

Women at the Forefront: Narratives of High-Achieving Women STEM Students Through Astin's Student Involvement Theory

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ABSTRACT

The educational system has raised growing concerns in the field of science education, particularly in relation to the learning achievement among students in the STEM strand, as the lack of experiential and focused learning has become a pressing issue in the academe. This study explores the stories of high-achieving women STEM students before and during the pandemic and aims to unearth insights from those experiences. The study utilized a qualitative design following a narrative approach to examine the three consistently top-performing STEM students. Each participant, a consistent honor student from a low-income family, underwent an in-depth interview. Using thematic analysis as a method in analyzing the data, the study exposed the following themes that strongly align

with Astin's Theory of Student Involvement as they underscore students' active investment of time, energy, and commitment in their academic pursuits – persistent striving for academic excellence, navigating learning challenges in unstable learning environments, and perseverance as a coping mechanism in the face of setbacks. The findings highlight how these students navigated their studies and maintained consistent academic performance amid the educational disruptions caused by the pandemic. Each narrative provides significant insights into the perseverance and strategies of top-performing STEM students from low-income families and offers implications for schools and parents, strengthening support for students, especially in times of crisis.

Keywords: *High-achieving students, STEM, pandemic, student involvement, Davao City, Philippines*

INTRODUCTION

Prior to the pandemic, international assessments such as the Programme for International Student Assessment (PISA) had already revealed that globally, the majority of the students require some support to engage with science-related contexts, and even the basic and familiar ones (OECD, 2023). At this level, students are described as “low-achieving students” as their performance in science falls below the expected proficiency levels. The sudden change in the educational system caused by the occurrence of the COVID-19 pandemic further magnified this concern. According to UNESCO, the learning loss brought by the pandemic is equivalent to the learning gains in the last two decades (UNESCO, 2023).

In an international context, particularly in European and non-European countries, Di Pietro (2023) found that with the transition from traditional classroom-based instruction to various remote learning, there emerged a concern in an educational context about the poor Science learning performance of the students, particularly those who were studying the Science, Technology, Engineering, and Mathematics (STEM) programs. This requires hands-on laboratory work, comprehensive problem solving, and experiential

learning in which the distance learning could not thoroughly cater (Syauqi et al., 2024). The suspension of face-to-face classes has caused learning loss among students (Engzell et al., 2021).

In the Philippines, it was reported that students' proficiency level in science remained below the global average (Chi, 2023). The results indicated in PISA 2022 revealed that only 28% of the Filipino students could recognize the correct explanation of a familiar scientific phenomenon, which is the minimum proficiency in science. This shows that the country continues to lag significantly in STEM achievement (Ines, 2023). Moreover, Bernardo et al. (2023) found that Filipino students continue to demonstrate low levels of science proficiency, with many learners struggling to meet basic science literacy standards. Added to these challenges were the experiences of students during the COVID-19 pandemic, when both teachers and students faced substantial challenges in science learning (Adarlo et al., 2023). These included reduced engagement, limited access to laboratory experiences, and technological constraints.

In a context-specific study, a structural equation model of grade 9 learners' science performance in Davao de Oro shows that performance is strongly influenced by instructional management, motivation, and learning environment (Rebucas & Dales, 2022). It can be hindered when hands-on experiences and learning environments are inadequate, as these factors affect students' engagement and interest in science (Elesio, 2023). These influential factors, if not addressed satisfactorily, could contribute to difficulties in achieving high performance among STEM students.

Given the different claims presented in international, national, and local settings, which mostly focused on the impact of the COVID-19 pandemic on STEM education, there are still gaps that warrant further exploration. Existing studies have focused more on the STEM-specific difficulties of the average student population and their learning outcomes than on the lived experiences of consistently high-achieving STEM students (Ives, 2021; Ding et al., 2025). Moreover, Aarntzen et al. (2023) found lower academic well-being among STEM students during the pandemic and highlighted the importance of peer and faculty support, but did not focus specifically on high-achieving students.

A literature review on the learning privileges experienced by STEM students, done by Beruin (2025), found the importance of resilience and adaptation in learning across pre-, during-, and post-pandemic periods, but did not isolate high-achieving STEM students as a distinct group for investigation. These existing studies leave a significant gap in understanding how high-achieving STEM students adapt to and sustain their academic success despite the pandemic-related setback. Addressing this gap is crucial, as UNESCO (2021) emphasizes that a continued decline in student performance in STEM-related fields could have long-term consequences. This includes reduced scientific innovation, reduced competitiveness in the global workforce, and inequality in educational participation and opportunities.

This study was anchored in Alexander Astin's theory of Student Involvement (1984) and used the Input-Environment-Outcome (I-E-O) conceptual model. Through the lens of Astin's Theory of Student Involvement, this study shows how these students invest their time, effort, and engagement in their learning, both academic and non-academic, thereby contributing to their development. This theory served as a guide in giving a valuable interpretation of the shared experiences of high-achieving STEM students regarding their academic involvement, managed challenges, and sustained motivation as they continued their personal and academic journeys before and during the pandemic. This study addresses the gaps of existing studies by employing a qualitative narrative approach through answering the research questions: (1) What stories do top-performing STEM students tell about their academic involvement and engagement in learning activities before and during the COVID-19 pandemic? (2) What insights did top-performing STEM students gain about how their level of involvement influenced their academic success and personal growth during the pandemic?

METHODS

Research Design

This study used a qualitative design and followed a narrative study approach. Bhandari (2025) defined qualitative research as a design used to gain a deep understanding of how a person perceives and experiences a certain event. Furthermore, a narrative model was used in this study to examine the subject at the outset and to review the situations or obstacles the person encounters (McLeod, 2024). The use of this research design and approach was highly helpful in gaining a deeper understanding of the experiences of grade 12 STEM students in their efforts to remain top-performing, as it focuses on personal experiences and people's stories about a stated event.

Research Locale

The study was conducted in one of the private schools in Davao City. This school offers basic education programs, including SHS academic tracks, specifically the STEM strand. The school participates in the government's SHS Voucher Program which provides financial assistance to eligible students enrolled in its SHS academic tracks.

Sampling Technique

The participants in this study were identified using purposive sampling with the following set of criteria: (1) Grade 12 students who completed the STEM academic strand at a private school in Davao City; (2) student must have been consistently on the honor roll before and during the pandemic; and (3) demographic profile of the students was considered, including whether their families were living on a minimum-wage income, to better explore the participants' resilience. There were three (3) target participants who participated in an in-depth interview who were assigned with pseudonyms – Beaver, Fighter, and Tenacious. The parents and teachers of each participant were also interviewed to gather additional information. Ethical principles such as obtaining informed consent, confidentiality, preventing harm, and avoiding misconduct were considered in the conduct of this study.

RESULTS AND DISCUSSION

Persistent Striving for Academic Excellence

They started strong, embodying the traits of an exceptional STEM student with high academic ambitions, driven by personal motivations like inspiring siblings, supporting family, and earning parental pride. They put in extra effort on days marked by structured face-to-face classes, hands-on experiments, collaborative projects, and extracurricular involvement. Before the pandemic, their academic journey revolved around their school and even at home. Humbled by their parents' status as minimum-wage earners, they were filled with a burning desire to be academically successful and to land a job that could meet their family's needs and wants.

Understanding the lessons was easy because the teachers were physically present to guide and help them. Beaver shared, *“About academics, it was somewhat okay because it’s face-to-face, the teacher was there every day.”* Moreover, it was found that motivation from their teachers helped them do well in their studies. A study by Ozcan (2021) found that the presence of teachers in students' learning has a significant influence on their academic success. The research emphasized the importance of a teacher's professional competence, qualities worthy of students' imitation, motivational prowess, and consistent guidance in students' achievement. It is also noted that having meaningful classroom interactions between teachers and students through students' exposure to varied instructional strategies is an important strategy for motivating students (Radil et al., 2023; Diong et al., 2023; Ahn et al., 2021). Moreover, Hiebert and Grouws, as cited by Suhaini et al. (2020), noted that one important factor in students' achievement is proper instruction. The participants in the study reported that as their teachers delivered the lesson, they understood well.

The study also revealed that these STEM students have a strong desire to be part of the honors list. Because of their shared ambition and drive to succeed, they challenged themselves to work harder to reach the desired spot. Beaver narrated, *"I wanted to know what it felt like to be in the top 8, top 9. I actually achieved it, and at that time I thought, 'what would it feel like to be number one?' I ended up reaching that too unexpectedly"*. If a student desires to achieve something, he or she would be very willing to excel in his or her own learning process (Lisá et al., 2023). Additionally, Tenacious shared, *"I'm quite competitive. In the classroom, I always study hard. I spend most of my time studying. I really used to love studying back then."* According to the study conducted by Agustina et al. (2021), students' motivation is positively correlated with their academic achievement. In the current study, participants' strong commitment to academic excellence reflects their high engagement and involvement in their studies, aiming to achieve high grades and be part of the roster of high-achieving students. Although tasked with typical household chores, they still managed their time well and set aside dedicated time to study and complete their schoolwork at home. Fighter shared, *"Before the pandemic, I was very responsible when it came to my studies. I used to set a schedule and list down all my responsibilities, both at home and in school."* Being able to manage oneself requires being responsible with one's time and achieving good outcomes such as independence and academic achievement (Zhao et al., 2023; Siswanto, 2024).

In Astin's theory, these findings are among the inputs to this study, which show the participants' pre-pandemic experiences, motivation, and academic discipline. The findings support this component of the theory, as they highlight how participants invest time and effort in their studies to achieve excellent results. This also shows that the participants, despite their family status, have worked their way up to become consistently top-performing students even before the pandemic.

Navigating Learning Challenges in Unstable Learning Environments

Then, the pandemic hit, and suddenly, their world shifted. Their once-motivated, disciplined, and focused character was disrupted when the pandemic transformed everyone's lives overnight. Modular and online distance learning became the norm for quite some time, requiring students to learn independently. The investigation by Hammerstein et al. (2021) revealed that school closures negatively affected students' learning. The participants narrated how distractions at home, unstable and limited internet access, financial limitations, and the absence of direct teacher supervision made schooling more difficult.

Learning in an unstable environment made them lose interest in learning the lesson on their own, as they found it very exhausting. Beaver lost her rhythm as everything was new to her. No one guided her, which eventually led her to consider just giving up slowly. Beaver narrated, *"At that time, I felt like I was losing energy. While we were having modular classes, I really started to feel tired."* Fighter also shared, *"It was really difficult for me because no one was there to explain things. That was the time when I truly struggled the most."* Students' satisfaction and motivation with their learning are greatly influenced with the presence of classroom instruction and interaction (Baber, 2020; Yao et al., 2020; Yu, 2021). Due to the pandemic, most of the lessons were self-taught through printed modules and YouTube tutorials. According to the study of Mogavi et al. (2021), instructor accessibility and reduced interaction with teachers as significant barriers to active learning in synchronous online classes. It emphasized that the absence of direct guidance may hinder student participation and engagement, thus reduce motivation among students.

Juggling school and home tasks was a challenge for the participants. Beaver expressed, *"At home, I was usually the one who cooked and do the grocery shopping. So, I could only work on my modules when it was almost time to pass them."* The greatest challenge during online learning was the home learning environment, including the household responsibilities that students need to accomplish and other distractions that negatively affected their learning (Barrot et al., 2021; Vallespin & Prudente, 2023). Similar to the participants' narratives, their experiences revealed that studying at home while doing household chores was challenging, as it reduced their focus on studying (Duran & Sumagang, 2022).

Moreover, participants reported experiencing an unstable internet connection, which disrupted learning. Fighter shared, *"Sometimes when I would be in a place with poor signal, it made everything even*

harder. There were times I submitted my work late.” Poor internet connectivity was among the top challenges students encountered during emergency remote learning that affected to students' effective participation in online classes and completing academic tasks (Fabito et al., 2020; Malaga & Salbibia, 2024). These struggles they experienced echo the findings of Adedoyin and Soykan (2020), who noted that remote learning during COVID-19 was characterized by unequal access to learning resources, reduced student motivation, and diminished engagement.

Consequently, inequality in access to learning resources was also due to the family's financial limitations which made self-learning more challenging and stressful (Penaflor et al., 2023). Tenacious shared, *“When I had online classes, it was really hard since I did not have money for mobile data.”* Since learning was done remotely, resources such as internet connection were necessary. With that, because of low socioeconomic status, access to these resources was limited, posing academic challenges for students (Francis & Weller, 2022). This limited financial resources among underprivileged families resulted in a negative attitude towards distance learning, particularly in online mode (Aristovnik et al., 2020). This, in turn, created an unfavorable circumstance for learners who were struggling to meet the academic workloads.

Moreover, just like other students who spent most of their pandemic days at home, the participants also found themselves spending excessive time on their gadgets and doing academic task at the later time. Fighter recalled, *“During the modular setup, I became really lazy. I spent most of my time on my phone, playing online games. Then, when the deadline was near, that's when I would rush to answer everything.”* Additionally, Tenacious expressed the same experience, *“Because of my gadgets, I was always on my phone. I'd forget to do my schoolwork, and when deadlines came, I would end up cramming.”* Studies have reported that the use of digital tools among students increased significantly during the pandemic which made students easily distracted and cannot concentrate well (Bilal et al., 2021; Gökçearsan et al., 2023). It then led to increased academic procrastination (Jin et al., 2024). Students who were frequently distracted by their phones were more likely to delay academic tasks and experience learning difficulties.

Their once-consistent involvement faltered, leading to fading motivation and a sense of disconnection. These negative effects of pandemic made them distant, and it slowly hindered their active engagement in the learning journey that had once burned with hopes of making their dreams come true. This theme supports Astin's theory, which posits that students' learning and development are influenced by the amount of physical and psychological energy they invest in educational activities. The experiences narrated by the participants, such as home distractions, unstable internet connectivity, financial constraints, and limited teacher supervision during the pandemic, illustrate factors that hindered their ability to engage in learning fully. Student involvement was affected, as these challenges reduced opportunities for active participation, interaction, and sustained concentration in their studies.

Perseverance as a Coping Mechanism in the Face of Setbacks

Despite the setbacks, the pandemic's trials became their turning point, helping them continue and regain their footing. They struggled, but they persevered. The participants were forced to confront their disrupted involvement.

The experiences they had during the pandemic made them stronger as a person. They convinced themselves even more of the need to return to what they were used to and persevered to overcome the pull that made their academic life less interesting. Tenacious expressed, *“My mindset is that I need to do well because this is for my future.”* To support this claim, Lee's study, as cited by Rajabalee and Santally (2020), revealed that when students' viewpoints in a situation are positive, they are more likely to be satisfied with their learning experiences. This will lead students to persevere, take full responsibility and initiative in their own learning, which will aid their academic achievement (Matolo, 2022; Chen et al., 2024). As Fighter shared, *“I started working hard, whenever a task was given to me, I made sure to do it right away. I kept pushing myself because I wanted to aim even higher.”* Beaver also expressed, *“It never crossed my mind to stop; I just kept going, no matter what. I have learned to rely more on hard work.”* Several studies also

reported that students with stronger academic drive were more motivated to persist in their studies, even when faced with challenges, and more capable of adapting to changes in learning environments (Chan et al., 2022; Choudhury, 2022). As these high-achieving STEM students were eager to excel academically, their positive thinking made them more aware of what they should do to actively engage in their studies despite the challenges of the pandemic.

They exerted greater effort to reach their full potential while managing their time effectively. These were rooted in the deep motivation they had from their parents, who guided and reminded them to do well in their studies. Fighter shared, *"To ease what I was feeling, I always remember what my mom told me. After that, I would go ahead and do my tasks, even when things were difficult for me."* This parental support has greatly helped her excel in her learning and not give up easily on her dreams. Parental involvement in a student's learning is positively related (Wilder, 2023). Furthermore, this involvement is particularly strong when parents do not exceed their expectations for their children's academic achievement. Thus, excessive pressure on a student's academic performance would negatively affect academic success (Gülbetekin & Tunç, 2022). In the context of this study, they did not set many expectations for their children, but consistent support and reminders were their primary motivational strategy.

On the other hand, the parental support Tenacious received from her parents was quite different from that of Beaver and Fighter. Her efforts came from her desire to receive appreciation from her parents. She refused to surrender. She studied and worked harder to hear that sincere word of recognition from her parents. Tenacious shared, *"One of my biggest motivations is to hear even just a simple "congrats!" from them. That is why, until now, I continue to do my best in school. I want to show my father that there's still a child of his who can finish school, someone who keeps striving no matter how difficult life gets."* A person who receives praise tends to perform better than those who do not receive praise (Liu & Yin, 2026). Students need encouragement, motivation, and appreciation from their parents to support their education, through praising their efforts and accomplishments (Schmid & Garrels, 2021; Eker & Yildizli, 2025). Tenacious expressed the importance of her parents' appreciation and made this desire her reason for persevering in her studies despite the setbacks she experienced during the pandemic.

Another significant realization that these consistently high-achieving STEM students had was their unleashed competitiveness. They transformed their minds for a stronger desire to be more successful. Beaver found herself tutoring her neighbors, realizing that her purpose of learning is beyond personal gain. She worked hard to learn the lessons well so that she could share and teach other students. Beaver mentioned, *"Whenever I teach them, I felt more eager to study the lessons so I could explain better and help my classmates more. Every time they came to me for help, I felt smart, and I realized that I actually knew a lot, and that feeling made me proud."* Umemoto and Inagaki (2023) found that learners tend to focus on and engage in their studies to expand their understanding and abilities with consistency and persistence.

In Gunawan's (2020) study on student learning motivation, it was found that the higher a learner's motivation, the higher her achievement in her educational endeavors. Fighter said, *"I realized that you should not always be content with staying at a low level, you should aim higher."* Beaver also shared, *"I always made sure to produce outputs that were not of poor quality."* One of the factors that influences a person's motivation to learn is their aspirations (Lacey et al., 2022). With that, there is a clear direction and purpose that drives a person to realize her desires, which, in this context, are to be academically successful.

Being adaptive with the challenges of the learning modality, students were able to withstand the demands of the pandemic (Villegas et al., 2024). Fighter mentioned, *"I want my tasks to be organized, and I like having a clear picture of what I need to do and understand everything well."* Moreover, Tenacious expressed, *"I am dedicated. Despite all the experiences I have faced, especially with my father, I kept going."* This implies only that students with a strong desire to succeed demonstrate greater persistence and are more likely to continue studying, even in difficult learning environments.

The strong foundation they had before the pandemic became their lifelines, and the tremendous experiences they had during the pandemic ignited new strengths and capabilities. The theme of

perseverance as a coping mechanism in the face of setbacks highlights students' determination to continue despite academic challenges. Participants described exerting greater effort, maintaining focus on studies, and refusing to give up even when confronted with difficulties. This finding closely aligns with Astin's Theory of Student Involvement, which asserts that students' learning and development are influenced by the time and energy they invest in their studies. The participants' perseverance demonstrates a sustained commitment to learning, as they continued to engage in academic tasks despite setbacks. Rather than disengaging from their studies, they remained actively engaged in the learning process, reflecting a high level of student involvement and resulting in good academic performance.

CONCLUSION

This study set out to narrate the experiences of high-achieving women STEM students before and during the pandemic and to unearth insights from those experiences, using Astin's theory of student involvement, with his IEO model, as the guiding framework. Analysis of interview transcripts revealed three dominant themes: persistent striving for academic excellence, navigating learning challenges in unstable learning environments, and perseverance as a coping mechanism in the face of setbacks. These findings support Astin's assertion that student involvement, defined as the amount of energy students invest in their academic and social activities, is critical to student success. The findings affirm that high levels of involvement, even amid challenges, contribute positively to student outcomes.

Moreover, the study's findings yielded implications for Astin's theory and the IEO model. This includes a more comprehensive understanding of student involvement that incorporates perseverance, dynamic environmental factors, socioeconomic context, and the importance of support systems. These insights can enhance the theory, making it more applicable to contemporary educational challenges, particularly in the context of school disruptions such as the COVID-19 pandemic.

References

- Aarntzen, L., Nieuwenhuis, M., Endedijk, M. D., van Veelen, R., & Kelders, S. M. (2023). STEM students' academic well-being at university before and during later stages of the COVID-19 pandemic: A cross-sectional cohort and longitudinal study. *Sustainability*, 15(19), Article 14267. <https://doi.org/10.3390/su151914267>
- Adarlo, G. M., De Leon, M. M., & Favis, A. M. T. (2023). Unsettling familiar ways of teaching and learning: Challenges in science education during a pandemic. *Philippine Sociological Review*, 71, 71–95. [suspicious link removed]
- Agustina, E. T., Wahyudin, A. C., & Pratiwi, A. A. (2021). The students' motivation and academic achievement at tertiary level: A correlational study. *Journal of Arts and Education*, 1(1), 1–10. <https://doi.org/10.33365/jae.v1i1.33>
- Ahmed, S. (2024). The pillars of trustworthiness in qualitative research. *Journal of Medicine, Surgery, and Public Health*, 2, Article 100051. <https://doi.org/10.1016/j.glmedi.2024.100051>
- Ahn, I., Chiu, M. M., & Patrick, H. (2021). Connecting teacher and student motivation: Student-perceived teacher need-supportive practices and student need satisfaction. *Contemporary Educational Psychology*, 64, Article 101950. <https://doi.org/10.1016/j.cedpsych.2021.101950>
- Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability*, 12(20), Article 8438. <https://doi.org/10.3390/su12208438>
- Baber, H. (2020). Determinants of students' perceived learning outcome and satisfaction in online learning during the pandemic of COVID-19. *Journal of Education and e-Learning Research*, 7(3), 285–292. <https://doi.org/10.2139/ssrn.3679489>

- Barrot, J. S., Llenares, I. I., & del Rosario, L. S. (2021). Students' online learning challenges during the pandemic and how they cope with them: The case of the Philippines. *Education and Information Technologies*, 26(6), 7321–7338. <https://doi.org/10.1007/s10639-021-10589-x>
- Bernardo, A. B. I., Cordel, M. O., Calleja, M. O., Teves, J. M. M., Yap, S. A., & Chua, U. C. (2023). Profiling low-proficiency science students in the Philippines using machine learning. *Humanities and Social Sciences Communications*, 10(1), Article 192. <https://doi.org/10.1057/s41599-023-01705-y>
- Beruin, L. (2025). A systematic literature review of learning privileges experienced by STEM students across pre-pandemic, pandemic, and post-pandemic learning periods. *Discover Education*, 4(1), Article 902. <https://doi.org/10.1007/s44217-025-00902-y>
- Bhandari, P. (2025, February 7). *What is qualitative research? | Methods & examples*. Scribbr. <https://www.scribbr.com/methodology/qualitative-research/>
- Bilal, M. A., Rehman, H. U., Mehmood, K., Fazal, K., Siddiqui, A., Irfan, S., & Shahid, J. (2022). The impact of COVID-19 pandemic on effective learning: Sharing a developing country's experience. *Pakistan Journal of Rehabilitation*, 11(1), 1–8. <http://www.pakjr.com/ojs/index.php/PJR/article/view/1488>
- Chan, S. M., Delatina, A. C., Diego, A. R., & Elarmo, F. (2022). *Academic resilience and academic motivation of senior high school students* [Unpublished manuscript]. ResearchGate. <https://doi.org/10.13140/RG.2.2.21690.20169>
- Chen, D. L., Ertac, S., Evgeniou, T., Miao, X., Nadaf, A., & Yilmaz, E. (2024). Grit and academic resilience during the COVID-19 pandemic. *npj Science of Learning*, 9(1), Article 57. <https://doi.org/10.1038/s41539-024-00265-3>
- Chi, C. (2023, December 9). Philippines still lags behind world in math, reading and science — PISA 2022. *Philstar.com*. <https://www.philstar.com/headlines/2023/12/06/2316732/philippines-still-lags-behind-world-math-reading-and-science-pisa-2022>
- Choudhury, S. (2022). Exigency-driven academic motivation of learners: A comparative analysis during COVID and pre-COVID scenario. *IIM Kozhikode Society & Management Review*, 13(1), 101–114. <https://doi.org/10.1177/22779752221090338>
- Di Pietro, G. (2023). The impact of Covid-19 on student achievement: Evidence from a recent meta-analysis. *Educational Research Review*, 39, Article 100530. <https://doi.org/10.1016/j.edurev.2023.100530>
- Diong, J., Lee, H., & Reed, D. (2023). The effect of face-to-face versus online learning on student performance in anatomy: An observational study using a causal inference approach. *Discover Education*, 2(1), Article 3. <https://doi.org/10.1007/s44217-022-00027-6>
- Duran, R., & Sumagang, E. (2022). STEM students' experiences in modular distance learning amidst pandemic: Basis for academic interventions. *Asia Pacific Journal of Advanced Education and Technology*, 1(2), 1–10. <https://apijnet.com/wp-content/uploads/2022/07/STEM-Students-Experiences-in-Modular-Distance-Learning-Amidst-Pandemic-Basis-for-Academic-Interventions.pdf>
- Eker, S., & Yildizli, H. (2025). The effect of perceived parental academic involvement on achievement: The mediating role of academic motivation. *Psychology in the Schools*, 62(11), 4740–4759. <https://doi.org/10.1002/pits.70036>
- Elesio, J. M. (2023). Science laboratory environment and attitude towards chemistry lessons of senior high school students. *East Asian Journal of Multidisciplinary Research*, 2(2), 839–850. <https://doi.org/10.55927/eajmr.v2i2.3027>
- Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences*, 118(17), Article e2022376118. <https://doi.org/10.1073/pnas.2022376118>
- Fabito, B., Trillanes, A., & Sarmiento, J. (2020). Barriers and challenges of computing students in an online learning environment: Insights from one private university in the Philippines. *International Journal of Computing Sciences Research*, 5(1), 441–458. <https://doi.org/10.25147/ijcsr.2017.001.1.51>
- Francis, D. V., & Weller, C. E. (2022). Economic inequality, the digital divide, and remote learning during COVID-19. *The Review of Black Political Economy*, 49(1), 41–60. <https://doi.org/10.1177/00346446211017797>
- Gökçearslan, Ş., Durak, H. Y., & Esiyok, E. (2023). Emotion regulation, e-learning readiness, technology usage status, in-class smartphone cyberloafing, and smartphone addiction in the time of COVID-19 pandemic. *Journal of Computer Assisted Learning*, 39(5), 1450–1464. <https://doi.org/10.1111/jcal.12785>

- Gülbetekin, E., & Tunç, Y. (2022). The relationship between parental academic success pressure and support and academic motivation of high school students. *Turkish Journal of Child and Adolescent Mental Health*, 29(3), 174–188. <https://doi.org/10.4274/tjcamh.galenos.2021.86658>
- Gunawan, I., Wardani, A. D., Kusumaningrum, D. E., Benty, D. D. N., Sumarsono, R. B., Nurabadi, A., & Handayani, L. (2020). Student learning motivation: A conceptual paper. *Advances in Social Science, Education and Humanities Research*, 478, 49–53. <https://doi.org/10.2991/assehr.k.201112.049>
- Hammerstein, S., König, C., Dreisörner, T., & Frey, A. (2021). Effects of COVID-19-related school closures on student achievement—A systematic review. *Frontiers in Psychology*, 12, Article 746289. <https://doi.org/10.3389/fpsyg.2021.746289>
- Jin, Y., Zhou, W., Zhang, Y., Yang, Z., & Hussain, Z. (2024). Smartphone distraction and academic anxiety: The mediating role of academic procrastination and the moderating role of time management disposition. *Behavioral Sciences*, 14(9), Article 820. <https://doi.org/10.3390/bs14090820>
- Lacey, M. M., Shaw, H., Abbott, N., Dalton, C. J., & Smith, D. P. (2022). How students' inspirations and aspirations impact motivation and engagement in the first year of study. *Education Sciences*, 12(12), Article 885. <https://doi.org/10.3390/educsci1212885>
- Le, H. C., Nguyen, V. H., & Nguyen, T. L. (2023). Integrated STEM approaches and associated outcomes of K-12 student learning: A systematic review. *Education Sciences*, 13(3), Article 297. <https://doi.org/10.3390/educsci1303297>
- Lisá, E., Sokolová, L., Jablonická, P., & Kardelisová, L. (2023). Motivation to succeed is not enough: Motivated students need to know how to plan/organize their steps on their way to success. *Frontiers in Psychology*, 14, Article 1119409. <https://doi.org/10.3389/fpsyg.2023.1119409>
- Liu, C., & Yin, X. (2026). Effects of person praise on students' motivation and performance under ego-involving and task-involving feedback conditions. *Instructional Science*, 54(1), 1–22. <https://doi.org/10.1007/s11251-026-09789-0>
- Malaga, J. R., & Salbibia, M. G. (2024). Student information and communication capability and preferences and the challenges of online learning during the quarantine. *Research Journal of Education, Science and Technology*, 4(1), 1–12. <https://rjest.org/index.php/journal/article/view/72>
- Matolo, M. A. (2022). Modular distance learning: A phenomenological study on students' challenges and opportunities during pandemic. *Journal of Academic Research*, 7(1), 12–25. <https://ejournals.ph/article.php?id=20485>
- McLeod, S. (2024). *Narrative analysis in qualitative research* [Unpublished manuscript]. ResearchGate. <https://doi.org/10.13140/rg.2.2.30491.07200>
- Mogavi, R. H., Zhao, Y., Haq, E. U., Hui, P., & Ma, X. (2021). Student barriers to active learning in synchronous online classes: Characterization, reflections, and suggestions. *arXiv*. <https://doi.org/10.48550/arXiv.2105.04252>
- Organisation for Economic Co-operation and Development. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Ollerenshaw, J. A., & Creswell, J. W. (2002). Narrative research: A comparison of two restorying data analysis approaches. *Qualitative Inquiry*, 8(3), 329–347. <https://doi.org/10.1177/10778004008003008>
- Ozcan, M. (2021). Factors affecting students' academic achievement according to the teachers' opinion. *Education Reform Journal*, 6(1), 1–18. <https://doi.org/10.22596/erj2021.06.01.1.18>
- Penafior, K., Acera, M. A., Melencion, E. J., Ampac, M. E. M., Toribio, A., Gaterin, K. M., Agan, M., Doloritos, G. L., Oracion, X. V., Jamora, B., & Lumanas, K. M. (2023). Students' economic status and access to technology in relation to their academic stress on online learning at the University of Bohol. *Academe*, 22(1), 25–38. <https://doi.org/10.15631/aubgsps.v22i1.186>
- Radil, A. I., Goegan, L. D., & Daniels, L. M. (2023). Teachers' authentic strategies to support student motivation. *Frontiers in Education*, 8, Article 1040996. <https://doi.org/10.3389/feduc.2023.1040996>
- Rajabalee, Y. B., & Santally, M. I. (2020). Learner satisfaction, engagement and performances in an online module: Implications for institutional e-learning policy. *Education and Information Technologies*, 26(3), 2623–2656. <https://doi.org/10.1007/s10639-020-10375-1>
- Rebucas, E., & Dales, Z. (2022). A structural equation model on students' performance in science of Grade 9 learners in Davao de Oro division. *International Journal of Scientific Research and Management*, 8(5), 1–16. <https://doi.org/10.26438/ijsrms/v8i5.116>

- Schmid, E., & Garrels, V. (2021). Parental involvement and educational success among vulnerable students in vocational education and training. *Educational Research*, 63(4), 456–473.
<https://doi.org/10.1080/00131881.2021.1988672>
- Siswanto, S. (2024). The effect of self-directed learning (SDL) in higher education: Increasing student independence and achievement. *Jurnal Inovasi Teknologi Pendidikan*, 11(1), 45–58.
<https://journal.uny.ac.id/index.php/jitp/article/view/60338>
- Suhaini, M. (2020). Factors influencing student achievement: A systematic review. *International Journal of Psychosocial Rehabilitation*, 24(5), 550–560. <https://doi.org/10.37200/ijpr/v24i5/pr201720>
- Syauqi, S. K., Winarno, N., Samsudin, A., Damopolii, I., & Firdaus, R. A. (2024). From online to in-person: Students' motivation and self-regulation in science teaching activities during and after the COVID-19 pandemic. *INSECTA: Integrative Science Education and Teaching Activity Journal*, 5(1), 87–107.
<https://doi.org/10.21154/insecta.v5i1.8689>
- Tran, T., Hoang, A., Nguyen, Y., Nguyen, L., Ta, N., Pham, Q., Pham, C., Le, Q., Dinh, V., & Nguyen, T. (2020). Toward sustainable learning during school suspension: Socioeconomic, occupational aspirations, and learning behavior of Vietnamese students during COVID-19. *Sustainability*, 12(10), Article 4195.
<https://doi.org/10.3390/su12104195>
- Umemoto, T., & Inagaki, T. (2023). Relationships between achievement goals, motivation instability, and learning persistence in asynchronous distance classes. *SAGE Open*, 13(4), 1–12.
<https://doi.org/10.1177/21582440231219075>
- UNESCO. (2021, March 8). *New UNESCO and IEA brief: Missing out on half of the world's potential in mathematics and science*. <https://www.unesco.org/en/articles/new-unesco-and-iea-brief-missing-out-half-worlds-potential-mathematics-and-science>
- UNESCO. (2023, January 24). *Recovering lost learning: What can be done quickly and at scale?*
<https://www.unesco.org/en/articles/recovering-lost-learning-what-can-be-done-quickly-and-scale>
- Vallespin, M. R., & Prudente, M. (2023). *Perception of STEM students in an online learning during the COVID-19 pandemic: Advantages, academic challenges, and solutions*. SSRN. <https://doi.org/10.2139/ssrn.4397421>
- Van Lancker, W., & Parolin, Z. (2020). COVID-19, school closures, and child poverty: A social crisis in the making. *The Lancet Public Health*, 5(5), e243–e244. [https://doi.org/10.1016/S2468-2667\(20\)30084-0](https://doi.org/10.1016/S2468-2667(20)30084-0)
- Villegas, J. P., Nemenzo, P. S., Salutillo, C. T., & Garcia, M. M. (2024). Impacts of pandemic among private university students in Southeastern Philippines: Insights for educational sustainability in the post-COVID-19 era. *Discourse and Communication for Sustainable Education*, 15(1), 5–18.
<https://doi.org/10.2478/dcse-2024-0002>
- Wilder, S. (2023). Effects of parental involvement on academic achievement: A meta-synthesis. In *Mapping the field* (pp. 137–157). Routledge. <https://doi.org/10.4324/9781003403722-12>
- Xu, A. (2022, November 15). *Bridging the gaps in STEM education with Sustainable Development Goals (SDGs)*. AltaSea. <https://altasea.org/xu-post/>
- Yao, J., Rao, J., Jiang, T., & Xiong, C. (2020). What role should teachers play in online teaching during the COVID-19 pandemic? Evidence from China. *Science Insights Education Frontiers*, 5(2), 517–524.
<https://doi.org/10.2139/ssrn.3565608>
- Yu, Z. (2021). The effect of teacher presence in videos on intrinsic cognitive loads and academic achievements. *Innovations in Education and Teaching International*, 59(5), 574–585.
<https://doi.org/10.1080/14703297.2021.1889394>
- Zhao, Z., Ren, P., & Yang, Q. (2024). *Student self-management, academic achievement: Exploring the mediating role of self-efficacy and the moderating influence of gender insights from a survey conducted in 3 universities in America*. arXiv. <https://doi.org/10.48550/arXiv.2404.11029>