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The Mathematics Academic Divide: Extreme Student Performers in Blended Learning

ALBURAN, Julita N.

0009-0006-8883-4561; University of Eastern Philippines. Catubig, Philippines. alburanjulita9@email.com.br.

A B S T R A C T

The COVID-19 pandemic accelerated the integration of blended learning modalities in higher education, transforming traditional pedagogical landscapes (p. 1). This qualitative phenomenological study explored the lived experiences ("shapes"), challenges, and coping strategies ("shades") of extreme student performers—both high- and low-achieving students—in tertiary mathematics classes at the University of Eastern Philippines during the implementation of an alternating blended learning framework (one week online, one week face-to-face) (pp. 1-2, 4). Guided by social constructivist and personalized learning theories, qualitative data were collected via semi-structured interviews during the second semester of the Academic Year 2022–2023 and analyzed using Colaizzi's method (pp. 1, 4). Five major themes emerged from the thematic analysis: (1) Internet Connectivity and Technological Difficulties; (2) Financial Difficulties and Budget Management; (3) Health, Motivation, and Emotional Struggles; (4) Teaching Strategies and Learning Resources; and (5) Coping Mechanisms and Time Management (p. 1). The comparative analysis revealed that while both cohorts experienced severe infrastructural and economic constraints, high-performing students displayed significantly greater resilience, self-regulation, and adaptive study configurations (pp. 1, 11, 16). Conversely, low-performing students were disproportionately overwhelmed by the digital divide, leading to late submissions and fragmented concept comprehension (pp. 1, 8, 13). These insights offer critical directions for policy formulation, digital infrastructure upgrades, and inclusive instructional design in regional mathematics education (p. 1).

RESUMO

A pandemia de COVID-19 acelerou a integração de modalidades de aprendizagem híbrida no ensino superior, transformando as paisagens pedagógicas tradicionais (p. 1). Este estudo fenomenológico qualitativo explorou as experiências vividas ("formas"), os desafios e as estratégias de enfrentamento ("naturezas") de alunos com desempenho excepcional — estudantes de alto e baixo desempenho — em turmas de matemática do ensino superior na Universidade das Filipinas Orientais durante a implementação de uma estrutura de aprendizagem híbrida alternada (uma semana on-line, uma semana presencial) (pp. 1-2, 4). Guiados pelas teorias socioconstrutivista e de aprendizagem personalizada, dados qualitativos foram coletados por meio de entrevistas semiestruturadas durante o segundo semestre do Ano Letivo de 2022–2023 e analisados pelo método de Colaizzi (pp. 1, 4).Cinco temas principais emergiram da análise temática: (1) Conectividade à Internet e Dificuldades Tecnológicas; (2) Dificuldades Financeiras e Gestão Orçamentária; (3) Saúde, Motivação e Dificuldades Emocionais; (4) Estratégias de Ensino e Recursos de Aprendizagem; e (5) Mecanismos de Enfrentamento e Gestão do Tempo (p. 1). A análise comparativa revelou que, embora ambas as coortes tenham vivenciado severas limitações infraestruturais e econômicas, os alunos de alto desempenho demonstraram resiliência, autorregulação e configurações de estudo adaptativas significativamente maiores (pp. 1, 11, 16). Por outro lado, os alunos de baixo desempenho foram desproporcionalmente sobrecarregados pela exclusão digital, levando a envios tardios e à compreensão fragmentada de conceitos (pp. 1, 8, 13). Esses insights oferecem direções críticas para a formulação de políticas, atualizações na infraestrutura digital e design instrucional inclusivo na educação matemática regional (p. 1).Palavras-chave: Aprendizagem Híbrida Alternada, Alunos com Desempenho Excepcional, Matemática no Ensino Superior, Método de Colaizzi, Exclusão Digital (pp. 1, 4).

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Introduction

The global crisis triggered by the COVID-19 pandemic forced higher education institutions to rapidly abandon conventional face-to-face instruction in favor of flexible learning configurations (p. 2). Among these models, alternating blended learning—a system alternating between one week of digital online delivery and one week of face-to-face instruction—became a standard operational framework to sustain academic continuity while adhering to health protocols (p. 2).

In the landscape of Philippine higher education, this transition was heavily anchored in statutory mandates. Republic Act No. 7722 (the Higher Education Act of 1994) guarantees the protection and promotion of affordable, accessible, and quality education for all citizens (p. 2). To align with this mandate during the pandemic, the Commission on Higher Education (CHED) issued CHED Memorandum Order No. 06, series of 2022 (p. 2). This policy authorized Higher Education Institutions (HEIs) to independently determine, implement, and convert teaching approaches (including flexible, face-to-face, and blended arrangements) based on localized environmental conditions and program outcomes (pp. 2-3).

However, the operationalization of alternating blended learning exposed structural systemic inequalities, particularly within abstract disciplines like mathematics (p. 2). Mathematics instruction fundamentally requires continuous cognitive scaffolding, precise calculation clarity, immediate feedback loops, and highly interactive problem-solving environments (p. 3). Moving these processes to modular distance delivery or unstable online platforms altered how students engaged with mathematical content (pp. 2-3).

While baseline digital readiness has been heavily documented, fewer qualitative studies look closely at "extreme performers"—defined here as the distinct cohorts of exceptionally high-achieving and severely low-achieving (challenged) students (pp. 1, 3). Investigating how these two polar groups navigate identical structural constraints provides crucial insight into equity gaps in education (p. 2). This study explicitly addresses this gap by mapping the "shapes" (subjective experiences and barriers) and "shades" (dynamic coping strategies) of extreme student performers enrolled in undergraduate mathematics courses at the Main Campus of the University of Eastern Philippines (pp. 1, 3-4).

Methodology

Research Design

This study utilized a qualitative phenomenological research design to investigate the firsthand lived experiences of students navigating alternating blended learning (pp. 1, 4). Phenomenology is highly suited for this inquiry, as it prioritizes capturing the precise meanings, psychological stresses, and structural adaptations that individuals attribute to a shared real-world phenomenon (p. 4).

Locale and Informants

The study was conducted at the Main Campus of the University of Eastern Philippines (UEP) during the second semester of the Academic Year 2022–2023 (p. 4). Informants were selected from distinct undergraduate branches running tertiary mathematics programs, including the College of Education (BEEd and BSEd tracks), the College of Science, and the College of Engineering (Electrical and Civil Engineering programs) (p. 4).

Purposeful sampling was used to establish two distinct student cohorts (pp. 1, 4-5):

1. **High-performing students:** Those demonstrating consistent academic excellence and top-tier marking indicators within their mathematics modules (pp. 1, 4-5).
2. **Low-performing students:** Those identified as academically challenged or vulnerable to failing within the identical mathematical tracks (pp. 1, 3-5).

Sampling across both target cohorts continued until data saturation was fully realized, ensuring no new thematic frameworks emerged from subsequent interviews (p. 5).

Instruments and Data Collection

Data collection utilized custom-developed, semi-structured interview guides containing open-ended prompt tracks and contextual probing vectors (p. 5). To optimize comprehensibility and capture nuanced emotional accounts, the student guides were adapted into localized languages (p. 5). The structural content validity of the instrument was verified by an expert panel consisting of a PhD in Mathematics, a PhD in English, and a senior phenomenological methodology specialist (p. 5).

Interviews were conducted face-to-face and onsite within locations curated for participant comfort (p. 6). All interactive sequences were audio-recorded with explicit consent, accompanied by contemporaneous behavioral annotations in a field journal to record non-verbal markers (p. 6). Transcripts were compiled verbatim and verified through a member-checking process (p. 5).

Data Analysis

The collected qualitative accounts were systematically processed through Colaizzi's method of qualitative data analysis, which involves (pp. 1, 4, 6):

1. Thoroughly reading transcripts to gain a direct sense of the experiences (p. 4).
2. Extracting specific phrases and significant statements directly describing the blended modality (pp. 4, 6).
3. Formulating contextualized meanings from these significant statements (pp. 4, 6).

4. Clustering the formulated meanings into distinct, organized themes shared across participants (pp. 4, 6).
5. Synthesizing these themes into an exhaustive description to construct a comparative analysis matrix (pp. 4, 30).

Ethical Considerations

Institutional clearance was obtained from university authorities prior to deployment (p. 6). Every informant executed a comprehensive written informed consent form before any interview sequence (p. 6). Strict anonymity was protected throughout by replacing identifying participant details with alphanumeric identifiers (e.g., Student 1, Student 2) (p. 6). All audio and digital assets were securely isolated in restricted local data lockers (p. 6).

Results and Discussion

The thematic analysis yielded five primary structural themes describing the experiences of the extreme student cohorts (p. 1). The sub-sections below contrast the specific realities of low-performing and high-performing students within these themes (pp. 1, 30).

Internet Connectivity and Technological Difficulties

Infrastructural deficits served as a significant systemic barrier for both student cohorts, though their responsive actions differed significantly (pp. 7, 12).

A. Low-Performing Cohort

Low-performing students reported that unstable internet signals and outdated gadgets directly impeded their learning (pp. 8-9, 30). These limitations frequently resulted in missing synchronous classes entirely, missing important updates, and submitting tasks past deadlines (pp. 8-9, 13, 30). For instance, Student 1 highlighted:

"Sometimes I couldn't join online classes because the signal was weak... we needed to rely on YouTube tutorials just to learn." (p. 8)

Furthermore, hardware limitations compounded this academic isolation, as many relied exclusively on basic smartphones that frequently malfunctioned during calculations (pp. 8-9, 30). As noted by Student 4:

"We couldn't understand each other because the signal was weak... Another problem was the gadgets since I only used a cellphone." (p. 9)

B. High-Performing Cohort

High-performing students encountered identical connectivity challenges but demonstrated higher resilience and proactive adaptation (pp. 1, 10-11, 30). Instead of allowing a weak connection to prevent submission, these students altered their schedules to optimize bandwidth (pp. 10-11, 30). Student 5 explained:

"In our place, the signal was weak so I had to wake up early to search the internet." (p. 11)

They proactively navigated their physical environments to find working connections, demonstrating a clear focus on maintaining academic performance despite technical issues (pp. 11, 30). Student 7 shared:

"Here, the internet connection was also weak. We had to search for a place where the signal was strong." (p. 11)

Financial Difficulties and Budget Management

The economic cost of maintaining digital connectivity created widespread stress, altering students' access to instructional materials (pp. 12, 30).

Average Daily Internet Cost Connection for Disadvantaged Students:
Php 50.00 / Day (Often requiring coin-operated "Piso-Wi-Fi" navigation)

A. Low-Performing Cohort

For low-performing students, the ongoing cost of internet access was an immediate barrier (pp. 12, 14, 30). Many depended on localized, coin-operated Wi-Fi machines ("piso-wifi"), which provided unstable access based on available pocket money (pp. 9, 13). Student 6 stated:

"We had financial difficulties... To use the internet, we had to spend 50 pesos a day, and that was already a lot for us." (p. 13)

When financial resources ran low, these students faced delayed submissions and missed updates, without displaying alternative ways to adapt (pp. 12-14, 30).

B. High-Performing Cohort

High-performing students faced similar financial challenges but found creative ways to manage their limited resources (pp. 14, 16, 30). They shared hardware, planned their mobile

data usage carefully, and recognized the financial advantages of remote learning, such as saving on travel and lodging (pp. 14-15, 30). Student 1 stated:

"During my first year, there was only one cellphone, and my brother and I would take turns using it." (p. 14)

Student 5 observed the relative economic benefit:
"During that time, my parents were struggling financially, so online learning was an advantage because we didn't have to spend on a boarding house or transportation." (p. 15)

Health, Motivation, and Emotional Struggles

The isolation of online learning and prolonged screen time caused noticeable physical and emotional strain across both groups (pp. 16, 31).

A. Low-Performing Cohort

Low-performing students were often overwhelmed by stress, which disrupted their study habits and focus (pp. 16, 18, 31). They reported physical issues like fatigue and overthinking about grades, alongside personal health difficulties (pp. 17-18). Student 3 noted:

"Your mental health suffers because you're always glued to gadgets, and you feel disappointed when you can't submit on time, and you start overthinking about your grades..." (p. 17)

Physical health problems, such as hearing difficulties mentioned by Student 7, further complicated their ability to follow online lectures:

"I also had a hearing problem because my left ear was not functioning... The teacher's voice was not loud enough for me to hear the lessons properly." (p. 18)

B. High-Performing Cohort

High-performing students also experienced physical stress and health challenges but relied on personal goals and family support to maintain their academic motivation (pp. 18, 20, 31). Student 3 shared:
"Failing felt unfair to me before... but I would think to myself, 'I can still recover.'" (p. 19)

Even when facing heavy workloads that disrupted their routines, they focused on the long-term utility of the subject matter to keep moving forward (pp. 19-20, 31). Student 5 noted:

"Sometimes I would forget to eat to the point that my stomach would hurt because of so many online activities." (p. 19)

Teaching Strategies and Learning Resources

The transition to digital materials and independent modules shifted the responsibility of learning toward the students, highlighting a clear gap in how each cohort handled self-directed study (pp. 20, 25).

A. Low-Performing Cohort

Low-performing students struggled with independent module study, frequently experiencing confusion without structured teacher guidance and regular feedback (pp. 20, 22, 31). Student 2 explained:

"Modular learning was through online sources; we would just download the PDF files and study by ourselves... Sometimes the process was really hard to understand." (p. 21)

Student 5 also highlighted how a lack of academic feedback made it difficult to monitor their own progress:

"Learning through modules was good... My only problem was after submitting my modules, I didn't receive feedback." (p. 22)

B. High-Performing Cohort

High-performing students engaged actively with the provided materials and sought out additional resources to master complex topics (pp. 23-25, 31). They utilized problem sets for deliberate practice and turned to online search tools to clarify unfamiliar concepts (pp. 23-25). Student 1 shared:

"The problem sets given by Sir Bless really helped us because the more he gave, the more we mastered the topic in integral calculus." (p. 23)

Student 8 highlighted their immediate, proactive approach to addressing gaps in understanding:

"In online learning, when there were parts of the lesson that I didn't understand during the discussion, I would immediately search them on Google." (p. 20)

Coping Mechanisms and Time Management

Students' ability to organize their time and maintain study discipline was a major factor influencing their final academic outcomes (pp. 25, 29).

A. Low-Performing Cohort

Low-performing students attempted to set study schedules, but their efforts were frequently disrupted by personal responsibilities, social media, and a lack of consistent study habits, often leading to cramming (pp. 25-27, 31). Student 5 admitted:
"Sometimes, I had difficulty organizing my tasks... Social media was a distraction, and my focus would get divided." (p. 26)

B. High-Performing Cohort

High-performing students maintained strict study discipline, dedicated extra hours to mastering the material, and regularly collaborated with peers to ensure they met their academic deadlines (pp. 27-29, 31). Student 1 stated:
"When it came to time management, I really stayed up late to make sure I could pass requirements on time." (p. 28)

Student 2 also emphasized their proactive approach to peer learning:
"If you are really willing to attend class, you will really find ways... even voluntarily approaching classmates who already understand the lessons." (p. 28)

Table 1:

Comparative Matrix of Extreme Student Cohort Experiences: The structural differences between the two student groups across the five core themes are summarized below (p. 30):

Analytical Theme	Low-Performing Students	High-Performing Students
3.1 Tech & Connectivity	Missed classes, delayed submissions, relied on basic smartphones that encountered technical issues (pp. 8-9, 30).	Navigated physical locations for signal, altered study hours, used mobile devices strategically (pp. 11, 30).
3.2 Financial Management	High financial stress from data costs, relied on inconsistent coin-operated Wi-Fi networks (pp. 9, 13, 30).	Shared hardware resources, budgeted data tightly, minimized non-essential internet use (pp. 14, 30).
3.3 Emotional Health	Overwhelmed by anxiety, experienced mental exhaustion, struggled to balance health with studies (pp. 17, 31).	Maintained motivation through long-term goals and family support, practiced self-care (pp. 19, 31).
3.4 Resource Utilization	Experienced confusion with standalone modules, lacked consistent instructional feedback (pp. 21-22, 31).	Used problem sets for deliberate practice, proactively researched concepts online (pp. 20, 23, 31).
3.5 Time Optimization	Encountered difficulties with task organization, faced distractions, prone to cramming (pp. 26, 31).	Maintained strict schedules, extended study hours, utilized peer learning networks (pp. 28, 31).

Conclusion and Policy Recommendations

The qualitative findings indicate that alternating blended learning introduces significant structural challenges for all students, but low-performing individuals remain particularly vulnerable to the negative impacts of the digital divide (p. 32). While high-achieving students rely on personal discipline and adaptive study strategies to maintain performance, less-prepared students face a combination of technical, financial, and emotional challenges that directly hinder their academic progress (pp. 1, 32).

To address these disparities and build a more equitable learning environment, the following institutional interventions are recommended:

Targeted Digital Aid: Establish institutional partnerships to provide subsidized data access and device-lending programs specifically for financially vulnerable students (pp. 1, 32).

Structured Instructional Feedback: Mandate consistent feedback timelines for modular submissions to guide students who struggle with independent study (pp. 22, 31).

Peer Support Systems: Create organized peer-tutoring networks that connect high-performing and low-performing students to encourage collaborative problem-solving (pp. 28, 31).

Mental Health Resources: Provide accessible counseling and time-management workshops to help students navigate the emotional stress of non-traditional learning models (pp. 1, 31).

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