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Learning Experience Design for Hybrid Education Models in International STEM Challenges and Competitions

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ABSTRACT

In our globally connected world, designing STEM (Science, Technology, Engineering, and Mathematics) programs with an international focus, is paramount to preparing stu- dents for the complexities of the modern landscape, where collaborations across borders and cultural understandings are indispensable skills. Our research engaged 1200+ Latin American students in aerospace challenges integrating digital tools and soft skills. By crafting education challenges and competitions with UN Sustainable Development Goals, students engage in real- world issues, fostering a global mindset. This hybrid approach combined in-person and remote activities. Our post-analysis gains highlighted enhanced technical skills, creativity, and global collaboration. Feedback emphasized the need for more engaging elements. Our analysis included renowned engineering competi- tions, fostering soft skills development. This integration benefits students and contributes to future STEM leaders. The hybrid model facilitated cross-border collaboration among students from Mexico, Colombia, Argentina, Brazil, Canada, Chile, the United States, and Puerto Rico. Our paper represents the results of five years of hybrid STEM activity implementations, showcasing sustained benefits. Notably, collaboration extended to professors, fostering a network committed to advancing STEM education through digital transformation.

Index Terms—STEM, Digital Transformation, Online Learn- ing, Phenomena Based Learning, Learning Environments, Pro- fessional Education, Educational Innovation

I. INTRODUCTION

In our globally connected world, designing STEM edu- cational programs with an international and interdisciplinary approach is essential. Utilizing digital tools to foster cross- border collaboration and cultural inclusion is fundamental. These programs must prepare students for environments where international cooperation and cultural understanding are cru- cial. Aligning educational challenges with the UN's Sustain- able Development Goals [1] promotes a global mindset and develops soft skills such as collaboration and creativity.

Over the past five years, we have coordinated and executed STEM activities aimed at increasing female participation inscience and engineering. This collaboration includes repre- sentative teams in international competitions, such as the IKTAN[1] Roving team participating annually in the NASA Human Exploration Rover Challenge[2] and the TecXotic[3] team in the MATE ROV underwater robotics competition[4], both from Tecnologico de Monterrey Campus Cuernavaca. These efforts foster the development of future scientists and engi- neers through international competitions. A hybrid learning model, combining in-person and remote activities, has proven effective in expanding access and diversity among participants. Students from countries such as Mexico, Colombia, Argentina, Brazil, Canada, Chile, the United States, and Puerto Rico have successfully collaborated. The results of these programs show significant improvements in technical skills, creativity, and global collaboration. However, there is a need to make activities even more engaging. Overcoming challenges related to the participation of diverse populations and the perception that STEM is reserved for certain profiles is crucial, especially in increasing the participation of women and other underrep- resented groups.

Additionally, these programs must be designed with a methodological structure that allows them to be replicable and measurable in terms of effectiveness and reach. This paper presents the results of hybrid activities and events developed under a phenomena-based learning methodology, which focuses on leveraging real-world phenomena as entry

[1]IKTAN is the name of the team and means ”ingenious” in the indigenous Mexican Nahuatl language.

[2]Annual competition, hosted by NASA’s Marshall Space and Flight Center, that challenges students to design, build, and test rovers for missions on planetary surfaces.

[3]TecXotic is the team’s name, which means ”Blue as Water” in the indigenous Mexican Nahuatl language.

[4]The Marine Advanced Technology Education (MATE) Center’s annual underwater robotics competition that encourages students to develop ROVs (Remotely Operated Vehicles).

points for exploration and discovery. These programs aim to expose participating students to careers and programs in science, technology, engineering, and mathematics (STEM), inspiring them to pursue these fields.

Surveys like the 3M[5] State of Science Index [2], which provides comprehensive insights into public attitudes towards science and technology, reflect a growing curiosity and ap- preciation for the sciences, which is encouraging for the future of STEM education. This index is relevant because it highlights trends and shifts in public perception, help- ing educators and policymakers understand the importance of science in everyday life and guiding the development of effective STEM programs. Digital transformation offers significant advantages such as greater geographical reach, flexibility, accessibility, and the participation of international experts, promoting global collaboration and knowledge ex- change. It continuously updates educational content, reduces costs, allows personalized learning according to individual needs, and ensures educational continuity in adverse situations. In summary, internationally facilitated STEM programs are essential to prepare students for the complexities of the modern world, promoting accessible, flexible, and culturally inclusive education that fosters global and collaborative skills.

This article argues that international hybrid STEM pro- grams, designed and executed under a phenomena-based learning methodology and combining in-person and remote activities, offer significant advantages in preparing students for future jobs and fostering global collaboration.

This text aims to highlight the importance of STEM educa- tional programs designed with a methodological structure and an international, interdisciplinary approach. Utilizing digital tools aims to foster global collaboration and cultural inclusion while highlighting the benefits of this approach in training students and future STEM leaders. The digital tools used during the challenges and competitions include:

- Tinkercad[6]: This platform facilitates the development of three-dimensional models based on research and sketches created during the Inquiry/Research, Design, and Build stages. Tinkercad offers a user-friendly interface for be- ginners, allowing for quick prototyping and iteration of ideas.
- Blender[7]: Blender provides advanced modeling capabili- ties, enabling the creation of highly detailed and complex 3D models. Both tools support the entire workflow from initial concept to final design, ensuring that participants can effectively translate their research and ideas into tangible models.

[5](Minnesota Mining and Manufacturing Company) is a multinational American corporation known for its innovative products in healthcare, safety, industry, electronics, and consumer goods. It is also renowned for its strong culture of innovation and commitment to sustainability.

[6]Free, web-based 3D design and modeling tool, developed by Autodesk, known for its ease of use

[7]Free, open-source 3D creation suite, developed by the Blender Foundation, known for its comprehensive modeling, animation, and rendering capabilities

CoSpaces[8]: This platform facilitates the development of virtual and mixed-reality projects, offering a versatile platform for immersive learning and interactive simu- lations. Users can import three-dimensional models and make detailed adjustments, allowing them to observe and manipulate variables within simulated environments.

- 3D Printing[9]: For schools equipped with 3D printers, this technology is essential for visualizing and realizing prototypes generated after the 3D modeling process. It allows students to bring their digital designs into the physical world, providing a tangible representation of their work.
- Spatial.io[10]: Used as the primary tool during the Meta- verse challenge, this platform enables online collabora- tion by allowing users to visualize and interact with 3D models in a shared virtual space. It supports real-time communication and teamwork, making it ideal for remote collaboration.

These tools were selected for their low cost or free use, along with a quick but challenging learning curve. They serve as platforms for developing digital literacy, preparing users to advance to more sophisticated tools like Blender and other industry-standard tools such as Unity[11] and SolidWorks[12].

There is a need to design STEM educational programs with an international and interdisciplinary approach, using digital tools to foster cross-border collaboration and cultural inclusion. This approach is essential to prepare students for a globalized world where international cooperation and cultural understanding are crucial. The research involved over 1,200 Latin American and United States students in aerospace chal- lenges, demonstrating significant improvements in technical skills, creativity, and global collaboration. Additionally, the hybrid learning model facilitated cross-border collaboration among students from diverse countries.

II. Theoretical Framework

This framework on phenomena-based learning emphasizes inquiry and discovery, grounded in critical principles such as constructivism, connectivism, and experiential learning. It focuses on active knowledge construction and the use of digital resources, highlighting technology integration, global collaboration, and cultural sensitivity. Additionally, it stresses an iterative design process with continuous evaluation and reflective practices, preparing students for global STEM chal- lenges.

Phenomena-based learning is rooted in constructivist and experiential theories, emphasizing active knowledge construc- tion through experiences and interactions. This approach,

[8]Free, web-based platform, developed by Delightex, for creating and exploring virtual and augmented reality environments

[9]Technology that creates physical objects from digital designs by layering materials sequentially

[10]Free, web-based platform, developed by Spatial Systems Inc. for online collaboration in virtual reality and augmented reality spaces

[11]Cross-platform game engine developed by Unity Technologies.

[12]Computer-aided design (CAD) software developed by Dassault Systemes.

grounded in Vygotsky's constructivism [3] and Kolb's expe- riential learning theory [4], immerses students in authentic phenomena, fostering inquiry, exploration, and discovery. By contextualizing learning in the real world, it promotes essential critical thinking and problem-solving skills.

The pedagogical principles include:

- Constructivism: Promotes active learning through expe- riences.
- Connectivism: Emphasizes the importance of networks and digital resources.
- Experiential Learning: Based on reflection and direct experiences.

Technology integration is crucial, encompassing:

- Blended Learning: Combines in-person and online methods.
- Virtual Laboratories and Simulations: Provides prac- tical experimentation opportunities.
- Collaborative Tools: Facilitates communication and teamwork, as proposed by Bybee [5].

Niemi and Harju affirm that global collaboration and cul- tural sensitivity include:

- Cross-Cultural Competence: Promotes communication and cultural respect.
- Virtual Exchange Programs: Fosters international part- nerships and project collaboration [6].

Finally, the framework emphasizes an iterative design pro- cess, with continuous evaluation and improvement of learning experiences, and reflective practices, fostering metacognitive skills and self-directed learning. Dolata and Katsuiba highlight that these integrated elements in hybrid education models for international STEM challenges prepare students to success- fully navigate a globalized and technologically advanced world [7].

III. Methodology

At the core of the phenomena-based learning approach presented in this article is an innovative methodology devel- oped by Javier Montiel, M.Ed. This methodology is designed to guide students through a structured journey, from the exploration of phenomena to the discovery of career paths. Depicted as an inverted pyramid, it provides a comprehensive framework for designing and implementing learning experi- ences that seamlessly integrate disciplinary content with career exploration opportunities.

A. *Learning Experience Design Pyramid*

The Learning Experience Design Pyramid Framework, shown in Fig. 1, comprises seven interconnected stages:

- Inquiry/Research: Students investigate a selected phe- nomenon, exploring its context, significance, and im- plications. This phase lays the foundation for deeper exploration.

- Design: Students conceptualize ideas based on their re- search, incorporating interdisciplinary connections and

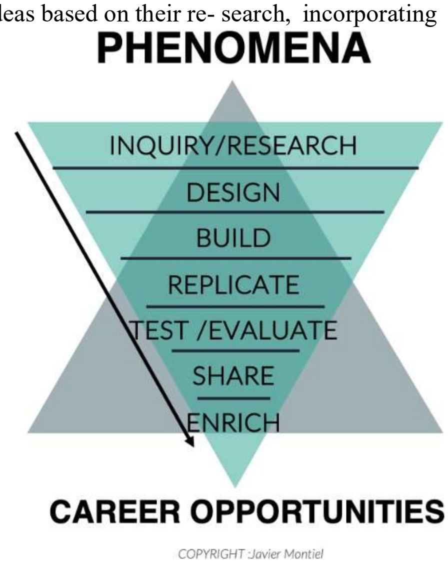


Fig. 1. Phenomena 2.jpg

authentic contexts. Creativity and innovation are encour- aged as students envision projects and activities that spark curiosity and engagement.
- Build: Students create tangible artifacts or representations related to the phenomenon. This hands-on approach fa- cilitates experiential learning and reinforces conceptual understanding.
- Replication: During the design and development of their prototypes, students gain valuable insights into the impact of variables on their models and observe how these models emulate or deviate from real-world phenomena.
- Test/Evaluation: Students critically reflect on their learn- ing experiences and assess the effectiveness of their projects. Through self-assessment and peer review, they identify strengths, weaknesses, and areas for improve- ment, allowing for adjustments and refinements.
- Sharing: Students share their findings with a broader au- dience, contributing to collective knowledge and inspiring others to explore similar pathways. At this stage, they can participate in challenges and competitions.
- Enrichment: Students extend their learning beyond the initial investigations, exploring related topics, disciplines, or applications, fostering a lifelong learning mindset.

There are other similar learning models, such as the one proposed by Niels Floor from LXD.org [8]. The key difference between the Pyramidal Model and the LXD.org Model is Montiel's emphasis on phenomena-based learning. This ap- proach not only allows students to explore interdisciplinary topics deeply but also helps them discover career opportunities in fields related to the studied phenomena. Phenomena-based learning focuses on observing and exploring real events, facilitating contextualized and relevant learning. This prepares students to face real-world challenges and explore various career paths.

Both models share a systematic, learner-centered structure. However, Montiel's Pyramidal Model stands out for its specific focus on the phenomena of career exploration, adding value in preparing students for the professional world. Additionally, this methodology is inspired by the Service-Learning approach proposed by Resch and Schrittesser, which helps students gain a deeper understanding of course content and fosters a greater sense of civic engagement [9].

Educational programs involving communities in STEM dis- ciplines represent one of the most significant and rewarding challenges for those developing educational projects for the general public. As Joel Mokir says, science and technology are the primary drivers of the global economy, mutually reinforcing each other to propel it even further [10].

Integrating phenomena-based learning into STEM programs focuses on using real-world phenomena as entry points for exploration and discovery. Aligning educational objectives with captivating phenomena, such as natural occurrences or technological advancements, can spark curiosity, stimulate research, and demonstrate the relevance of STEM disciplines in everyday life. The described methodology can be adapted to community learning experiences, guiding participants from phenomena exploration to career discovery, incorporating elements of research, design, hands-on activities, reflection, and sharing. This approach empowers participants to acquire disciplinary knowledge and cultivate essential skills and dis- positions for future success.

B. Implementation

The implementation engaged over 1200 Latin and Amer- ican students in aerospace challenges, aligned with the UN Sustainable Development Goals (SDGs) for four years (see Table I).

TABLE I
NUMBER OF PARTICIPANTS BY COUNTRY

Country	Number of Participants
Mexico	956
Colombia	183
Argentina	19
Brazil	17
Canada	11
Chile	10
United States	8
Puerto Rico	2

The study involved participants from NASA Sparx, the International Space Metaverse Challenge, and the Mars Inno- vation Challenge. Throughout these programs, students were tasked with researching, ideating, innovating, and solving mission-critical needs in water and sanitation, food produc- tion, and energy, reflecting SDGs #2[13], #6[14], and #7[15]. The

13UN's SDG #2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

14UN's SDG #6 Ensure availability and sustainable management of water and sanitation for all

15UN's SDG #7 Ensure access to affordable, reliable, sustainable, and modern energy for all

students who participated in the programs were mentored by school teachers and instructors using the Learning Experience Design Pyramidal Framework and participated in online video conferences.

- NASA Sparx (2021, 2022): The Next Gen STEM SPARX (Sparking Participation and Real-world Expe- riences in STEM) program emphasizes engineering to connect students to STEM in a uniquely NASA way. Engaging K-12 students with the Engineering Design Process (EDP), this program challenges participants to use NASA technologies to address real-world commu- nity problems. Through the initiative, students explore and propose innovative solutions, develop prototypes, and gain firsthand experience in applying cutting-edge technologies. In collaboration with the Aviation Youth Mentoring Program[16] in Washington, D.C., international students also participated in the pilot program.
- International Space Metaverse Challenge (2023): De- veloped by the International Aerospace Academy[17], this challenge fosters creativity and technical skills by engag- ing early elementary to high school students in solving habitat problems on Mars. Using free 3D modeling software, participants created research-based 3D models and dioramas, which were then placed in the Metaverse. These innovative projects were showcased at the 2023 Space Exploration Educators Conference[18] in partnership with AEXA[19], highlighting the students' abilities to apply their knowledge in a virtual environment.
- Mars Innovation Challenge (2023, 2024): This initiative by Explore Mars focuses on developing innovations to help humans thrive on Mars, emphasizing alignment with the UN SDGs in water and sanitation, food production, and energy. These critical aspects are essential for sustain- ing life on Mars and are relevant to Earth's sustainability. In collaboration with Thrive Games and their blockchain game THRIVE ON MARS, the challenge encourages participants to address real-world problems creatively and practically. The winning innovations received a cash award and the opportunity to be featured in the THRIVE ON MARS game, offering young innovators a unique chance to influence space exploration and global sustain- ability.

C. The Participants

A survey was administered to a sample representing 35% of the students who participated in the activities described earlier. The survey instrument included closed and open-ended

16Program that inspires and guides young people interested in aviation through mentorship, education, training, and hands-on experiences.

17Organization dedicated to promoting education and training, designed to engage students, educators, and professionals in aerospace.

[18]Annual event organized by Space Center Houston that provides educators with innovative STEM resources and strategies to inspire their students in space exploration.

[19]Technology company specializing in virtual and augmented reality solu- tions for aerospace applications and education, collaborating with NASA and other organizations.

questions, utilizing a simplified Likert Scale[20] to measure agreement with various statements and open-ended questions to gather detailed feedback. The methodology involved the electronic distribution of the survey, ensuring participant con- fidentiality. Quantitative data were analyzed using descriptive statistics, and qualitative responses were thematically coded. This approach allowed for evaluating the hybrid model's impact on students' technical skills, creativity, and global collaboration.

Parallel to this, a control group survey was conducted with a similar number of students who participated in entirely in- person activities in Mexico. These activities were organized by university students from the STEM Engagement group of the IKTAN Roving team, which annually participates in the NASA Human Exploration Rover Challenge. An essential participation requirement for this competition is community outreach.

Two types of data analysis were performed in this article:

- Comparison with the Control Group: A detailed com- parison was conducted regarding participant satisfaction

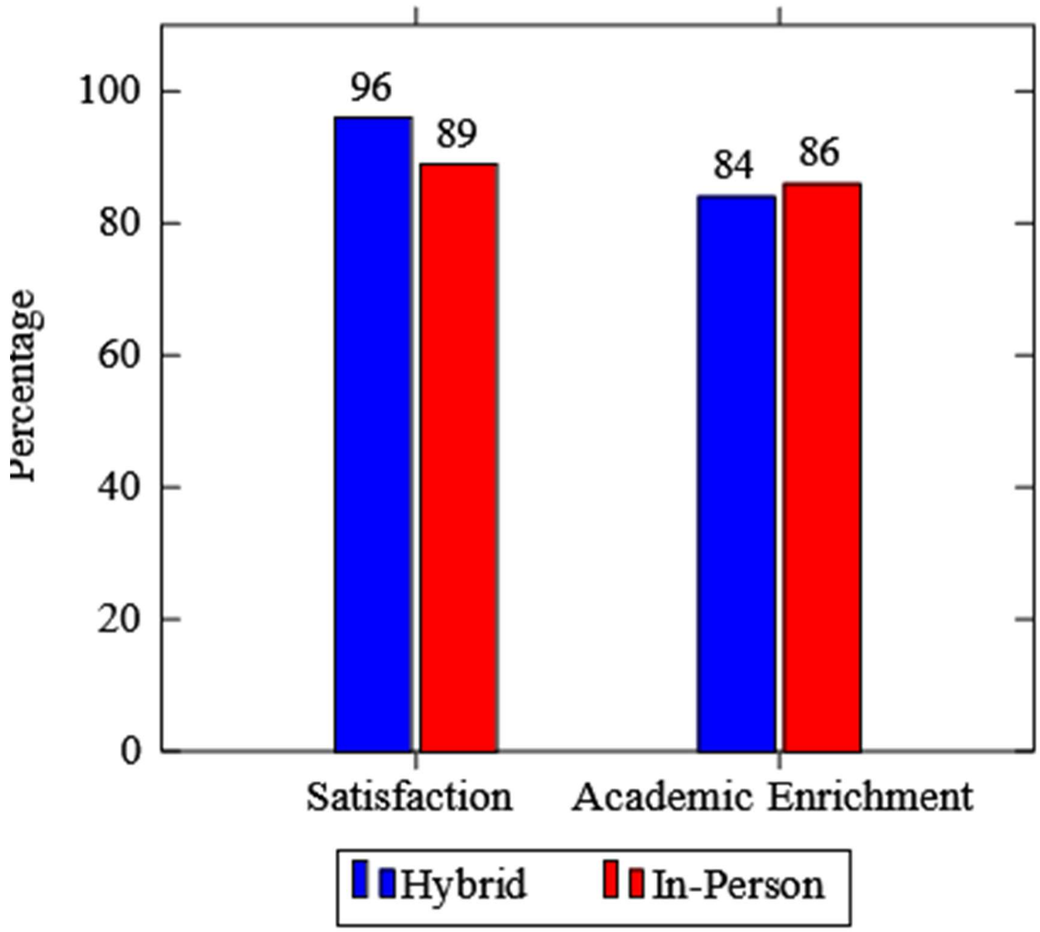


Fig. 2. Hybrid Vs In-Person Learning Models

with activities and events, as well as the impact of these activities on the academic enrichment of the participants. Additionally, a comparison of the costs, resources, and implications of both implementations was made to evaluate their effectiveness and efficiency.

- Influence on Interest in STEM Programs: The influ- ence of these events and activities on participants' interest in STEM programs was analyzed. The impact of these programs on promoting student participation in science and engineering projects, and in national and interna- tional competitions, was also evaluated. Additionally, participants were surveyed about their areas or fields of study interest, previous STEM experiences, participation in school, regional, national, or international events and competitions, involvement in extracurricular activities, and their perception of the value added by these activities.

These analyses provide a comprehensive understanding of the impact of hybrid and in-person activities on students, highlighting both satisfaction and academic and professional development in the STEM field.

IV. Results and Evaluation

A. *Results on Hybrid vs in In-Person Model (Control Group)*

Fig. 6 compares the perceived value and satisfaction,and the perceived impact of academic enrichment, between hybrid and in-person learning models.

Satisfaction: The chart shows that the hybrid model has a higher satisfaction rate (96%) than the in-person model (89%). This indicates that students might find the combination of in- person and online elements more satisfying than in-person teaching alone.

[20]Survey tool that measures attitudes and perceptions using a series of state- ments with responses on an ordinal scale, ranging from ”strongly disagree” to ”strongly agree.”Academic Enrichment: As also shown in Fig. 2, the in- person model slightly outperforms the hybrid model in terms of perceived academic enrichment, with percentages of 86% and 84%, respectively. This suggests that while students ap- preciate the hybrid model for its flexibility and variety, they might perceive the in-person model as slightly more enriching academically.

Overall, the chart demonstrates that both learning models have their strengths, with the hybrid model leading in satisfac- tion and the in-person model having a slight edge in perceived academic enrichment.

Comparison with Control Group: A control group survey conducted with students participating in entirely in-person activities revealed the following: Students in the hybrid model reported higher satisfaction (96%) compared to the control group, indicating that the integration of digital tools and international collaboration enhances the learning experience.

Table II provides a comparative analysis of the costs as- sociated with hybrid workshops versus in-person workshops. This comparison includes setup costs, operational costs, and personnel costs, highlighting the financial implications of each workshop format.

Costs	Hybrid Workshops	In-Person Workshops
Setup Costs	Moderate (technology infrastructure, software licenses)	High (physical venue rental, equipment)
Operational Costs	Lower (reduced travel, materials can be digital)	Higher (travel, accommodation, physical materials)
Personnel Costs	Potentially lower (remote instructors, reduced on-site staff)	Higher (instructors and support staff on-site)

TABLE II
COSTS BETWEEN HYBRID VS IN-PERSON WORKSHOPS

The implications of choosing between hybrid and In-Person

workshops extend beyond financial considerations. These for- mats have significant impacts on the flexibility, accessibility, and engagement levels experienced by participants. A compar- ative analysis of the implications for hybrid versus In-Person workshops (see Table III), illustrates how each approach caters to different needs and circumstances.

Implications	Hybrid Workshops	In-Person Workshops
Flexibility	High (participants can join from various locations)	Low (participants must be physically present)
Accessibility	Higher (geographic barriers reduced)	Lower (limited to local participants)
Engagement	Variable (depends on technology and facilitation)	High (direct, In-Person interaction)

TABLE III
IMPLICATIONS BETWEEN HYBRID VS IN-PERSON WORKSHOPS

The choice between hybrid and In-Person workshops also impacts the resources required to conduct these sessions. Key considerations include technology, physical space, materials, and staff training. Table IV offers a comparative analysis of the resources of hybrid and In-Person workshops.

Resources	Hybrid Workshops	In-Person Workshops
Technolog y	High (reliable internet, virtual platforms, technical support)	Low (essential audiovisual equipment, physical space)
Physical Space	Low (minimal requirement)	High (adequate space to host participants)
Materials	Digital materials (easier to distribute and update)	Physical materials (printing, distribution)
Training for Staff	Higher (training on digital platforms, online facilitation)	Lower (in-person teaching methods)

TABLE IV
RESOURCES BETWEEN HYBRID VS IN-PERSON WORKSHOPS

When considering the opportunity costs of hybrid versus in- person workshops, various factors such as reach, scalability, learning experience, and environmental impact are considered. Table V provides a comparative analysis of the opportunity costs for both formats

The control group survey revealed higher satisfaction among students in hybrid activities (96%) versus in-person activities, highlighting the benefits of digital tools and international collaboration. Financial analysis (Table II) shows hybrid work- shops have lower operational and personnel costs but moderate setup costs. Hybrid workshops offer greater flexibility and accessibility (Table III), though In-Person workshops maintain higher engagement. Resource requirements (Table IV) indicate hybrid workshops need more technology and training, while In-Person require more physical space and materials. Opportu- nity costs (Table V) show hybrid workshops are more scalable and environmentally friendly.

B. Results of the implementation of the Learning Experience Design Pyramid

The Learning Experience Design Pyramid (LEDP) frame- work, developed to guide students through structured learning

Opportunity Costs	Hybrid Workshops	In-Person Workshops
Reach	High (can reach a global audience)	Limited (local or regional audience)
Scalability	High (easy to scale up with more participants)	Limited (dependent on venue capacity)
Learning Experience	Mixed (depends on technology use and participant engagement)	High (direct interaction and hands-on activities)
Environment Impact	Lower (reduced travel and physical materials)	Higher (travel and use of physical resources)

TABLE V
OPPORTUNITY COSTS BETWEEN HYBRID VS IN-PERSON WORKSHOPS

experiences, integrates disciplinary content with career explo- ration. The LEDP consists of seven stages: Inquiry/Research, Design, Build, Replication, Evaluation, Sharing, and Enrich- ment. Over 1,200 Latin American students participated in aerospace challenges aligned with the UN Sustainable Devel- opment Goals (SDGs).

Benefits of LEDP

- Enhanced Technical Skills and Creativity: Significant improvements in technical skills and creativity, with 96% reporting high satisfaction and perceived value from hybrid STEM programs.
- Global Collaboration and Cultural Inclusion: Pro- moted cross-border collaboration and cultural understand- ing,

enhancing global collaboration skills.

- Interest in STEM and Career Exploration: 84% believed academic enrichment programs improved their performance, fostering interest in STEM careers. Students showed increased motivation for STEM-related projects and competitions, with over 52% having participated in similar experiences before.

The chart in Fig. 3 shows the distribution of students by field of study. The majority (37.8%) are interested in STEM pro- grams, followed by those who are undecided (29.3%). Other fields include Biochemical/Health (16.2%), Humanities/Arts (12.0%), and Social Sciences (4.7%). This indicates a strong interest in STEM, with many students still undecided about their field of study.

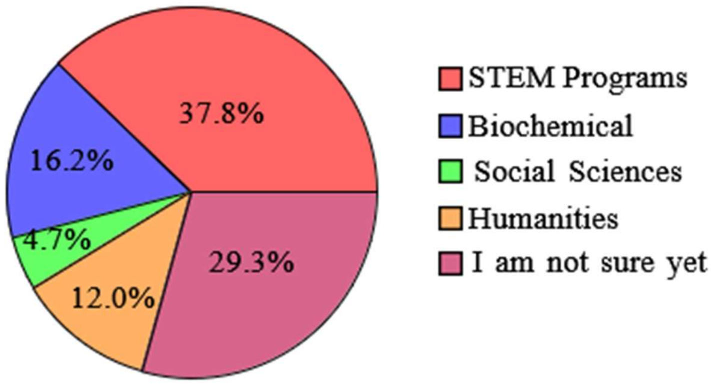
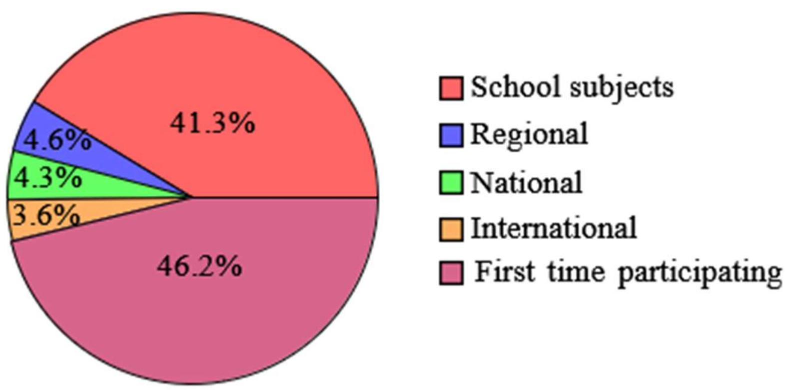


Fig. 3. Distribution of Students by Field of Study

The chart in Fig. 4 shows the participation levels in STEM challenges and competitions among students. The largest group consists of first-time participants, followed by those involved in school subjects. Smaller groups have participated at regional, national, and international levels, indicating a wide range of experience among the



students.

Fig. 4. Participation Levels in STEM Challenges and Competitions

The chart in Fig. 5 shows that most students engage in STEM activities through their school subjects, with a signif- icant portion also participating in extracurricular activities. A smaller group of students does not engage in STEM activities, emphasizing the importance of school programs in promoting STEM engagement.0

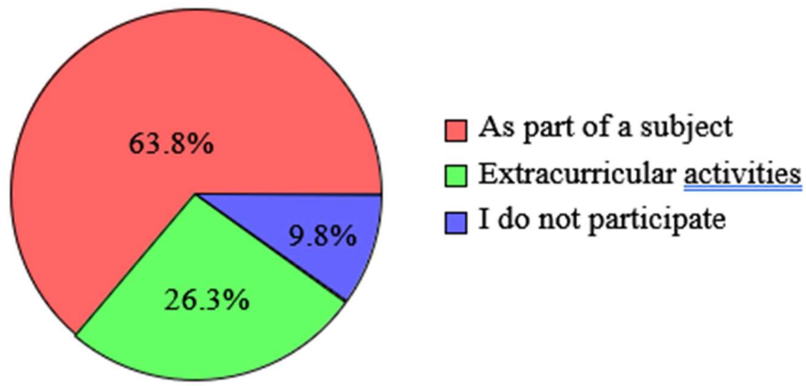


Fig. 5. Participation in STEM Activities

Fig. 5. Participation in STEM Activities

Fig. 6 shows students' perceptions regarding the benefits of early technological experiences. Most students agree that early exposure to technology provides professional advantages, while a small minority are unsure or disagree. This highlights the significant role early technological experiences play in perceived career benefits.

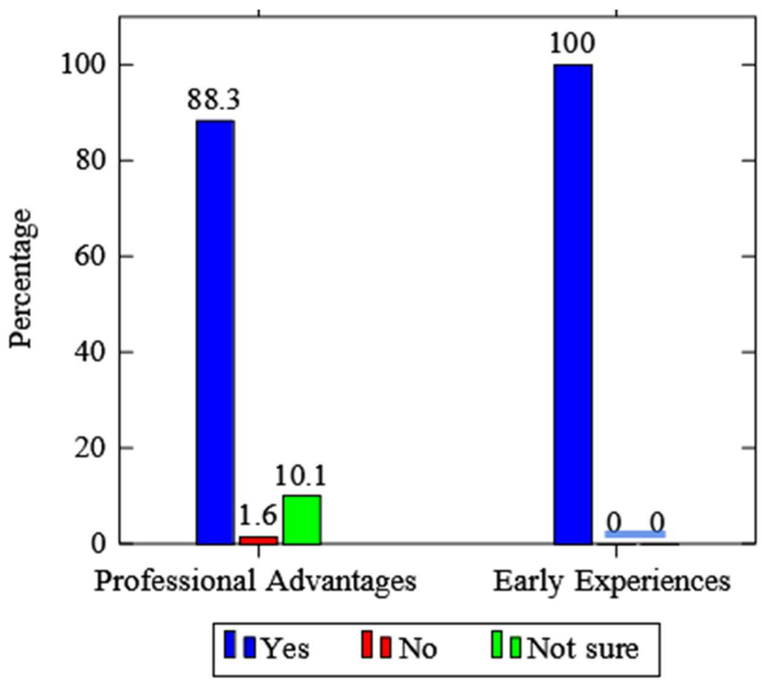


Fig. 6. Perception of Technological Problem Solving and Early Experiences

Finally, Fig. 7 shows survey responses on the impact of early exposure to STEAM technologies. The highest agree- ment is for the positive impact on critical reasoning skills. Early exposure and its influence on career choices also have notable agreement. However, the influence on professional vocation has the highest partial agreement but the lowest complete agreement. Overall, respondents generally recognize the positive impacts of early STEAM exposure, though there is some variation in the level of agreement across different aspects.

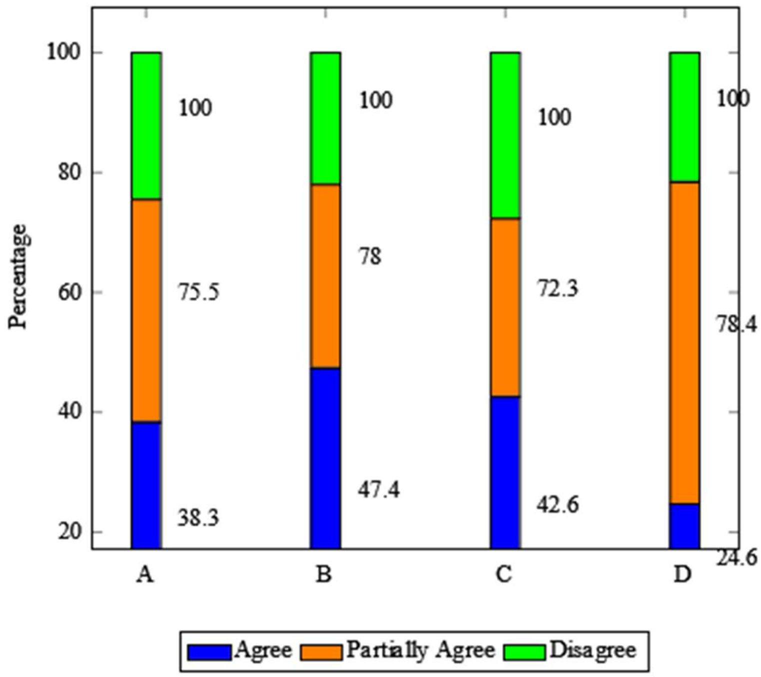


Fig. 7. Survey responses: A: Early Exposure to STEAM Technologies, B: Impact of STEAM Technologies on Critical Reasoning Skills, C: Influence of Early Technological Tool Use on Career Choices, D: Early use of technological tools influences their choice of professional vocation or career

C. Results of the Participant's Learning Experience and Curr´ıcula

The Mars Innovation Challenge engaged around 300 students from various Latin American countries and the United States, providing a platform to explore STEAM by solving real-world problems related to life on Mars. Using the Learning Experience Design Pyramidal Framework, students competed and received awards in various categories. Notable winners included projects in geothermal energy, water sanitation, sustainable food production, and innovative agricultural solutions. Students from the IKTAN Roving and TecXotic teams at Tecnologico de Monterrey Campus

Cuernavaca also participated as mentors, earning several recognitions, including a ”STEM Engagement Award” at the NASA Human Exploration Rover Challenge 2021.

V. CONCLUSIONS

Integrating technology, personalized approaches, teaching innovation, and skill development is essential for enhancing the learning experience and preparing students for a tech- nologically advanced future. Utilizing tools like Gemini to boost creativity and productivity in the classroom, adapting educational sessions interactively with AI, exploring new teaching methodologies that incorporate AI as a teaching aid, and fostering digital and critical thinking skills through AI platforms can significantly impact 21st-century education.

The Learning Experience Design Pyramid (LEDP) offers substantial advantages in preparing students for future careers by enhancing technical skills, creativity, and global collabora- tion. The hybrid model's ability to integrate digital tools and maintain an international focus makes it a valuable framework for modern STEM education. Comparisons with traditional in- person models highlight the benefits of incorporating digital and collaborative elements into educational programs.

Future implementations of the LEDP should continue to emphasize real-world applications and international collabora- tion. Expanding the framework to include more diverse fields and interdisciplinary projects could enhance its effectiveness in career-based education experiences. By integrating the LEDP framework into educational systems, institutions can better prepare students for the complexities of the modern work- force, ensuring they possess the necessary skills and global perspective to succeed in their careers.

This approach significantly contributes to the development of education in the United States and Latin America by fostering cross-border collaboration and cultural understand- ing, crucial for the global workforce. Students gain essential technical and soft skills by integrating STEM programs with an international focus and digital tools, preparing them for real-world challenges. The involvement of over 1,200 Latin American students in aerospace challenges and the collabora- tion between students from diverse countries enhances global perspectives and problem-solving abilities. This hybrid model also promotes the exchange of best practices among educators, enriching educational experiences in both regions and creating a network of committed STEM advocates.

Future directions for the LEDP framework include its application as an educational model to develop programs in collaboration with various space sector companies and implement these projects in educational institutions. These programs will be presented at the Space Center Houston in February 2025. Educational initiatives include collaborations with volunteers from Axiom Space, Blue Origin, Aexa, Magnitude, and Explore Mars, allowing students to work directly with industry experts. This enhances their learning experience and offers a practical, applied perspective on the knowledge gained. Such collaborations strengthen students'technical competencies and help them develop crucial soft skills such as teamwork, communication, and problem-solving in real contexts. These advanced educational experiences ensure that students are better prepared for the demands of the global labor market and can significantly contribute to innovation and technological development.

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