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RESEARCH ARTICLE

Real-life Industry immersions that can enhance positive behavior towards Mathematics and Science to Build-up for Math-Sci-oriented choices in academic settings

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ABSTRACT

This qualitative study examines the impact of real-life industry immersions on students' attitudes towards mathematics and their academic choices related to the subject. It explores how these experiences, grounded in the principles of Operant Conditioning, Neuroplasticity, Behavioral Shaping, and Behavioral-Environmental Interaction, can foster positive behaviors and build a foundation for math-oriented career paths. Behavioral Shaping emphasizes the gradual reinforcement of problem-solving skills, fostering confidence and persistence in tackling mathematical challenges. Meanwhile, Behavioral-Environmental Interaction highlights the influence of dynamic learning environments on students' engagement and attitudes toward mathematics, showcasing the importance of supportive settings in fostering interest and motivation. Through semi-structured interviews with 25 teachers from academic settings in the Philippines, the study examines the role of industry immersions in promoting hands-on learning, fostering collaboration, and contextualizing mathematical concepts in real-world applications. Findings underscore the importance of integrating industry-driven projects, leveraging environmental factors, and providing equitable access to these transformative experiences. The study concludes that industry immersions can effectively bridge the gap between theoretical instruction and practical application, ultimately shaping students' perceptions of mathematics as a valuable tool for solving real-world problems and pursuing fulfilling careers.

Keywords: Industry immersions; Mathematics; Positive Behaviors; Academic Choices

1. Introduction

In contemporary education, narrowing the divide between theoretical instruction and practical

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application has emerged as a key strategy for fostering impactful learning experiences. Mathematics, often regarded as abstract and challenging, can transform into a conduit for innovation when students are exposed to authentic, real-world contexts. According to Fantinelli et al. [1], hands-on experiences enhance comprehension by connecting learning to practical scenarios, cultivating problem-solving capabilities, and fostering confidence. Moreover, such experiences equip learners with essential professional skills aligned with workplace demands, meeting the expectations of employers. As Pang et al. [2] suggest, universities and industries must collaborate to create programs that focus on workplace-oriented learning. Chaika [3] underscores the need for a well-rounded approach that seamlessly integrates theoretical and practical aspects to ensure meaningful education.

This study delves into two key psychological principles namely Operant Conditioning and Neuroplasticity to examine how industry immersions influence students' behaviors and attitudes toward mathematics. ***Operant Conditioning*** highlights the significance of positive reinforcement, where desirable behaviors, such as persistence in solving mathematical challenges, are encouraged through acknowledgment or rewards. This mechanism strengthens the likelihood of repeating such behaviors by associating them with favorable outcomes like praise or tangible incentives [4,5]. On the other hand, ***Neuroplasticity*** emphasizes how consistent exposure to mathematical concepts in diverse settings fortifies cognitive pathways, fostering adaptability and problem-solving abilities. Such adaptability proves crucial for applying knowledge effectively across various contexts [6].

Engaging students in math-centric industries reveals the practical relevance of mathematical principles in solving real-world problems, thereby fostering a positive perception of mathematics and encouraging sustained interest [7]. Recognizing students' achievements or showcasing tangible outcomes of their efforts reinforces persistence and confidence, aligning seamlessly with Operant Conditioning. ***Behavioral Shaping,*** under sociopsychological principles, involves building habits of problem-solving through consistent real-life application, making mathematics a more approachable and practical discipline. Behavioral shaping, as Cooper et al. [8] describe, cultivates targeted behaviors through differential reinforcement, gradually shaping students' skills. This approach not only fosters motivation but also emphasizes problem-solving as a critical educational priority [9,10]. Sutarno et al. [11] advocate for equipping students with these competencies to navigate an increasingly complex world. Meanwhile, repeated and meaningful practice in real-world contexts activates the Neuroplasticity, enhancing understanding and retention of mathematical ideas, transforming them from abstract concepts into practical tools for success.

These immersive practices bridge the divide between theoretical instruction and practical application, enabling students to develop critical thinking, resilience, and adaptability. Consistent reinforcement and hands-on practice not only bolster learners' confidence but also reshape their attitudes toward mathematics, positioning it as a fundamental skill for addressing real-world challenges, including environmental challenges. As Zhu and Liu [12] observe, many ***environmental issues*** arise from human behaviors, necessitating behavioral changes to promote sustainable development. ***Behavioral-Environmental Interaction,*** which examines how physical and social learning environments in industries impact attitudes toward mathematics, also plays a pivotal role. Bastille and Wittemyer [13] highlight that these interactions are key to understanding how behaviors respond to environmental factors and, in turn, influence resource use. Recent years have seen growing calls for reforms at the undergraduate level, aimed at equipping students to apply mathematical modeling and critical thinking skills more effectively [14,15]. This dual emphasis on Operant Conditioning and Neuroplasticity forms the foundation of this study, which seeks to explore how behavioral and cognitive growth can be nurtured through industry-driven learning opportunities.

Academic institutions hold a significant responsibility in facilitating these engagements. Collaborating with industries and incorporating sociopsychological principles into educational methodologies, schools can empower students to make well-informed academic decisions and pursue math-oriented career paths. Mebert et al. [16] define student engagement as the effort, interest, and attention invested by learners in the educational process. Speight et al. [17] argue that meaningful engagement goes beyond mere participation, requiring deeper involvement and connection. This strategy ensures that students are equipped not only with the motivation but also the essential skills to thrive in a rapidly evolving, interconnected world and address pressing environmental issues.

2. Literature

The integration of real-life industry immersions has proven to be an effective method in fostering positive attitudes and behaviors toward mathematics. In the Philippines, students typically undergo an 18-year educational journey to earn a bachelor's degree, comprising compulsory kindergarten, six years in elementary school, four years in junior high school, two years in senior high school, and at least four years of tertiary education [18]. Mathematics, often perceived as abstract and detached from practical use, gains new relevance and value when its real-world applications are demonstrated. Studies show that math anxiety significantly hinders achievement, causing students to avoid the subject and diminishing their working memory, which is vital for solving complex problems [19-21]. To address this issue, reforms in Philippine education introduced initiatives like Work Immersion, offering students opportunities to apply mathematical concepts in actual workplace settings [22]. Educators facilitate this transformation through innovative teaching approaches that connect theoretical knowledge with practical applications. This study examines how Operant Conditioning and Neuroplasticity support the objective of reshaping students' perspectives on mathematics.

Student engagement is crucial for understanding academic behavior and instructional effectiveness. It provides insights into students' activities and is vital for designing effective teaching strategies [23]. Behavioral engagement, which includes attendance, attention, participation, and compliance, is a key factor for academic success. Engaged students tend to exhibit better cognitive processing and learning outcomes [24-27]. The importance of ***behavioral shaping*** lies in its correlation with enhanced learning when students are curious and interested, as opposed to being disinterested or "disengaged" applying mathematical principles in real-life industry settings, students build confidence and persistence, ultimately associating mathematics with achievement and success. Furthermore, this framework aligns with neuropsychological theories, suggesting that consistent exposure to positive educational stimuli can strengthen motivation and alter students' perceptions toward mathematics as a practical and vital discipline.

Meanwhile, ***Behavioral-Environmental Interaction*** examines the interplay between external environments and individual learning behaviors [28]. Immersions in dynamic and supportive workplaces, such as engineering firms or financial institutions, allow students to observe how environmental factors such as collaboration, feedback, and resource availability shape attitudes toward mathematics [29]. This interaction underscores the significance of aligning educational environments with student needs to optimize engagement and academic performance.

Operant Conditioning explains how positive reinforcement strengthens productive behaviors in mathematics learning. In this study's context, industry immersions allowed students to experience tangible outcomes such as solving engineering problems or interpreting financial trends that provided immediate feedback and a sense of accomplishment. These direct applications not only transformed abstract theories into meaningful experiences but also reinforced persistence and resilience, directly supporting the behavioral mechanisms outlined by the framework**.** Faculty members who participate in these immersions also benefit

from acquiring current industry insights, which enhance their teaching effectiveness and allow them to guide students with confidence [30]. A well-designed program of this nature strengthens motivation among learners and promotes sustained engagement with mathematics. Effective math instruction integrates multiple interconnected components, including the instructor, the students, and the learning environment [31].

Meanwhile, ***Neuroplasticity*** emphasizes the adaptability of the human brain, allowing it to reorganize and strengthen cognitive pathways through repeated exposure to diverse experiences. Introduced by William James in 1890 and expanded upon by Jerzy Konorski [32,33] the concept highlights the brain's capacity to adapt to external and internal stimuli, leading to functional and structural changes [34]. In mathematics education, immersions present students with scenarios where they can repeatedly engage with mathematical principles in practical settings, such as optimizing financial budgets or developing technological algorithms. This repetition solidifies neural pathways, enabling students to build problem-solving abilities and become more adaptable and innovative thinkers. Educators who incorporate these methods ensure that learners are not only exposed to theoretical ideas but also equipped to apply them effectively, making mathematics a vital and enduring skill.

Global policy perspectives further reinforce the value of making mathematics education more relevant and accessible to diverse learners. The OECD's Mathematics for Life and Work [35] report highlights how factors such as curriculum design, labor-market demands, student attitudes, and broad access policies shape participation in upper secondary mathematics. The report underscores that when students perceive mathematics as valuable and connected to real-world contexts, their engagement and equity in learning outcomes improve. These findings support the argument that mathematics instruction benefits from approaches such as industry immersion that integrate authentic applications, promote inclusivity, and respond to the evolving skills required in contemporary society.

Recent studies have underscored the importance of understanding behavioral influences and technology integration within educational contexts, particularly in how students and educators engage with digital tools. For instance, Lavidas et al. [36] explored the adoption of artificial intelligence applications among humanities and social sciences students. They found that factors such as performance expectancy, habit, and enjoyment significantly predict AI usage intentions. Complementing this, Lavidas et al. [37] identified practical considerations affecting teacher engagement with online surveys namely, the roles of authority, incentives, survey design, ethical safeguards, reminders, and timing. In a related vein, Papadakis et al. [38] illustrated how emerging educational technologies such as computer simulation, cloud-based smart platforms, and augmented reality can enhance open and immersive learning environments [39]. Collectively, these findings suggest that effective integration of educational innovations hinges on the interplay between user motivation, reinforcement structures, and immersive, context-driven learning concepts that align closely with the psychological frameworks underpinning this study.

The terms "industry immersions," "positive behaviors", and "academic choices" capture the interconnected elements that contribute to student growth. Immersions allow students to directly apply mathematical concepts to real-world problems, such as creating architectural designs or analyzing financial trends. Additionally, faculty members who gain firsthand experience in their respective fields acquire the knowledge and skills needed to provide students with relevant guidance and updated insights [40,41]. Positive behaviors, such as curiosity, persistence, and confidence, are cultivated through these experiences, aligning with principles of reinforcement. Similarly, academic choices are influenced as students begin to perceive mathematics as a foundational tool for future career opportunities.

Educators are integral to the success of these initiatives, shaping their students' experiences and learning outcomes. Teachers are widely recognized as catalysts for meaningful change in education, shaping learners' perspectives and decisions [42,43]. Through the development and implementation of industry-based immersion programs, educators connect curriculum objectives with practical applications, inspiring students to see the value of mathematics beyond the classroom. This strategy not only delivers immediate learning benefits but also cultivates a sustained interest in mathematics, ensuring students view it as a necessary skill that supports their academic and professional ambitions.

3. Methodology

3.1. Research design

This study employed a qualitative research design to investigate the impact of real-world industry immersions in promoting positive attitudes toward mathematics and influencing students' academic choices related to the subject. This approach facilitated an in-depth understanding of participants' personal experiences and the factors shaping their perceptions and behaviors. The exploratory nature of the design was instrumental in gaining insights into the challenges associated with mainstreaming inclusive education practices, as it highlighted key themes, connections, and narratives [44]. Emphasizing open-ended exploration, the study aimed to uncover detailed perspectives on how practical industry exposure relates to mathematical engagement. This design was chosen for its adaptability in exploring complex human behaviors and attitudes, enabling the collection of rich, descriptive data.

3.2. Participants

The study involved 25 teachers from academic institutions in the Philippines, representing a diverse range of perspectives and experiences. Participants were selected through purposive sampling to ensure alignment with the study's focus on industry immersions and mathematics education. This approach enabled the inclusion of teachers with varying levels of exposure to mathematics-related industries, providing a comprehensive view of how such experiences shape students' academic behaviors and attitudes [45].

3.3. Instrument

A semi-structured interview guide (**Table 1**) served as the primary data collection instrument, designed specifically to explore participants' experiences and perspectives on the role of industry immersions in shaping mathematical behaviors and environmental interaction. The guide featured open-ended questions to prompt detailed responses, encouraging participants to share in-depth reflections on the subject. The instrument was carefully crafted to ensure clarity and relevance while avoiding leading or overly restrictive questions. Interviews, as a method of dialogue between the researcher and participants, were structured to facilitate in-depth exchanges [46].

Table 1. Instrument of the study

Objectives	Interview questions	N
Determine industry immersions that can enhance positive behaviors of learners towards mathematics	1. What is your idea of immersing students in math-oriented industries to enhance positive behaviors of learners towards mathematics? Elaborate your opinion 2. What factors contribute to frustrations in teaching and learning mathematics, and in what ways can industry immersions help address these challenges? 3. What kind of immersions can enhance the behavior of learners in liking mathematics in the long-term? Elaborate more.	25
Determine how real-life industries build	1. Can immersion of learners early on in math oriented	

Objectives	Interview questions	N
up for math-oriented choices in academic settings	experiences in industries build-up more interests towards mathematics? Explain further. 2. What are the experiences in industries that can change the mindset of learners leading towards choosing math-oriented courses? Elaborate more. 3. How should the academe capitalized on the real-life math-oriented industries in building up choices in academic setting in favor of mathematics? Elaborate further.	

Table 1. (*Continued*)

3.4. Data gathering

The data collection process involved conducting detailed interviews with participants, fostering an open, conversational atmosphere to encourage the free expression of thoughts. Participants chose the interview locations, ensuring they felt comfortable and minimizing external pressures. Responses were thoroughly documented, and participants were informed of their rights, including the option to withdraw at any time and an explanation of the interview's objectives [47].

3.5. Data analysis

Content analysis was used to systematically examine and categorize responses into key themes, including hands-on learning, collaboration, and real-world applications. These themes were then interpreted through the lens of Operant Conditioning, Neuroplasticity, Behavioral Shaping, and Behavioral-Environmental Interaction, ensuring that the analysis maintained a direct link between theoretical foundations and empirical observations. This approach allowed the findings to clearly demonstrate how psychological principles operate within industry-immersion experiences. This highly flexible method has been widely used across various research fields, including library and information science [48,49]. Participants' responses were reviewed and coded according to recurring themes relevant to the study's objectives. This structured approach facilitated a comprehensive interpretation of how industry immersions shape mathematical attitudes and behaviors, presenting findings in an organized manner while maintaining an objective and concise analysis.

3.6. Ethical considerations

The study adhered to rigorous ethical standards to protect and respect participants. Informed consent was obtained prior to data collection, with participants fully briefed on the study's purpose, procedures, and their right to withdraw at any time. Ensuring autonomy and informed decision-making, the researchers emphasized that participants could choose to participate voluntarily without any impact on their access to future opportunities or care [50]. Confidentiality was rigorously maintained by anonymizing participants' identities and securely storing all collected data. Throughout the interview process, the researchers fostered a respectful and non-judgmental environment, ensuring participants felt comfortable sharing their insights.

4. Results

Research Objectives 1. Determine industry immersions that can enhance positive behaviors of learners towards mathematics

Question No. 1. What is your idea of immersing students in math-oriented industries to enhance positive behaviors of learners towards mathematics? Elaborate your opinion

1.1 *Providing Contextual Relevance*

Twenty (20) respondents emphasized that students' difficulty in engaging with mathematics often stems from not perceiving its real-world relevance. Industry immersions in sectors such as engineering, finance, technology, animation, or environmental science allow learners to observe firsthand how mathematical principles solve tangible problems. These experiences transform abstract concepts into practical tools for innovation and problem-solving, fostering curiosity and motivation. Whether through simulations, coding, robotics, or project-based tasks, such applications make challenging mathematical ideas more approachable, enabling students to achieve incremental successes and build confidence.

> "Teachers believe that students struggle with mathematics because they fail to see its relevance to their lives. Immersion in industries such as engineering, finance, data analysis, or technology allows students to witness firsthand how mathematical principles solve real-world problems."

> "I often find that students struggle with abstract math concepts because they cannot visualize how these concepts apply to everyday scenarios. Students often ask, 'Why do I need algebra?' But when they see engineers using equations to calculate forces or computer scientists applying algorithms, they realize math is everywhere."

1.2 *Hands-On Learning Opportunities*

Twenty three (23) respondents expressed that exposure to math-oriented industries can provide students with hands-on experiences, such as internships, job shadowing, or industry-driven project-based learning. This practical engagement builds confidence and enthusiasm for math. They had students participate in a project with a local architecture firm where they calculated areas, volumes, and material costs for a building design. Working alongside professionals helped them see math as a practical tool, not just equations on paper. TheyBeyond math, they learned teamwork and presentation skills while interacting with industry mentors. Job shadowing opportunities were eye-opening experiences. Observing engineers, accountants, or scientists made them realize math could lead to rewarding careers, encouraging them to aim higher in their academic goals.

> "Exposure to math-oriented industries can provide students with hands-on experiences, such as internships, job shadowing, or industry-driven project-based learning. This practical engagement builds confidence and enthusiasm for math. We had students participate in a project with a local architecture firm where they calculated areas, volumes, and material costs for a building design."

> "We partnered with an environmental NGO for a recycling project. Students calculated the volume of materials collected and projected potential savings. Beyond math, they learned teamwork and presentation skills while interacting with industry mentors. Job shadowing opportunities were eye-opening experiences. "

1.3 Cultivating Problem-Solving Skills and Collaboration

Sixteen (16) respondents expressed that they emphasize critical thinking, problem-solving, and collaboration—skills that are transferable across disciplines. This can help students build positive attitudes towards math as a tool for teamwork and innovation. Real-world projects offer diverse entry points for students with different abilities, fostering inclusivity and a sense of achievement in math. When students collaborate on solving a real-world problem, like designing a sustainable building, they realize math is a team effort, not an isolated struggle. Working together on open-ended problems forces them to think

critically and weigh multiple factors, skills applicable far beyond math class. Integrating collaboration, creativity, and problem-solving into math education, teachers report that students become more engaged, confident, and motivated. These skills not only foster a deeper understanding of math but also prepare students for teamwork and innovation in real-world contexts.

> "I emphasize critical thinking, problem-solving, and collaboration—skills that are transferable across disciplines. This can help students build positive attitudes towards math as a tool for teamwork and innovation. Real-world projects offer diverse entry points for students with different abilities, fostering inclusivity and a sense of achievement in math."

> "Working together on open-ended problems forces them to think critically and weigh multiple factors, skills applicable far beyond math class. Many of my students initially view math as intimidating, but projects like budgeting for a mock event allow them to apply math collaboratively."

Question No. 2. What factors contribute to frustrations in teaching and learning mathematics, and in what ways can industry immersions help address these challenges?

2.1 *Heavy Workload and Administrative Tasks*

Twenty one (21) respondents expressed that they often face an overwhelming workload with lesson planning, grading, and administrative duties. These tasks can take up time that could otherwise be dedicated to improving teaching strategies or offering personalized support to students. Administrative tasks, like committee responsibilities or research deadlines, often overshadow teaching. This creates tension between institutional expectations and personal aspirations. They often feel they don't have enough time to deeply plan engaging and differentiated lessons because they're preoccupied with grading or administrative work. This leads to using more generic materials, which may not address the diverse needs of students. This perspective underscores that the core issue isn't just the workload itself but the misalignment between the demands placed on teachers and the resources or time allocated to meet them effectively.

> "Teachers often face an overwhelming workload with lesson planning, grading, and administrative duties. These tasks can take up time that could otherwise be dedicated to improving teaching strategies or offering personalized support to students. Administrative tasks, like committee responsibilities or research deadlines, often overshadow teaching."

> "Teachers often feel emotionally drained, which affects their ability to connect with students meaningfully and adjusting to the emotional demands of teaching, such as dealing with student trauma or maintaining work-life balance, can feel overwhelming. Teachers sacrifice personal time, including evenings and weekends, to keep up with their workload."

2.2 *Lack of Support or Resources*

Seventeen (17) respondents expressed that limited resources, outdated materials, or insufficient access to technology can hinder effective teaching. They may feel unsupported in meeting student needs. Even in well-funded institutions, lack of professional development opportunities can leave them feeling stagnant or underprepared for evolving educational demands. Due to the outdated materials they often end up purchasing their own supplies or resources to fill gaps, leading to financial strain. For instance, buying classroom decorations, learning aids, or even printer ink becomes a personal responsibility. These challenges highlight

how resource limitations not only hinder effective teaching but also place additional emotional and financial burdens on educators. Addressing these issues requires systemic change and consistent advocacy for better support

> "Limited resources, outdated materials, or insufficient access to technology can hinder effective teaching. I always feel unsupported in meeting student needs. Even in well-funded institutions, lack of professional development opportunities can leave them feeling stagnant or underprepared for evolving educational demands."

> "When technology is available but outdated, such as old computers or malfunctioning projectors, it slows down lessons and disrupts the flow of teaching. I feel frustrated having to troubleshoot technology issues mid-class which is very time consuming."

2.3 Student Behavior and Engagement Issues

Fifteen (15) respondents mentioned that managing disruptive behavior of their students can lead to their frustration, particularly when there's little support from administration or parents in addressing these issues. They spend so much time dealing with one or two students who are constantly disruptive that they feel like they're neglecting the rest of the class. It's not fair to anyone. Also, parents often don't show up for meetings, and when they do, they sometimes excuse their child's behavior rather than working with them to address it. It's frustrating but they cannot do anything to stop the situation. Additionally, they mentioned that disruptions take time to address, which reduces the time available for teaching. This can result in rushed lessons or incomplete coverage of material. Managing constant disruptions without adequate support can lead to stress, frustration, and ultimately burnout, making it harder to maintain patience and a positive demeanor. These constant disruptions not only affect them but also other students' ability to focus, creating a chaotic or uncomfortable learning environment.

> "Managing disruptive behavior of students can lead to our frustration, particularly when there's little support from administration or parents in addressing these issues. We spend so much time dealing with one or two students who are constantly disruptive that we feel like we're neglecting the rest of the class. It's not fair to anyone."

> "Disruptions take time to address, which reduces the time available for teaching. This can result in rushed lessons or incomplete coverage of material. These constant disruptions not only affect me but also other students' ability to focus, creating a chaotic or uncomfortable learning environment. "

Question No. 3. What kind of immersions can enhance the behavior of learners in liking mathematics in the long-term? Elaborate more.

3.1 *Real-Life Applications (STEM Integration)*

Sixteen (16) respondents expressed that when students work on projects like budgeting for a school event or analyzing sports data, they become more invested. It makes math feel less abstract and more like a practical tool they can use. They emphasize incorporating real-life scenarios that utilize mathematical concepts. Connecting mathematical theory to practical situations, students can see the relevance of what they learn. For example, using budgeting, environmental statistics, or sports analytics can help learners visualize mathematics in their daily lives. Practical problems often have multiple solutions or approaches, encouraging students to think critically and creatively. The participants work with other teachers to design

interdisciplinary lessons combining math with science, geography, or economics. In summary, by focusing on these strategies, teachers can create meaningful connections between math and the real world, fostering both understanding and appreciation of the subject.

> "When students work on projects like budgeting for a school event or analyzing sports data, they become more invested. It makes math feel less abstract and more like a practical tool they can use. They emphasize incorporating real-life scenarios that utilize mathematical concepts."

> "Real-world problems provide context, which helps students remember and understand mathematical concepts better. Practical problems often have multiple solutions or approaches, encouraging students to think critically and creatively. They work with other teachers to design interdisciplinary lessons combining math with science, geography, or economics."

3.2 *Incorporation of Arts and Creativity*

Ten (10) respondents expressed that they've noticed that when students create art projects that involve symmetry or fractals, they become more fascinated with the patterns and structures in mathematics. It blends creativity with numerical thinking. Using art and creative projects to illustrate mathematical concepts can appeal to diverse learning styles. Activities such as creating geometric art, exploring symmetry, or using music to understand patterns can enhance engagement. Creating tangible representations of mathematical ideas helps students who learn best through seeing or doing. Integrating art and creative projects into mathematics education not only enhances student engagement but also bridges the gap between abstract concepts and practical application. Ultimately, This approach not only enhances engagement but also demonstrates the versatility and beauty of mathematics in everyday life.

> "I've noticed that when students create art projects that involve symmetry or fractals, they become more fascinated with the patterns and structures in mathematics. It blends creativity with numerical thinking. Using art and creative projects to illustrate mathematical concepts can appeal to diverse learning styles."

> "Using art and creative projects to teach mathematics is a dynamic way to engage students with diverse learning styles. It combines the logical structure of math with the expressive and exploratory nature of art, making abstract concepts more accessible and enjoyable."

3.3 Collaborative Learning

Eighteen (18) respondents expressed that some of their best experiences have been in group settings where students tackle challenges together. They learn not just from math, but also from each other, which fosters a community that values learning. Engaging students in collaborative projects promotes social interaction and peer learning. Having a group project allows their students to discuss and solve problems together, which can enhance understanding and reduce anxiety around the subject. Math can often induce anxiety in students. Collaborative learning environments can alleviate this by providing a sense of community and support. Students feel less isolated when they engage in learning together, and the shared experience can create a more relaxed atmosphere. Group activities not only enhance academic understanding but also build essential life skills like communication, teamwork, and adaptability. Working in groups allows students to learn from each other.

> "Some of my best experiences have been in group settings where students tackle challenges together. They learn not just from math, but also from each other, which fosters a community that values learning."
>
> "Collaborative projects are a powerful teaching tool, especially in mathematics, where problem-solving and critical thinking often benefit from diverse perspectives. Group activities not only enhance academic understanding but also build essential life skills like communication, teamwork, and adaptability."

Research Objectives 2. Determine how real-life industries build up for math-oriented choices in academic settings

Question No. 1. Can immersion of learners early on in math oriented experiences in industries build-up more interests towards mathematics? Explain further.

Positive Reinforcement Through Real-Life Applications

Ten (10) respondents expressed that yes, exposing students to math applications in industries early on can significantly enhance their interest. When learners see math in action whether it's in engineering, finance, or data analysis they start to understand its relevance. For example, having students work on industry projects like designing a bridge (engineering) or managing a budget (finance) shows them that math isn't just abstract concepts; it's a critical tool for solving real-world problems. Having students engage with professionals in fields allows them to see how mathematical theories and formulas are applied practically. This connection can demystify math and make it less abstract, fostering a sense of relevance and curiosity. These experiences help bridge the gap between education and the workforce, equipping students with both the knowledge and the inspiration to pursue math with enthusiasm. In essence, by integrating these opportunities into the curriculum, educators can make math more meaningful, engaging, and accessible for all learners.

> "Yes, exposing students to math applications in industries early on can significantly enhance their interest. When learners see math in action—whether it's in engineering, finance, or data analysis—they start to understand its relevance."
>
> "Math can often feel abstract, especially when taught in isolation from its practical uses. Industry-focused experiences allow students to see and use math in a context that resonates with their environment. Exposing students to industry-aligned math applications is a powerful way to demonstrate the subject's relevance and ignite interest."

1.2 *Bridging the Gap Between Theory and Practice*

Fourteen (14) respondents expressed that Math is often taught abstractly, which can alienate students. Industry experiences serve as a bridge between theory and practice. University-level students, for instance, who collaborate with industries on internships or projects, often report higher motivation because they see their coursework directly impacting real-world outcomes. However, this may require collaboration between schools and industries, which can be resource-intensive. Integrating industry projects or internships, students can apply their theoretical knowledge to solve tangible problems. Working on industry-driven projects, students can gain specific skills that are highly valued in the workforce, such as project management, teamwork, and communication, along with technical expertise.

> "Math is often taught abstractly, which can alienate students. Industry experiences serve as a bridge between theory and practice. University-level students, for instance, who collaborate with industries on internships or projects, often report higher motivation because they see their coursework directly impacting real-world outcomes."

> "When students are able to work on real-world projects, their motivation often increases. They begin to realize that what they learn in the classroom is not just for passing exams but is essential to solving problems outside of academia."

1.3 *Equity and Access Challenges*

Twelve (12) respondents expressed that immersion programs are more effective in well-resourced schools. In underserved areas, where access to technology or industry partnerships is limited, this approach may not be feasible. Efforts to implement such programs must ensure that all students have access to these opportunities, not just those in privileged environments. In well-resourced schools, students often have access to cutting-edge technology, high-speed internet, and state-of-the-art equipment. These tools are essential for participating in many industry-oriented immersion programs, such as coding, digital design, or data analysis projects. The key to successfully implementing industry immersion programs in underserved areas is recognizing the systemic barriers and addressing them through creative, collaborative solutions. By focusing on resource-sharing, virtual experiences, community partnerships, and scalable projects, it's possible to give all students regardless of their background, access to the transformative experiences that help them connect education to the real world.

> "In well-resourced schools, students often have access to cutting-edge technology, high-speed internet, and state-of-the-art equipment. These tools are essential for participating in many industry-oriented immersion programs, such as coding, digital design, or data analysis projects."

> "Those involving industry collaborations or technology-based learning, are more effective and easier to implement in well-resourced schools. The challenge, then, becomes not only making these programs effective but also ensuring that they are equitable and accessible to all students, regardless of their socio-economic background. "

Question No. 2. What are the experiences in industries that can change the mindset of learners leading towards choosing math-oriented courses? Elaborate more.

2.1 Real-world Application in Tech & Engineering Fields

Sixteen (16) respondents expressed that exposing students to industries like software development, robotics, or civil engineering can make math more relatable. In engineering, math is not just theoretical, it's the backbone of everything. Students see how mathematical principles, such as calculus and linear algebra, are essential in designing bridges or programming algorithms. This motivates them to choose math-related courses when they understand it's not just abstract numbers, it's solving real-world problems. Additionally, they mentioned that they emphasized the importance of problem-solving in engineering. In engineering, every problem requires a solution, and that solution is often rooted in math. Whether it's minimizing material costs, optimizing machine efficiency, or predicting failure points in a design, math is the tool that engineers use to find the best possible answers. Students often hear about the 'creative' aspects of engineering but don't realize how much math plays a role in those creative solutions.

> "Exposing students to industries like software development, robotics, or civil engineering can make math more relatable. In engineering, math is not just theoretical, it's the backbone of everything. Students see how mathematical principles, such as calculus and linear algebra, are essential in designing bridges or programming algorithms."
>
> "Students often hear about the 'creative' aspects of engineering but don't realize how much math plays a role in those creative solutions. Once they understand that the most innovative designs come from careful mathematical analysis, they're more inclined to see math not just as a subject to be learned but as an essential skill for innovation and problem-solving."

2.2 Healthcare & Medical Technology

Ten (10) respondents discussed the impact of exposing students to careers in healthcare, particularly in medical technology. Biostatisticians and medical researchers use complex math to analyze data, predict disease outbreaks, and create life-saving drug formulas. When students understand that math can be used to improve health and save lives, they're more likely to view math as an essential part of medicine, not just a subject they 'have to' take. Health-related industries highlight the ethical and life-impacting value of math. Healthcare is becoming increasingly interdisciplinary, where professionals from diverse fields, including math, collaborate to solve complex medical problems. Collaborative approach helps students recognize the many ways math contributes to solving real-world health challenges. In summary, these insights underscore the importance of connecting math to healthcare careers to inspire students to pursue math-related courses.

> "Biology teachers discussed the impact of exposing students to careers in healthcare, particularly in medical technology. Biostatisticians and medical researchers use complex math to analyze data, predict disease outbreaks, and create life-saving drug formulas."
>
> "Highlighting the team-based nature of modern healthcare, students can see how math is integral to medical innovations, not just an isolated subject. This collaborative approach helps students recognize the many ways math contributes to solving real-world health challenges."

2.3 Technology and Data Analytics

Eleven (11) respondents expressed that the rise of data science has a profound influence on students' outlook on math. When students see how data analytics is used to drive decisions at companies like Amazon, or how AI and machine learning require a solid understanding of algorithms and statistics, they see math as the foundation of future technologies. The promise of shaping tomorrow's digital world excites many of them to dive deeper into math-oriented coursework. Emerging fields like AI and data science show math's role in technological advancement. Additionally, they mentioned how data science is influencing the field of social sciences. Big data is transforming fields like sociology, political science, and economics, where data scientists analyze large datasets to understand human behavior, political trends, and economic patterns. The math behind this is crucial statistical analysis, probability theory, and regression models are all used to make sense of complex societal data.

> "The rise of data science has a profound influence on students' outlook on math. When students see how data analytics is used to drive decisions at companies like

> Amazon, or how AI and machine learning require a solid understanding of algorithms and statistics, they see math as the foundation of future technologies."
>
> "The math behind this is crucial statistical analysis, probability theory, and regression models are all used to make sense of complex societal data. When students see that understanding patterns in big data can lead to social and political change, they start to view math as not just a technical skill, but as a key to solving real-world societal issues."

Question No. 3. How should the academe capitalize on the real-life math-oriented industries in building up choices in academic settings in favor of mathematics? Elaborate further.

3.1 Linking Math to Industry Needs (Perspective from Industry-Savvy Educators)

Eleven (11) respondents expressed that those with connections to industries like finance, technology, engineering, and data science can actively integrate real-world examples from these fields into their curriculum. By demonstrating how mathematical concepts are used in industries like data analytics, machine learning, cryptography, and financial modeling, educators can show students the relevance and power of math in modern problem-solving. For example, illustrating calculus in optimizing logistics or using probability in risk assessment in finance makes the content more tangible. Additionally, they mentioned that data analytics and machine learning rely heavily on statistical methods, linear algebra, and calculus to make sense of large datasets and optimize algorithms. To further elaborate on the integration of real-world examples from industries like finance, technology, engineering, and data science into the curriculum, educators can draw on specific mathematical concepts and methods used in these fields to make abstract mathematical ideas more accessible and engaging for students.

> "By demonstrating how mathematical concepts are used in industries like data analytics, machine learning, cryptography, and financial modeling, educators can show students the relevance and power of math in modern problem-solving."
>
> "To further elaborate on the integration of real-world examples from industries like finance, technology, engineering, and data science into the curriculum, educators can draw on specific mathematical concepts and methods used in these fields to make abstract mathematical ideas more accessible and engaging for students."

3.2 Highlighting Career Opportunities (Perspective from Career-Focused Educators)

Twenty three (23) respondents expressed that they emphasize the wide range of careers that require strong mathematical skills, such as actuarial science, architecture, engineering, or logistics. Students are more likely to pursue mathematics if they can connect it to high-paying, stable, and growth-oriented careers. They can organize career days where professionals from fields that rely heavily on math (like engineering, finance, and analytics) discuss their careers and Provide mentorship opportunities with professionals in math-heavy careers. Additionally, they mentioned that they should invite professionals from diverse math-oriented industries (e.g., actuarial scientists, data analysts, architects, engineers, financial planners, and logistics managers) to share their career journeys, day-to-day responsibilities, and how they use math in their work and allow students to engage with these professionals through Q&A sessions, hands-on demonstrations, or mini workshops.

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3.3 Encouraging Collaboration and Problem-Solving (Perspective from Collaborative Educators)

Eight (8) respondents expressed that Mathematics isn't just about formulas and algorithms; it's about problem-solving and collaborative thinking. Real-life industries, such as healthcare, energy, or construction, depend on teams of professionals working together to solve complex problems. They can incorporate project-based learning where students collaborate on math-related challenges, mirroring real-world situations where multi-disciplinary teams solve mathematical problems. Additionally, they mentioned that expanding on the idea that mathematics is deeply connected to problem-solving and collaborative thinking, incorporating project-based learning (PBL) into the curriculum can simulate real-world scenarios and help students understand how mathematical concepts are applied in professional, team-oriented contexts. Real-world problems rarely fit into one discipline. Projects should combine mathematics with science, technology, and social sciences.

"Mathematics isn't just about formulas and algorithms; it's about problem-solving and collaborative thinking. Real-life industries, such as healthcare, energy, or construction, depend on teams of professionals working together to solve complex problems."

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5. Discussion

Analyzing the responses of participants, two key psychological principles namely Operant Conditioning and Neuroplasticity that emerged as crucial frameworks for understanding the behavioral and cognitive changes facilitated by industry-related experiences. These principles provided an insightful way to examine how industry immersions contribute to the development of a positive mathematical mindset and foster lasting changes in attitudes and perceptions toward mathematics.

The findings reveal that hands-on learning and contextualized instruction are central in making mathematics relevant and engaging. When academic content is linked to students' real-life situations such as budgeting for projects, interpreting environmental data, or designing structures, it moves beyond abstraction and becomes a practical problem-solving tool [51-52]. This connection is reinforced by Operant Conditioning, wherein consistent positive reinforcement such as visible results or recognition sustains students' confidence and persistence.

Themes across the data also converge on the value of collaborative problem-solving, a skillset that fosters teamwork, adaptability, and critical thinking. These skills not only enhance understanding but also help students see mathematics as a shared endeavor rather than an isolated challenge [53]. Mathematics is

foundational for many fields, particularly science, technology, and engineering [54]. Neuroplasticity further reinforces this concept, suggesting that repeated engagement with applied mathematical tasks in environments strengthens cognitive pathways [55]. Respondents described instances such as calculating project budgets or optimizing algorithms, which not only reinforced their mathematical understanding but also sparked innovative thinking and flexibility traits essential for both academic achievement and professional success.

The role of Behavioral Shaping is evident in the progressive design of tasks, where complexity is gradually increased to build problem-solving proficiency [56,57]. This incremental reinforcement nurtures persistence and higher-order thinking, aligning with Operant Conditioning by ensuring that each stage of achievement encourages continued engagement [58]. Behavioral-Environmental Interaction further explains how dynamic and supportive learning spaces be it in a technology firm, engineering workshop, or other industry settings shape students' motivation and academic orientation [59]. Such environments provide mentorship, resources, and authentic contexts that validate the relevance of mathematics [60].

Importantly, the integration of mathematics with interdisciplinary applications such as technology, healthcare, and environmental science serves as a bridge between theory and practice [61,62]. These opportunities are not equally available to all learners, which underscores the need for equitable access to industry-linked programs. Addressing these disparities requires creative and scalable solutions so that immersive experiences can benefit students across different socio-economic contexts. A paradigm shift occurs when there is a profound change in how a field of study is understood, often triggered by new conditions or the disproving of previous assumptions [63].

Furthermore, the findings indicate that the duration and continuity of industry immersion programs significantly influence their long-term effectiveness. While short-term exposures can generate initial interest, extended and repeated engagements such as multi-phase projects, semester-long partnerships, or regular mentorship foster deeper skill development and sustained motivation. This aligns with reinforcement theory, which emphasizes that consistent and varied reinforcement over time strengthens desired behaviors. Another notable implication is the role of authentic assessment within these immersive experiences. Evaluating students through real-world outputs such as project proposals, feasibility studies, or applied research provides feedback that mirrors industry standards [64]. This not only validates students' efforts but also reinforces the direct applicability of mathematical concepts in professional contexts, strengthening the link between learning and future employability.

Institutional collaboration emerges as a decisive factor in maximizing the benefits of industry immersion. Partnerships between schools, local industries, and community organizations expand the scope of learning opportunities and address resource constraints, particularly in underserved areas. Such collaborations ensure that immersion programs remain relevant to evolving industry demands, keeping the curriculum aligned with real-world practices.

Overall, the synthesis of themes highlights that industry immersion, when grounded in Operant Conditioning, Neuroplasticity, Behavioral Shaping, and Behavioral-Environmental Interaction, is a powerful framework for fostering sustained engagement with mathematics. This conceptual alignment strengthens the link between the study's theoretical foundations and its empirical findings, supporting a paradigm shift in mathematics education toward engagement, contextual relevance, and equitable access.

6.Conclusion

The findings of this study show that well-designed industry immersions can significantly strengthen mathematics education by connecting abstract concepts to authentic, real-world contexts. These experiences enable students to understand the practical value of mathematics, foster greater engagement, and develop persistence, adaptability, and confidence in applying learned skills. The results align with the principles of Operant Conditioning, which sustains motivation through positive reinforcement; Neuroplasticity, which enhances adaptability through repeated application; Behavioral Shaping, which supports the gradual development of advanced problem-solving skills; and Behavioral-Environmental Interaction, which underscores the influence of supportive learning environments on sustained academic interest.

The study suggests that industry immersion is an effective strategy for creating mathematics education that is inclusive, relevant, and responsive to future workforce demands. Integrating such programs with applications in technology, environmental science, healthcare, and other disciplines can broaden their impact and provide opportunities to students from a range of socio-economic and educational backgrounds. This study, however, was limited to a specific participant group and setting. Expanding the research to include varied locations, educational levels, and long-term tracking would allow for a deeper understanding of the sustained academic, behavioral, and career-related outcomes of these programs.

Future research can explore alternative and scalable implementation models, including hybrid or community-based immersions, to address logistical and resource constraints while preserving the depth of experiential learning. Advancing and diversifying these initiatives, educators, industry leaders, and policymakers can work collaboratively to ensure that mathematics learning remains both applicable and empowering, preparing students to navigate and contribute to an increasingly complex and interconnected world.

Conflict of interest

The authors declare no conflict of interest.

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