

Effects of domestic violence and sexual abuse on STEM academic performance in four case studies

Luis Hernan Arellano-Ulloa

`luis.au@chihuahua.tecnm.mx`

Tecnológico Nacional de México

Julia Liliana Requena-Yáñez

Tecnológico Nacional de México

Gustavo Morán-Soto

Tecnológico Nacional de México

Case Report

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Abstract

This qualitative study refers to 4 engineering students, 2 women and 2 men. The women experienced sexual abuse and had a legal process with their assailants. The men living domestic violence from their parents. 2 main questions were developed in a semistructured interview: what are the effects of violence in your life (physical, emotional, thoughts, behavior, social)? And what can be done to reduce the effects by: you, family, institution, classmates, and professors? The results are analyzed with the professor and student approach to understand how violence hinders the students' learning process. Another follow up questions were developed to profound each case. Trauma effects are observed in these 4 students' life situations: anxiety, depression, sleep deprivation, low self-esteem, failing at class, among other effects that affect the learning process and reduce the opportunities these students have to succeed in education. To reduce these inequalities, students suggest creating support groups, teachers aware of workshops related to violence and other students' conditions, and therapy for the students.

Introduction

Violence is a complex social phenomenon that has been recognized as a global public health problem. According to the World Health Organization, it is defined as the “intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, which results in or has a high likelihood of resulting in psychological harm, injury, death, deprivation, or impaired development” [1, p. 3]. This definition acknowledges that violence encompasses psychological and emotional effects, some of which are silent and persistent. Violence could be classified in different types such as physical, psychological or emotional, sexual, and economic; as well as specific forms like gender-based, school-based, and domestic [2]. It is relevant to note that different types of violence could occur simultaneously, especially in settings where power dynamics and emotional dependency make it difficult to identify and report violent acts, such as domestic, school, and work environments.

Experiencing violent environments could have complex effects on people, and they could address such experiences through trauma. This trauma could be understood as an experience that poses a threat to a person's well-being [3], especially in situations that exceed their coping mechanisms. Current literature suggests that violent environments could have a negative effect on cognitive functioning, making people more likely to experience negative or anxious thoughts, hypervigilance, and difficulties with concentration, memory, and sleep. Likewise, it can impact people's life at an emotional level through panic attacks, depressive states, and feelings of worthlessness; on the behavioral level, people could experience difficulties social isolation; and on the physical level, they can experience fatigue, headaches, loss of appetite, and digestive disorders. In several cases, these responses may include intense emotional expressions, such as crying [4, 5]. These effects can directly affect academic performance and educational retention, particularly within STEM disciplines. In these fields, academic environments are often characterized by an institutional “chilly climate”, that directly affects the academic self-efficacy and persistence of students, both male and female, who are navigating severe vulnerabilities or trauma [6, 7, 8].

Furthermore, the exercise of authority in the family context has been associated with the use of violence, facilitating its persistence despite current efforts to raise awareness and prevent it [9]. Practices such as physical punishment of children, or the normalization of male control over women reflect patterns of violence present in modern society. According to Ayala-Carrillo [10], gender stereotypes continue to attribute socioeconomic superiority to men over women, and in some cases, this superiority legitimizes violence against them and their children, particularly in contexts where authority is exercised in a vertical or top-down structure.

In the family context, the 2015 National Survey of Children and Women, conducted by the National Institute of Public Health and UNICEF, revealed that in Mexico, 63% of children and adolescents between the ages of 1 to 14 experience physical or psychological violence [11]. Furthermore, INEGI reported that, between October 2020 and October 2021, 11.4% of the women population older than 15 years experienced some form of violence within the family context, with psychological violence being the most prevalent (9.2%), followed by economic or financial violence (3.1%), physical violence (3.0%), and sexual violence (1.7%) [12]. When students with stories of domestic violence face academic decline, institutions often evaluate them through grades and test scores. This institutional oversight acts as a direct trigger for epistemic injustice [13, p. 1], as the educational system routinely misinterprets the heavy psychological weight of chronic abuse as a fundamental lack of technical or logical competence.

Constant abuse during childhood, especially if the abuse occurred within the family, can lead to developmental trauma. Developmental trauma refers to the psychological consequences that often result from inadequate upbringing and parenting during crucial stages of child development. Trauma can also stem from natural disasters, exposure to violence such as rape, abuse or shootings, accidents, and sudden losses. Mental health experts define trauma as a stressful event that goes beyond normal experience, is disturbing, and involves a threat to physical integrity or life itself. Some symptoms of traumatized people are: intrusive flashbacks, anxiety, panic attacks, insomnia, depression, psychosomatic disorders, inhibition, violent anger outbursts, destructive behaviors, promiscuity, hyperactivity, anorexia, feeling like a bad person, guilt and shame, dissociation, hypervigilance, feelings of helplessness, inability to learn new information or synthesize, low self-esteem, and decreased motivation to attend classes [14].

Violence in STEM education is a current critical area of research. This type of majors' curriculum often masks systemic or interpersonal violence, making evident the need to conduct more research aiming to help professors to better understand their students emotional and psychological needs and develop better tools to uncover these hidden dynamics. The negative effects that students that grew up in violent environments could experience, can negatively affect their academic performance and educational retention [4, 5], especially during periods of academic transition, such as starting college. This stage in young people's lives is often marked by many changes, such as moving to a new city or gaining greater independence. It also involves making important decisions and establishing habits that will help them tackle the challenges of choosing and pursuing a career path. In this context, the family environment plays a pivotal role, as it can serve as a source of support or, conversely, increase the difficulties of

adaptation and academic performance. It is important to recognize that disciplines like science, technology, engineering, and mathematics (STEM), the academic contexts are usually characterized by high-performance demands, hierarchical institutional structures, gender gaps favoring male students, and competitive evaluation dynamics, and these conditions can increase the impact of adverse factors on student retention and performance [15].

It is likely that experiencing domestic violence extends its negative effects to other areas of an individual's life, including the educational setting. In this context, Durazo Bringas and Ojeda García [16] conclude that individuals who have been victims of any form of violence exhibit a decline in their learning ability, which is reflected in poor academic performance and, in some cases, school dropout. Current literature had identified a link between experiences of sexual abuse and the development of a range of emotional problems, relationship issues, as well as functional manifestations, among others [17]. These physical and psychological components of domestic violence significantly affect college students, as they impair essential functions such as concentration and attention, thereby contributing to anxiety and stress feelings that could hinder their academic performance. These factors can lead to interpersonal conflicts, failing, learning difficulties, adjustment problems, and delays in academic progress [18].

Purpose

Recognizing the vital role that the family environment plays in students' personal development is of paramount importance. Domestic violence can significantly influence the educational trajectory of those facing transitional and demanding stages, such as entering a higher education institution. This is why this study approached this issue from a contextual and educational perspective and without attempting to make clinical or diagnostic interpretations regarding students' mental health, aiming to contribute to a better understanding of some of the factors underlying poor academic performance in higher education. This study tries to contribute to deepening our understanding of the effects of different types of violence in institutional and cultural dynamics in STEM careers, which are often characterized by highly demanding academic environments. Additionally, this study aims to help define violence in STEM as a web of structural, symbolic, and epistemic exclusion that impacts the student's academic trajectory and social integration, and not merely as a direct physical or verbal aggression. Hence, this study is guided by the following research questions:

- How does living in a violent environment affect STEM students' academic performance?
- How do STEM students that have experienced violent environments react socially, cognitively, and emotionally in the educational context?

By answering these research questions, this study seeks to help STEM educators develop better strategies to advise students that may struggle due to their violent context outside the classroom. Understanding of the issues that students experiencing violent environments could have, would provide STEM professors with better tools to give a safe space where students can learn and create academic

networks that help them to successfully complete their college education and pursue a career in STEM fields.

Theoretical Framework

Impact on Psychosocial and Academic Development

Violence could have a negative impact on students' academic performance. For instance, experiencing violent environments could have psychological consequences like anxiety and stereotype threats (e.g., "women are not good at math"), diminishing actual performance on exams and complex tasks [19, 20]. These negative feelings could generate a rational response to an environment that constantly sends signals of non-belonging, making students less likely to successfully complete a STEM major [21]. This is not just an attrition issue; it is disidentification, since capable students that could have completed their degrees if they felt they belong to the STEM culture decide not to continue to protect their mental health. Additionally, experiencing violence could make STEM students more likely to feel excluded from informal networks (mentorship, office hours, study groups), hindering their social capital development, which ultimately affects their possibilities to overcome academic struggles during their college education [22].

The ecosystemic perspective, an approach in education

The ecosystemic perspective advocates for a more holistic and systemic view in addressing psychological problems. Each human being's subjectivity is influenced by their biological structure, family, social, and cultural conditioning, and it seeks to understand how family and social factors affect mental health. This includes behavioral interactions with oneself and with others, taking into account the dimensions of other systems: physical-chemical-neurological, identity-family-society, historical-cultural-spiritual, all within a geographical context creating a more integrative and complex history. It's not just about investigating the problems or symptoms but exploring thoughts, beliefs, sensations, emotions, and memories surrounding the problem [23]. Systemic therapies place the issues of family, couple, and individual contexts in perspective. Systemic therapies locate family, couple, and individual issues within a social and cultural context. They don't treat the individual and their problem in isolation; instead, they consider them in their context. Boff concludes that ecology involves an attitude of looking holistically, which, more than being the sum of the parts, is the organic interdependence of all the elements [24]. Regarding a system, Boff and Zubiri refer to the structural unity formed by its interacting elements [25, 26].

The Structural Dimension: The "Chilly Climate"

Current literature has shifted from viewing discrimination as individual acts to viewing them as characteristics of the environment itself. This concept has been labeled as "Chilly Climate", where academic contexts could be generating the appropriated environment to subtly classify certain groups

(women, racial minorities, LGBTQ+ community) as people that do not belong in such contexts. This segregation could be seen in STEM colleges as this specific context values objective characteristics that are desirable for their students as mathematics and problem-solving abilities, creating a paradoxical mask of subjective biases that may negatively affect the interest and performance of students with different backgrounds and contexts [27]. This constitutes structural violence, as it hinders students' possibilities and will to combat the oppressions they face when they come from different contexts, thereby validating the status quo [27].

Epistemic and Symbolic Violence

Epistemic injustice is a current concept in modern STEM education; it refers to when a subject is discredited in their capacity as a knower due to identity prejudices. In STEM, this phenomenon could be seen when the ideas of minority students are ignored in laboratories or study groups until they are repeated by a person that fits current engineering students' stereotypes [28]. This symbolic violence imposing norms that define who "looks like" a scientist (typically white, male, heterosexual) exerts violence against those who do not fit the mold, forcing them into painful cultural assimilation or attrition [29].

Resilience Mechanisms in Hostile STEM Environments

It is important to analyze how students from minorities navigate hostile environments. Current literature suggests that shifting the focus from an individual trait such as grit [30], to community traits like cultural wealth and strategic navigation could help to highlight students agency over passive strategies, helping them to cope with segregation and negative feelings in STEM education contexts [31, 32]. Students that show resilience behaviors in STEM cultures are usually mentored by a diverse support system, where they can rely on one person or group for technical expertise, another for psychosocial support, and others for career navigation. These support systems could help students to develop the necessary tools to face the STEM violent contexts and overcome their academic deficiencies [33, 34].

Given the "chilly climate" of STEM environments, resilience is often incubated in counter-spaces [30]. These are academic or social settings (e.g., affinity groups like science clubs, or informal study groups) where students with similar contexts and social backgrounds could feel like they belong while they learn and practice STEM topics. Research indicates that these spaces are not merely social; they are epistemic hubs where students exchange vital academic information that is otherwise withheld by the formal structure [34]. The cost of building academic resilience in STEM environments could negatively affect students' interest in pursuing a STEM related major, since they need to work significantly harder than their peers to prove their worth and overcome stereotype threats [29].

Methods

This qualitative study used a multiple case study design aiming to explore the lived experiences of STEM students encountering violent environments. Case studies are particularly effective when the boundaries between a phenomenon experienced by an individual could have some relationship with his/her context, but this connection is not evident [35, 36]. By thoroughly analyzing individuals' experiences as a "case", researchers could develop a deep understanding of participants' personal history; and these histories could be further analyze together aiming to identify cross-cutting thematic patterns through the comparison of multiple case studies from different persons [37].

Participants and Data Collection

Four semi-structured interviews of approximately 60 minutes were conducted with students (2 women and 2 men) enrolled in different engineering majors (see Table 1). These participants were selected following a purposive sampling to ensure a breadth of perspectives across different engineering majors and contexts growing in different violent environments. The same interviewer conducted all interviews, with these two main questions:

- 1. 1. What are the physical, emotional, thoughts, behavior, social effects of violence in your life?
- 2. 2. What can be done to reduce the effects by: you, family, institution, classmates, and professors?

Follow-up interviews were conducted after the first data analysis to collect more information about the most relevant findings coming from each participant. These follow up interviews help researches to better understand participants' experiences and compare similarities and differences between the four participants and develop a thorough response for this study research questions. In alignment with ethical standards for sensitive topics, informed consent was maintained as an ongoing process [38], ensuring that participants were certain that they could withdraw from any data collection point at any moment given the traumatic nature of the subject matter.

Table 1
Cross-case analysis participants description

Participant	Gender	Engineering Major	Age
A	Male	Industrial	19
B	Female	Industrial	21
C	Male	Chemical changed to Mechatronic	22
D	Female	Electromechanics	19

Individual Case Study Analysis

The first stage of the qualitative analysis involved four separate case studies. Each case study was treated as a holistic entity, aiming to preserve the narrative integrity of the four participants' experience. The interview transcripts were analyzed by three researchers with experience conducting qualitative

research following the phases proposed by the thematic analysis outlined by Braun and Clarke [39]. This approach was selected aiming to facilitate a flexible data interpretation based on participants' experiences and their feelings facing different violent contexts. Each case study thematic analysis followed these steps: 1) Familiarization: Transcripts were read multiple times to achieve "data immersion" [40]; 2) Initial Coding: Open coding was used to identify segments related to academic and environmental violence, and how it affected participants learning and academic performance [41]; and 3) Thematic Development: Codes were clustered into themes that described the participant's journey and their coping mechanisms [40].

Cross-Case Analysis

Once the four individual case studies were thoroughly analyzed, a cross-case analysis was performed. This technique facilitated the identification and understanding of patterns, similarities, and discrepancies across participants' experiences [42]. Cross-case analysis helped to move from the individual description of experiencing violent environments in STEM education to a more generalized conceptual understanding of this phenomenon and its effect on participants' academic performance [43]. By constantly comparing the themes that emerged from case to case, shared thematic intersections were identified and elevated to primary findings that guided the discussion and conclusions of this research [35, 44]. The cross-case synthesis helped to thoroughly answer this study's research questions and develop an understanding of how STEM students experience violence, and how these experiences disrupt their academic lives and their interest in completing their major.

Qualitative Analysis Quality Considerations

To ensure the trustworthiness of the findings, this study utilized peer debriefing with a constant discussion about the emerging themes and final findings comparing the four case studies. This constant communication between the three researchers that conducted the qualitative analysis helped to develop a thick description of the individual contexts of all participants, resulting in the development of a good understanding of how STEM students could react to violent environments. Furthermore, researchers practiced reflexivity during their analysis, acknowledging their positions as professors and potential biases during the interpretation of participants' narratives involving violence [45, 46]. This rigorous approach allowed the development of conclusions that could support the design of educational plans and social interventions tailored to ameliorate systemic violent environments in STEM education.

Results

Four Individual Case Studies Analysis

Case Study 1: Student A (Male, Industrial Engineering, 19 years old)

Student A grew up in a household characterized by chronic verbal and physical violence. His mother had him at a very young age (14–16) and his father, whom he met at 15, has never been financially responsible or present as a parental figure. Violence was normalized through belt lashings and constant

screaming for not achieving "perfection" in his grades, even when he put a lot of effort and performed well in most of his courses. He reported that his mother is mentally unstable and she has physically assaulted him, destroyed his property, and stole his savings several times.

After several years of having a negative relationship with his mother, he experienced a complex shift in this relationship. Faced with severe financial instability that threatened his survival, he felt compelled to reconcile with his mother. He reported a significant behavioral shift in her, noting that she now demonstrates maternal affection and financial support, a change he attributes to her recognizing past mistakes. However, this environment remains volatile; her abusive behavior and explosive tendency recur unpredictably, specifically triggered by heavy alcohol consumption, which he identified as the underlying catalyst for the historical family trauma.

Due to constant physical abuse and the lack of recognition of his academic achievements, his academic performance was intrinsically tied to a fear of failure and extreme self-demand. Hence, his learning approach shifted from a growth mindset to a survival mechanism, characterized by the internal pressure: "If I don't get straight A in my grades, I'm going to get yelled at home... I must do it perfectly, if I don't, there's punishment".

This maladaptive perfectionism severely impacted his self-esteem and academic trajectory during subsequent semesters. When forced to balance full-time engineering studies with two jobs to cover living expenses, the acute lack of rest and sleep fragmentation caused him to frequently fall asleep or lose focus in class. Consequently, he had to prioritize labor over academics to avoid homelessness. This compounding stress triggered acute anxiety attacks during high-stakes examinations, inducing a state of psychological shock, cognitive blankness, and intense chest pressure. To mitigate these attacks mid-exam, he utilized 5-second breathing exercises and graphic distraction (drawing on the test paper), though minor details were frequently missed due to the cognitive overload. Ultimately, this resulted in deep dissatisfaction, as his extreme self-demand failed to yield rewarding academic outcomes, leaving him feeling that his immense efforts were in vain.

Experiencing a violent environment had a severe impact on his health, resulting in chronic symptoms such as insomnia, loss of appetite, and physical exhaustion due to overworking even when ill. Additionally, to the physical consequences of growing up in a violent context, Student A reported feeling deep-seated anxiety and a persistent sense of guilt about the wrong things going on around him, making him feel that he was the problem and most things were going bad because of him. These negative feelings complicated his communication with others, generating social withdrawal and a lack of desire to make friends and networks that may help him to overcome all these issues, with comments such as: "The stress was overwhelming... I became a distant, curt, aloof person, mired in a thousand negative thoughts".

Over time, these chronic stressors manifested in severe physical and psychological pathologies. Student A was recently diagnosed with a weakened cardiovascular condition, with medical professionals indicating that his cardiac strain compounded by a family history of heart problems has likely reduced

his lifespan. To cope with these intense emotions and panic-induced chest pressures, he sought formal psychological therapy to acquire emotional regulation techniques. He also adopted physical exercise, specifically gym routines and sports, as a constructive mechanism for emotional release and cardiovascular rehabilitation.

Student A found vital support through his grandmother, who provided him with a secure place to live to prevent homelessness, establishing a reciprocal care dynamic that substituted for his absent parental structure. Additionally, he maintained a strong connection with a classmate who introduced him to a lawyer to document domestic abuse and threats. He was also introduced to his half-sister as a young adult, who provided him with a profound sense of acceptance and love, leading him to reflect on his normalization of abuse: "You think it's normal, the shouting, the things people say to you... until you get to know more about other people's environment, then you finally realize it."

He emphasized the critical importance of achieving financial independence and maintaining personal readiness to capitalize on growth opportunities despite chronic anxiety, stating: "The important thing is not to seize the opportunity, but to be ready to seize the opportunity, because change begins once you want to change." He also stated that interpersonal networks remained the cornerstone of his survival, with comments like: *"people have been my greatest strength in these moments when I even forget about myself"*. His maternal relationship shifted primarily to his great-grandmother, stating that without her presence through his darkest periods, he would have abandoned his pursuits entirely. Furthermore, romantic interpersonal dynamics briefly served as a catalyst for emotional growth. Although his relationship with a partner ended abruptly due to personal missteps, the experience was pivotal in mitigating his anxiety, restoring his desire to live, and teaching him to open emotionally to others.

Despite lingering psychological scars and academic setbacks, Student A maintains a resilient, forward-looking trajectory, concluding that while willpower alone cannot instantly erase trauma, continuous perseverance is the only mechanism to ensure future recovery, stating comments like: *"You can give it all of you, over and over... yet, the only answer is to push forward and keep going, because that scar won't last forever, and what you do today might be reflected in the future"*.

Case Study 2: Student B (Female, Industrial Engineering, 21 years old)

Student B was a victim of sexual abuse and pedophilia by a family member starting at age nine. At that developmental stage, she experienced profound confusion and self-blame, lacking the cognitive framework or sexual vocabulary to understand concepts like pedophilia, which led her to maintain silence until the abuse escalated and nearly culminated in rape. Although her parents initially dismissed her, telling her not to "bother" and to "go play", they later understood the complexity of her situation and fought for her justice. Her parents and brother became her core supportive framework during her therapeutic and judicial processes. However, she experienced severe frustration and emotional distress due to the lack of judicial resolution and the pervasive judgment of her extended family.

Experiencing sexual abuse severely deteriorated her mental health, and she was diagnosed with depression at a very early age. She felt profoundly disappointed and betrayed when extended family members chose to stay silent, defend the aggressor, or accuse her of fabrications, undermining her capacity to develop trust in interpersonal relationships, with comments like: "Impressively, no one has spoken to me. Once, a cousin called me and told me I was crazy because I had been raped. That happened recently and it hurt a lot. It happened last semester; I started crying and locked myself in the bathroom. It brought me right back to that moment." This secondary victimization remained chronic into her adult life; during family legal proceedings and separation, extended relatives actively ostracized her from family networks and labeled her as "dramatic" when she established strict boundaries, such as refusing to attend gatherings where the abuser was present.

These chronic family conflicts and the ongoing criminal proceedings directly impaired her academic development. She experienced acute anxiety attacks and profound emotional exhaustion every time she faced threats from relatives or had to relive her trauma while testifying in court. Consequently, she suffered severe cognitive and behavioral disruptions during higher education, frequently dissociating during lectures, experiencing cognitive blockages, and abandoning or missing examinations due to uncontrollable intrusive thoughts and anger, reporting that: "I normally freeze up during exams, and I have anxiety attacks... And because of that, I usually leave exams unfinished due to intrusive thoughts." This psychological burden heavily diminished her academic self-concept, causing her to experience severe insecurity and feel intellectually inferior to her peers within the classroom environment.

Despite these severe impediments, Student B exhibited academic resilience, successfully advancing to the final stages of her Industrial Engineering curriculum. While she credited her grandmother as her primary childhood confidant and valued multi-contextual psychological therapy as crucial for her mental health development, her later coping mechanisms evolved to incorporate peer modeling and cognitive restructuring. By observing resilient and high-achieving peers, she internalized vital self-regulatory tools, specifically persistence, perseverance, and the capacity to prioritize her own academic goals over external demands, with comments such as: "I obtained them [persistence and perseverance] through the inspiration of seeing other people like my brother, my professor, and professionals that inspire me... I have met classmates; a friend of mine has the highest GPA in the entire university, I learned a lot from her; I look at her." Her perception of higher education shifted by surrounding herself with motivating faculty members and supportive peer networks, and she cultivated a renewed sense of purpose and affection for her academic path, helping her to transitioned from being highly withdrawn to expanding social circles across multiple university faculties. In terms of trauma processing, although environmental stimuli (such as anti-violence campaigns or posters) continue to act as psychological triggers, she successfully developed cognitive reframing strategies that allow her to regulate her thoughts and prevent emotional destabilization.

Student B stressed the absolute necessity of support systems that validate victims' testimonies without generating secondary shame or re-victimization. Interpersonally, her engagement with external legal and advocacy spaces allowed her to form strategic peer support networks with other female survivors of

domestic and physical abuse. Sharing these narratives provided her with critical cognitive clarity, enabling her to identify and successfully terminate toxic relationships that had previously compounded her psychological distress.

She emphasized preventative structural changes, noting that strict parental respect regarding children's physical boundaries, such as not forcing them to perform physical greetings with relatives, is a critical foundational barrier against intra-familial abuse, with comments like: "At the age I was back then, I came to think that it would all be my fault. I was afraid of being scolded, because I was a child facing the world of adults. For that reason, I kept silent, until the abuse was about to turn into rape." Ultimately, through sustained therapeutic intervention and robust core-family backing, she reestablished high levels of self-confidence and determination, actively pursuing her professional aspirations with the firm internal conviction that her history of trauma does not define her capacity for future advancement.

Case Study 3: Student C (Male, Engineering Student)

Student C experienced a home environment where every conflict was resolved, fighting each other. While his father used hurtful words, his mother was the primary physical aggressor, hitting him with objects like pans on several occasions, with comments such as: "In my family there was always a situation that caused friction, and they resolved it with physical violence." This violent home environment caused him to develop constant feelings of stress and anxiety, leading him to chronic depression and a requirement for psychiatric medication since he was 14 years old. He reported having multiple suicide attempts between 2020 and 2024, alongside experiencing severe fainting episodes and acute energy depletion due to trial-and-error adjustment phases with psychiatric medications and different psychological approaches to manage his severe depression issues.

He went through a fundamental shift in perspective regarding his family dynamics, abandoning the exhaustive search for historical culprits or the futile effort to repair his immediate environment. By shifting toward a posture of compassionate objectivity, he began accepting reality as it is, decoupling his emotional state from collective family tensions, with comments such as: "my family remains fractured, and navigating it requires an emotional diplomacy that exhausts the spirit". While the overall family ecosystem remains undeniably complex, he managed the situation to develop one-on-one connections with each of his parents individually. This dual landscape forced him to re-evaluate blood ties and lead him to protect his internal balance through rigorous emotional boundary-setting and cautious diplomacy.

All the physical and cognitive consequences of his depression caused him to develop a deeply shy and antisocial behavioral style during high school. He systematically avoided expressing his opinions or contradicting his professors and classmates due to a deeply ingrained fear that any form of intellectual disagreement would inevitably trigger a violent response. Consequently, he constantly felt detached and disconnected in class, which severely hindered his ability to resolve academic doubts, clarify complex conceptual questions, or participate in meaningful ideas to interact with his peers. This historical communicative reticence underwent a profound metamorphosis during his final semesters. The severe psychological barriers and social anxiety that previously induced withdrawal and silence progressively

crumbled, allowing him to forge a new capacity to articulate complex thoughts aloud and participate assertively in collective university spaces, with comments like: "I feel more confidence exposing my ideas in front of others, and less anxious about the consequences of communicating what I'm thinking." This sociability breakthrough was not merely a superficial behavioral modification, but rather the external projection of newfound internal clarity; by thoroughly dismantling his fear of the external gaze through reason, he transformed what was previously conquered territory into a space of active, serene contribution.

Student C reported finding vital comfort in writing down his thoughts and reading all kind of books in absolute solitude. Despite maintaining a very restricted social circle, his best friend from college was highly influential in helping him see life from an entirely different perspective, which ultimately helped him to feel better and perform more effectively in his academic tasks. As his engineering curriculum advanced to highly demanding core coursework, writing and reading persisted as the foundational pillars for untangling internal chaos. He practiced poetry as an aesthetic channel that transformed raw pain and melancholy into art, while formal philosophy provided the cognitive framework necessary to reason through his place in the world.

Student C stressed the fundamental importance of having university professors who display genuine empathy toward their students, noting that educators must remain acutely aware that students may be enduring complex invisible traumas outside their academic life. He suggested that basic institutional interventions, such as an educator simply asking, "How are you?", could decisively help academic bodies identify student needs and latent mental health crises before they result in attrition. Furthermore, he critiqued existing institutional limitations, noting that contemporary higher education institutions urgently require a significantly larger volume of psychological staff, as a pair of psychologists is mathematically insufficient to properly handle the massive volume of students requiring clinical help, with comments such as: "It would be great if there were more psychologists on campus, 2 [psychologists] for 5000 students it's not enough."

As his engineering major advanced, his survival structure evolved into a harmonious convergence of three core axes: rigorous study, labor obligations, and strict physical conditioning. Rather than acting as a destabilizing strain, the high academic workload and simultaneous job commitments forced the development of ironclad discipline, exceptional time management, real-world problem-solving skills, and accelerated professional maturity, with comments like: "At first, balancing work and academic responsibilities was complicated; however, over time you develop efficiency and foster discipline. I believe that work is not an obstacle, but rather a factor that adds value in various aspects of my life." Furthermore, the gym was reframed as a natural sedative that completely dissolved somatic tension, transforming chronic stress into a rewarding sense of duty fulfilled. Ultimately, through deliberate self-exploration, internal vigilance, and structured routine, he achieved a state of deep calm and peaceful freedom, marking the definitive cessation of his internal warfare. His most vital psychological milestone manifested in the drastic, sustained reduction of self-destructive and suicidal ideation, making him a

highly resilient, mindful, and autonomous version of the self that inhabits its own mind without fear and protects his internal peace.

Case Study 4: Student D (Female, Engineering Student)

Student D was sexually abused by her mother's romantic partner. Her aggressor was a non-permanent resident in her home, but he was always around because he was the father of her younger sister, and he used the work environment and money as a lure to get close to her, with comments such as: "He would say to me, let's go to work, and all I was thinking was the money... Then he started getting closer to me, in an unusual way, with bad intentions." This sexual abuse was compounded by complex structural fractures within her family; her biological father separated from her mother when she was nine years old, and he always pressured her to accelerate her academic progression. Following the separation, her father established a new household, and his current spouse actively disenfranchised her and her sister, claiming they were not his legitimate daughters and asserting that his financial and paternal obligations belonged exclusively to his new stepchildren.

The psychological toll of her trauma was exacerbated by prolonged institutional and judicial systemic stress. Although her mother took immediate action to report the abuse once she spoke up, the subsequent legal process imposed an overwhelming burden. During the legal process, she always felt acute tension and hyper-sensitivity, and the physical presence of her aggressor compromised her cognitive capacity and safety perception. After sexual abuse she experienced a sense of "innocence lost", which made it difficult for her to talk about this negative experience. She also suffered from a lack of institutional empathy from early therapists who didn't take her seriously, making her feel isolated, with comments such as: "I mentioned that to the first psychologist, but she didn't take it seriously." These negative experiences led her to develop severe physical symptoms that negatively affected her health and self-confidence.

The accumulation of traumatic experiences deteriorated her academic performance and classroom integration. The chronic stress of the legal process compromised her ability to focus on learning, which ultimately caused her to fail a couple of courses and get behind in her classes. This academic vulnerability was worsened by a hostile peer climate; when seeking academic assistance from classmates in technically demanding courses, she encountered judgmental, dismissive, and mocking behaviors rather than supportive collaboration, with comments such as: "I asked my classmates for help with some circuit topics and they didn't help me... they acted like jerks or just judge me for not knowing that." In an attempt to meet external expectations and compensate for past delays, she pushed herself beyond her healthy boundaries, triggering a severe psychosomatic cycle where heightened stress led directly to a neglect of foundational self-care, with comments like: "the more I push myself, the more I start forgetting about myself in terms of sleeping and eating."

To counteract this destabilization, her coping mechanisms underwent an evolution. While she usually utilized manual crafts like crochet as a therapeutic distraction to anchor her attention away from the trauma, she later integrated targeted clinical psychology. The therapeutic intervention helped her

understand the importance of boundary-setting, and to successfully maintain authority and rules in her external workplace, with comments like: “The last time I was in therapy really helped me a lot, and basically, it helped me a lot with how I feel, which is the most important thing for me”.

Student D highlighted critical structural adjustments needed within the higher education landscape. She stressed the importance of having sensitive professors who care about their students as human beings, rather than treating them merely as another task to accomplish. Furthermore, she emphasized that academic institutions must actively dismantle intimidating pedagogical styles, noting that unapproachable teachers combined with mocking peer environments create learning barriers and prevent students from resolving academic doubts or participating in class, with comments such as: “Right now I’m in a summer course, and with the teacher I’m with, he seems really intimidating. I don’t know if it’s just me, but it can actually be scared to ask because of how he is. I don’t feel like he’s 100% approachable for questions.”

The results of the four case studies were summarized in Table 2 to facilitate the analysis of each case and the comparison between cases.

Table 2
Principal findings of each of the four cases studies

Category	Student A (AC17)	Student B (EM10)	Student C (RL16)	Student D (SV15)
Type of violence	Domestic, physical, psychological, and economic.	Domestic, sexual, and physical.	Domestic, physical, psychological, and economic.	Domestic, sexual, and physical.
Emotional impact	Anxiety, depression, low self-esteem, despair, guilt, stress.	Anxiety, depression, crying, guilt.	Anxiety, depression, guilt, hate, desperation, impotence.	Anger, crying, frustration, sadness.
Academic impact	High performance based on self-demand and extreme perfectionism.	Low performance, withdrawal from exams, absenteeism, and difficulty studying.	Academic lag, career change.	Decreasing performance, failed subjects, and lack of concentration.
Social impact	Social isolation, reluctance to interact with classmates, shyness.	Marked social isolation, dual behavior, struggles in affective bonds.	Marked social isolation, fear of expressing opinions, reluctance to interact with classmates, shyness.	Socially functional but hypervigilant and alert to men.
Risk factors	Self-harm, lack of support, homelessness, suicide attempts.	Dwelling on the past, recurring negative thoughts, suicide attempts, evasion, revictimization.	Hostile family environment, recurrent negative thoughts, suicide attempts.	Hostile family environment, dwelling on the past, pending legal proceedings, revictimization.
Physical symptoms	Hair loss, insomnia, loss of appetite, panic attacks, extreme fatigue.	Hair loss, insomnia, loss of appetite, dermatitis, stress-induced acne, tremors.	Insomnia, fatigue, fainting, side effects of medications.	Dermatitis, loss of appetite, fatigue.
Current family relationship	Tense	Close to the nuclear family, distant from the extended family.	Improving	Hostile

Note: codes in the table headers (e.g., AC17, EM10) represent internal tracking identifiers used by the research team during the transcription and coding phase and paired with the participant pseudonyms (e.g., Student A) to maintain a strict audit trail while ensuring absolute anonymity.

Category	Student A (AC17)	Student B (EM10)	Student C (RL16)	Student D (SV15)
Psychological support	Inadequate	Inconsistent	Prolonged	Inconsistent
Coping strategies	Therapy, support networks, financial independence, entrepreneurship, strong mindset.	Improving study habits, inspirational figures, goals, dreams, and self-motivation.	Writing, reading, therapy, having a job, strong analytical thinking.	Crochet, having a job.
Lifelines	Half-sister, great-grandmother, youth workshops, support networks, therapists.	Constant support from parents, best friend, siblings, teachers.	Friends, therapist, cousin, resilience.	Therapist.
Recommendations to universities	Better support networks, empathetic teachers, and well-trained psychologists.	Empathetic teachers.	Empathetic teachers, increasing access to mental health services.	Empathetic teachers, promoting better rapport within classmates.
Recommendations to other victims of violence	Seek support, seek someone to trust, do not normalize abuse, appreciate opportunities, hope, and patience with the process of change.	Seek support, seek someone to trust, surround yourself with positive friends, patience with the process, do not give up, set goals for the future, speak up, and awareness of depression signs.	Seek psychological help, learn to manage your emotions, do not isolate yourself, express yourself, ask for help, and challenge negative thoughts.	Be patient, try to understand what you really want.
Note: codes in the table headers (e.g., AC17, EM10) represent internal tracking identifiers used by the research team during the transcription and coding phase and paired with the participant pseudonyms (e.g., Student A) to maintain a strict audit trail while ensuring absolute anonymity.				

Findings of the Cross-Case Analysis

After the cross-case analysis of the four case studies, some similarities between the experiences of each participant were clustered into common themes. These themes helped to describe the participants' experiences and developed a better understanding of the challenges that students coming from violent contexts could face during their college education. The four common themes were labeled as:

1. Normalization of a violent environment: A significant theme was the initial normalization of violence, with participants struggling to understand the severity of their cases and how constant abuse

affected their mental and physical health. Both students A and D noted that they didn't realize they were living in extremely violent contexts until they compared their environment with others.

2. Academic challenges: All four participants reported experiencing issues understanding their class material and concentrate during their classes due to the constant depression generated by their violent context growing up. Engineering students' academic struggles normally trigger high anxiety levels, creating a vicious cycle that made participants fail courses and perform poorly in their college courses. Student A reported that his grades were a source of constant stress, as he was punished if his academic accomplishments were less than "perfect A" all the time. In student C case, the trauma caused by his violent environment directly interfered with the high cognitive demands of testing, making it very difficult for him to complete a test without experiencing anxiety attacks even when he felt prepared to perform well in such test.
3. The family paradox in violent environments: While close family members were the source of violence for all four participants, other family members emerged as the primary "lifelines" for support and understanding even when they were not as closely related to the victims as their aggressors. All participants reported that finding relatives and friends that helped them to understand the complexity of their situation and provided them with the necessary love and companion was instrumental in surviving their negatives experiences growing up in a violent home.
4. Institutional lack of interest and support systems: The four participants highlighted the need for more empathetic and accessible institutional support. They stressed the importance of professors' empathy and understanding when they see one of their students struggling in the class and suggested that professors should be better prepared to identify students with mental health issues by asking simple questions about their daily life. They also mentioned the need for more trained staff to help students with depression and anxiety issues, as student C explicitly mentioned the inadequacy of having only two psychologists for 5,000 students.

The key differences found between cases were highlighted aiming to facilitate the understanding of the struggles that engineering students experienced according to their contexts. These differences were labeled as:

1. Nature of the violent environment: Although the four participants reported violence within their family members, the cases spanned from systemic domestic physical abuse (men students A and C) to target sexual abuse by closed and extended family members (women students B and D).
2. Coping mechanisms: The biggest difference between participants was the coping strategies that they developed to deal with the consequences of living in a violent environment. These coping strategies varied from externalizing productivity and entrepreneurship (student A) to internalized creative outlets like writing and learning new hobbies like crochet (students C and D).
3. Outcomes of experiencing violence: Students B and D decided to take legal action against their abusers. They reported feeling anxiety and stress during the legal process as they had to relive their traumatic experiences. At the end, they felt disappointed with the legal consequences that their abusers had to face (one short conviction and one release after an appeal). On the other hand,

students A and C sought to manage their negative feelings against their aggressors through distance or avoidance rather than formal reporting.

Discussion

Engineering students that suffer from domestic violence growing up usually report having cognitive issues, as they struggle to pay attention in class, feel extreme fear of failure, and constantly experience exam blockages. It is likely that these academic struggles are related to the traumatic experiences that violent students lived, as trauma occupies cognitive resources necessary for complex problem solving and learning [3, 4]. This finding is especially relevant for engineering students, as they usually feel that the technical nature of their careers often leads to a feeling of emotional vacuum, where performing well is the only thing that really matters. The academic pressure that engineering students feel taking courses with difficult mathematical and technical topics could enhance their negative feelings, making them feel that something is wrong with them and generating more issues that could result in more violence acts in their daily lives [6].

Findings of this study highlight the importance of the institutional role helping engineering students to develop coping strategies to better response to their violent experiences. These coping strategies could help students to avoid their negative feelings, affect their academic performance, and keep their motivation to successfully complete their major. In this regard, college professors, mental health specialists, closes friends, and family members play an instrumental role helping engineering students to overcome difficulties and accept academic help and psychological therapy that could provide them with better tools to fight negative feelings that negatively affect their academic performance [23, 34].

Students that experienced violence are usually affected in their academic performance, however the type of violence that they experience could help engineering educators to identify the best way to advice their students and develop a safer learning environment. All participants reported that they suffered physical domestic violence, with three of them also reporting psychological violence, and two of them economic violence. Although the home environment where students grow up is outside the reach of college educators, it is important that universities around the globe develop programs and support systems that facilitate the identification of violent students. Identifying students coming from violent backgrounds at early stages of their college education could help professors to better advise them and motivate them to seek help to overcome their psychological struggles and develop better strategies to learn and perform at their real potential in class [5, 22].

Although the emotional negative effects of coming from violent environments were evident from all participants, female participants were the only ones that reported sexual abuse. The struggles related to this type of violence were different from other violent experiences, making female participants more likely to feel lack of confidence in others and experience emotional outbursts (like crying for no apparent reason) in important academic settings such as tests and class presentations. These negative feelings could generate additional stress, anxiety, and isolation on female students, making it more difficult to

overcome the gender stereotype threads that females usually face in engineering majors [6, 29]. It is important that engineering educators develop a deeper understanding of the gender violence that some of their female students could experience in their environment outside and inside college, and how those experiences could affect their abilities to learn, concentrate, ask questions, and work in teams where they do not feel completely safe. Having more psychological specialists in sexual abuse and more informed professors in college could help to better advise female students that suffered this type of violence and provide them with a learning environment where they can feel safe, heard, and understood, facilitating them the opportunity to focus on their academic performance [34].

The emotional impact of growing up in violent environments was reflected in constant feelings of anxiety, depression, and guilt. These negative feelings affected all participants' academic performance, making a connection between these two variables evident. Three of the four participants reported having difficulties with their studies, such as lack of concentration, lack of motivation, and trouble focusing on class, which usually led them to absenteeism and failure taking exams. The only participant that did not report major academic struggles, mentioned that he felt obligated to achieve academic perfection through extreme pressure and discipline coming from his parents, and performing well in his courses did not make him feel any personal satisfaction. This seek of academic perfection made this participant to be very hard on himself, study overtime without enough rest time, and created an unhealthy learning environment where he felt that failing any academic assignment was going to be extremely punished by his parents at home [4]. This evidence highlights the importance of psychological help and professors' empathy in violented students' academic performance and well-being, as good channels of communication and understanding could help engineering students to overcome academic struggles and misunderstandings of the importance of the relationship between mental health and good academic performance [24].

The social interactions of the four participants were negatively affected by their violent environment growing up, with three of them reporting a significant degree of isolation and lack of confidence developing close relationships with their professors and classmates. This social isolation was more evident in the female participants that were reluctant to share their opinions and create affective bonds in college, and they were hypervigilant around male peers and professors. The lack of interactions with peers and professors hinders the learning opportunities of engineering students and make them less likely to develop important abilities that are required in most of engineering positions such as teamwork, good communication, delegation of activities, and leadership [2, 22]. Another important issue affecting engineering students that have experienced violence is the physical symptoms that participants reported. Three of them mentioned regular episodes of insomnia and loss of appetite, which negatively affected their motivation to learn and concentration in class due to the lack of physical wellness and enough rest. The physical issues were more severe in academic aspects like tests and other evaluations, generating complicated reactions that affected students' physical appearance like hair loss, dermatitis, tremors, and acne breakouts. Letting peers and professors notice their stress and anxiety feelings was very difficult for students that were already struggling with their violent environment at home, making it

more difficult to overcome their depression and isolation issues and creating a negative environment in college that hinders their learning opportunities [4].

Among the strategies that participants reported for coping with the effects of growing up in a violent environment, psychological therapy and self-expression, whether verbal or written, were fundamental to understanding what was happening and how to deal with the negative feelings and physical alterations caused by their traumatic experiences. All participants reported having received psychological therapy; however, only one of them reported that it was adequate for processing their emotions. Among the inconsistencies mentioned by participants that reported that their therapy was not helping them to overcome their psychological struggles were judgmental attitudes, frequent changes in therapists, and the lack of enough mental health professionals to help engineering students to feel heard and understood in college, which ultimately led to feelings of revictimization and more isolation that contributed to their poor academic performance [3, 4]. Engineering educators should consider the implementation and promotion of psychological programs with specialists in domestic violence and their negative effects in the learning process of young students. These programs should aim to help students that are struggling with their mental and physical health due to their experiences in violent environments that hinder their learning opportunities and professional development and provide them with a safe environment where they can feel welcome and motivated to overcome any academic setback related to their depression feelings [34].

Another coping strategy mentioned by participants was setting goals that help them feel motivated to develop a plan and accomplish something important for them. This goal setting was frequently promoted by people that inspire students to improve their academic performance and life expectations, with friends and professors serving as role models that help students feel more motivated to overcome their negative feelings and seek help to be able to accomplish their goals [29, 34]. Additionally, to the relationships that participants reported with close friends and family members were fundamental in their process to overcome the emotional effects of violence. These emotional networks helped them to see their struggles and experiences from a different perspective, and their companionship and emotional support was very important to feel motivated to overcome the negative feelings related to their violent environments [24].

It is important to understand and analyze the possible risks that engineering students that experience violent environments could face if they are not provided with appropriate psychological help and support systems in their academic context. Engineering students that experience violence in home usually have a poor academic performance, but this is a consequence of very complex situations such as homelessness, economic struggles, and chronic domestic violence that need to be addressed to be able to help students to focus on their learning when they are in college [2, 4]. These complex risk factors could lead engineering students to negative behaviors like self-harm, recurrent suicidal thoughts, and dwelling on the past. All participants reported having made one or more suicide attempts, making clear that these students need professional psychological help and early detection to try to overcome their negative thoughts and focus on their academic activities [3, 4].

If engineering educators want to address the learning difficulties that students that suffered violent environments and its negative effects on their mental and physical health, then they need to develop a robust counseling department with psychological experts in violence and motivation. These counseling departments should have enough psychologists to provide all their students the opportunity to talk with them and build an environment where students could feel heard and understood, making them more likely to seek help and try to overcome their academic struggles [2, 34]. Furthermore, to the psychological support system in college, engineering professors should be trained to develop better tools to identify students with mental health issues and try to be more empathetic with their academic struggles, advising them to seek help with mental health professionals and providing them with extra opportunities to complete their class assignments in case they talk about their complications in class due to their violent context in home [5, 6, 33].

Although the academic struggles of violented engineering students are evident, all participants recommend being patient with themselves and with the process of understanding the violent environment and how it affects their college experience. They mentioned that their family relationships have improved; however, in most cases, these relationships are still strained. These family issues highlight the importance of building resilience and hobbies that could help students continue making progress in improving their lives [24].

Conclusion

The intersection of systemic domestic violence and academic performance in engineering majors presents a profound, yet critically under-researched, global challenge in college education. This study illuminated the complex, multifaceted ways in which early childhood and ongoing domestic trauma actively disrupt the cognitive, emotional, and physical capacities [23] of engineering students. Far from being a positive environment where students could development their abilities, the engineering academic culture—characterized by high stakes, dense technical curricula, and an implicit emotional vacuum—can act as an unintended catalyst for severe psychological distress, self-harm and suicidality for students coming from violent environments.

Findings of this study establish an undeniable link between domestic violence and the impairment of executive cognitive functions required for complex problem-solving. Trauma acts as a continuous, involuntary consumer of cognitive bandwidth, making engineering students from violent backgrounds routinely experience severe psychosomatic expressions of distress that cause attention deficits that hinder their learning opportunities. Furthermore, this study highlights that trauma is inherently gendered. Female engineering students face compounded marginalization; those who survived domestic sexual abuse reported distinct manifestations of trauma, including a pervasive lack of trust in peers and authority figures, alongside involuntary emotional outbursts during high-stakes presentations and examinations. In a discipline already fraught with systemic gender stereotypes, these trauma-induced vulnerabilities further isolate female students, impeding their capacity for collaborative fieldwork, peer networking, and equitable team-based learning. As traditional engineering pedagogy heavily emphasizes

collaborative milestones such as capstone design projects and laboratory pairings, the social isolation and hypervigilant mistrust exhibited by traumatized students directly hinder their professional skill acquisition. Additionally, Crucial industry competencies, including team leadership, effective delegation, and emotional intelligence, are severely compromised when a student feels fundamentally unsafe in their learning environment.

A pivotal insight from this investigation is the systemic insufficiency of existing university support structures. To counteract these deficiencies, engineering educators must discard passive, opt-in mental health models in favor of an ecosystem [23] of proactive, trauma-informed care. This requires a systemic overhaul of engineering education across robust and specialized institutional counseling, empathetic pedagogy, and the help of external and peer support networks.

Support and social cohesion are necessary for healing trauma. Each of us must take responsibility for healing our own traumatic wounds. To transform that experience, a change in the relationship with memories or lived experience is required [14].

Declarations

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gulations]." NOTE: The statements for ethical approval and guidelines should be provided as two separate statements under the 'Ethics approval' section. Please find our policy via the link below:

Ethics declaration

An Institutional Ethics Committee named "*Subcomité de ética y de prevención de conflictos de interés del Instituto Tecnológico de Chihuahua*" revised and approved the protocol according to *Federal Public Administration Ethics Code* in effect used by the Tecnológico Nacional from Mexico in the Institutional Ethics Committee.

Clinical trial number: not applicable.

Consent to Participate Declaration

Informed consent about the purpose of this research was provided by the four students'. They consent to get recorded and signed a consent letter with knowledge that this article would remain confidential information protected. All the participants gave an informed consent to participate and for publication, protecting their identity.

Consent to Publish declaration: not applicable.

Data availability statement

The interviews that support the findings of this study are available from correspondence author, but restrictions apply to the availability of these data, which were used under license for the current study and so are not publicly available. The data are, however, available upon request and with the permission of the participants.

Author contribution statement

Luis Hernán Arellano Ulloa contributed identifying the 4 cases of study, made the interviews, analyzed the interviews, included theoretical framework information

Julia Liliana Requena Yáñez analyzed the interviews, included theoretical framework information, included the results analysis and conclusions.

Gustavo Morán Soto constructed the method, analyzed the interviews, included theoretical framework information, included the results analysis and conclusions.

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