited these innovations. Institutional investment in manipulatives, ICT integration, and flexible teaching models (such as station rotation or flipped classrooms) can significantly boost engagement while accommodating diverse learners.

Perhaps one of the most critical insights pertains to students' attitudes toward mathematics, which were predominantly shaped by prior experiences of failure, anxiety, and perceived difficulty. Negative emotional responses to math are not new, but they are increasingly recognized as predictors of performance and persistence (Dowker et al., 2016). This study reinforces that attitudes are malleable. When teachers build positive relationships, provide encouragement, and model enthusiasm, students become more open to engaging with challenging tasks. School programs that integrate socio-emotional learning (SEL) in math classrooms (e.g., through reflection journals, peer affirmation, or narrative problem-solving) can counteract long-standing negative dispositions.

Motivation, a related but distinct theme, was shown to be conditional and easily disrupted by mood, cognitive overload, or environmental distractions. Deci and Ryan's (2002) Self-Determination Theory provides a useful framework here: motivation flourishes when students feel autonomous, competent, and connected. However, the dominant experience for many was one of constraint—rigid pacing guides, unfamiliar content, and limited feedback. Game-based learning, project-based math tasks, and real-life challenges (e.g., budgeting, local data analysis) were cited as effective motivators. Hence, a shift toward motivationally rich environments must be a deliberate pedagogical goal, not a byproduct.

The discussion would be incomplete without addressing the resource landscape. Access to traditional materials (books, modules) was uneven and often outdated, forcing teachers to supplement or improvise. Meanwhile, students increasingly turned to online videos and platforms such as YouTube or Google for support. This shift represents a blended learning revolution, yet one that is unfolding unevenly. While digital tools can democratize access and personalize learning, their pedagogical potential is only realized when paired with structure, curation, and guidance (Luckin et al., 2022). As this study shows, some students benefit immensely from educational videos, while others fall into passive consumption or misuse of technology for leisure. Teachers must therefore be trained in digital pedagogy (i.e., not just how to use tools, but how to teach students to learn with them).

Technology's double-edged nature was evident in its capacity to enable shortcut thinking and reliance on AI-generated responses without comprehension. The concern that learners "Google the answer" but cannot explain the process reflects a growing tension between accessibility and authenticity in learning. Critical digital literacy (i.e., the ability to evaluate, interpret, and apply digital information) is a 21st-century skill that mathematics educators must now teach alongside algebra or geometry (İlhan et al., 2024). Institutional guidelines on responsible technology use, as well as embedded tasks that require explanation, reflection, and metacognition, can help prevent over-reliance on tech tools.

Finally, assessment emerged as both a source of motivation and disillusionment. Students valued diverse and engaging formats, especially those involving games, group tasks, or immediate feedback. However, mismatches between what was taught and what was tested eroded confidence and trust. Assessment, when misaligned, acts as a gatekeeper rather than a guide. The findings echo Black and Wiliam's (2009) work on formative assessment, which emphasizes continuous, low-stakes checks for understanding as essential for learning. Teachers must be supported not just to assess, but to assess meaningfully (i.e., crafting tasks that reflect instruction, offering feedback that supports growth, and involving students in the assessment process through self-assessment and peer review).

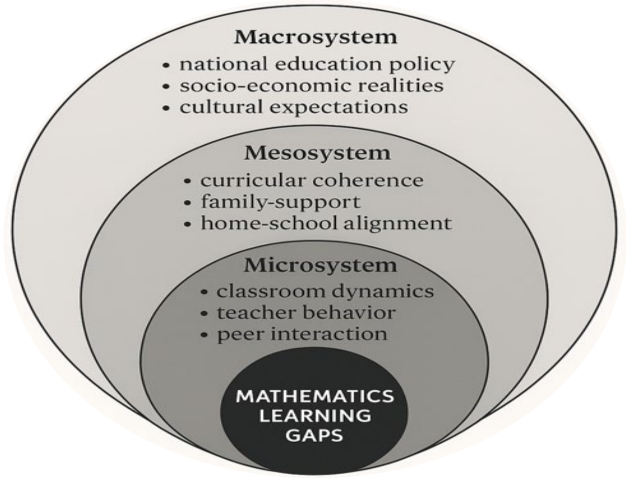

Figure 1 Systemic-Ecological Model of Mathematics Learning Gaps

Conclusion

The study's findings led to the formulation of a Systemic-Ecological Model of Mathematics Learning Gaps (see Figure 1), grounded in Bronfenbrenner's (1979) ecological systems theory. This model recognizes that learning gaps are not merely the result of individual student effort but emerge from dynamic interactions across systems: the microsystem (classroom dynamics, teacher behavior), mesosystem (curricular coherence, family support), exosystem (resource access, internet connectivity), and macrosystem (national education policy, socio-economic realities). To maximize practical relevance, the findings imply differentiated responses across stakeholder groups: teachers must adopt inclusive pedagogies and formative assessments; school administrators should foster enabling classroom environments; district education officers must ensure resource provision and curriculum support; and policymakers are called to enact reforms grounded in equity and systemic responsiveness. The study reaffirms that mathematics learning is not solely about numbers or symbols; it is a reflection of educational equity, systemic coherence, and student empowerment. To theorize the non-attainment of expected competencies is to advocate for a paradigm that values not just achievement, but understanding, engagement, and growth. However, as the study was limited to a single rural public high school and relied primarily on interviews without classroom observations, the transferability of findings may be constrained. Moreover, the relative weight of each factor in the model was not empirically established. Future research may address these gaps by expanding the sample across diverse school contexts, incorporating observational data, and applying prioritization techniques such as the Analytic Hierarchy Process (AHP) or integrating the model into a quantitative validation phase using PLS-SEM.

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