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Research Article

Empowering Future Engineers: Outcomes of Tecnologico de Monterrey's Engagement in the NASA Human Exploration Rover Challenge

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ABSTRACT

Since 2013, Tecnolo´gico de Monterrey has partici- pated in the NASA Human Exploration Rover Challenge, provid- ing its students with a valuable learning experience through high-impact international challenges. This multidisciplinary project engages students from various undergraduate and engineering programs, who collaborate to solve complex problems. By 2024, over 200 students will have been part of this initiative, with many facing their first international challenge. Over the years, the team has garnered multiple awards, demonstrating their global competitiveness. This paper examines how participation in the challenge has fostered the development of critical skills such as complex problem-solving, digital transformation, teamwork, innovation, leadership, and English communication. Additionally, it has opened doors to significant academic and professional opportunities, including scholarships, exchange programs, in- ternships at leading companies, and enhanced job placements after graduation. Particularly noteworthy is the significant im- provement shown by students with initially lower academic performance, highlighting the transformative impact of this experience on their motivation and commitment to academic and professional success. The study's unique contribution lies in its analysis of the long-term effects of such international challenges on students' career trajectories and personal development, with a specific focus on the Latin American educational context.

Keywords: Educational Innovation, Higher Education, Challenge-Based Learning, Learning Models, NASA Human Exploration Rover Challenge

I. INTRODUCTION

The TEC21 Educational Model, implemented by Tec- nolo´gico de Monterrey in 2019, integrates challenge-based learning (CBL) as a central element of its pedagogical ap- proach. CBL is an educational methodology where students engage directly with real-world challenges, applying their knowledge and skills in practical, impactful scenarios. This approach emphasizes active problem-solving, fostering a deeper understanding of subject matter and enhancing key competen- cies through hands-on experience.

Fig. 1. Tecnolo´gico de Monterrey's Team at the NASA Human Exploration Rover Challenge 2024

One notable application of this model is the participation in international competitions, such as the NASA Human Exploration Rover Challenge (NASA-HERC), an international competition where students design and build vehicles for space exploration missions (see Fig. 1). Since 2013, Tecnolo´gico de

Monterrey has achieved significant success in NASA-HERC, earning 14 awards, including first and second place globally, as well as recognitions for engineering excellence. These accomplishments highlight the students' technical skills and the effectiveness of the TEC21 Model in preparing them for global challenges [1], [2].

While the immediate benefits of participating in interna- tional competitions like NASA-HERC—such as the develop- ment of problem-solving, innovation, leadership, teamwork, and English communication skills—are well-documented, there is a lack of research on their long-term impact, par- ticularly in the context of Latin America. Furthermore, the emotional and motivational effects of these experiences on students remain underexplored, especially regarding how such participation influences their academic commitment and per- sonal growth over time.

A. Research Questions

This study seeks to explore the following questions:

1) **How does participation in NASA-HERC impact the development of key competencies such as problem- solving, innovation, leadership, and English commu- nication among Tecnolo´gico de Monterrey students?**
2) **What is the effect of NASA-HERC participation on students' academic and professional opportunities, including internships, study abroad programs, schol- arships, and job placements?**
3) **How does participation in NASA-HERC influence students' emotional competencies, motivation, and academic commitment?**
4) **What are the long-term impacts of these experiences on students' personal and professional trajectories, particularly in the Latin American educational con- text?**

These questions guide the study's investigation into how participation in NASA-HERC shapes both technical and soft skills, as well as broader academic and career outcomes. By addressing these aspects, the study aims to provide a deeper understanding of the holistic impact of such competitions on students.

Understanding the broader implications of participation in international competitions is essential, as these experiences play a significant role in students' overall development. The success of these initiatives has prompted various Tecnolo´gico de Monterrey campuses to engage in international competi- tions, underscoring their value in higher education. This study will not only enhance the understanding of these impacts but also offer insights to strengthen and expand similar initiatives across educational institutions.

II. THEORETICAL FRAMEWORK

Tecnolo´gico de Monterrey is dedicated to developing highly competitive leaders and entrepreneurial professionals in a global context. A key element of its educational strategy is Challenge-Based Learning (CBL), grounded in the theory of Experiential Learning, which posits that students learn most effectively by applying knowledge in real-world situations, thereby solving problems, testing solutions, and engaging with meaningful contexts [3]. This section provides a detailed analysis of the theoretical foundations and the impact of CBL in various contexts, including the specific challenges faced in Latin American educational systems.

A. *Impact of CBL on Disciplinary Competencies*

In disciplines like science and engineering, where prac- tical application is essential, CBL has become particularly prominent. Moore [8] emphasizes that Experiential Learning deepens conceptual understanding while also fostering critical skills such as innovation, leadership, and collaboration. Recent studies by Prince and Felder [4] and Smith et al. [5] demon- strate the effectiveness of active learning methods like CBL in enhancing knowledge retention and critical skill develop- ment. However, these studies primarily focus on short-term academic outcomes, often neglecting the long-term impact of CBL on students' career trajectories and emotional well- being. This gap is particularly evident in the context of Latin American higher education, where the enduring effects of CBL on student motivation, professional opportunities, and social mobility remain underexplored.

B. *Emotional and Motivational Impact of CBL*

While the benefits of CBL and Experiential Learning are well-documented, existing literature often overlooks the emo- tional and motivational impacts. Bergmann and Sams [6] show that active teaching methods, such as CBL and Flipped Learn- ing, can significantly increase student participation and moti- vation. However, there is insufficient exploration of how these methods influence students' emotional resilience and long- term commitment to their academic and professional goals. In the specific context of international competitions, Herna´ndez and Garc´ıa [7] analyzed the impact of the NASA Human Exploration Rover Challenge on Latin American students, concluding that such experiences boost both academic mo- tivation and professional opportunities. However, their study falls short of examining the long-term professional trajectories of participants or the broader socio-economic impacts of these opportunities.

C. *Challenges of Implementing CBL in Latin America*

While the literature provides a strong foundation for under- standing the benefits of CBL, several critical areas remain un- derexplored, particularly in the context of Latin America. Jou, Hung, and Lai [9] highlight the necessity of integrating real- world perspectives into CBL but do not adequately address the difficulties faced in resource-constrained environments. Similarly, Savery [10] discusses the importance of motivation and engagement in learning, yet there is limited empirical re- search on how these factors sustain over the long term in CBL environments, especially in culturally and socio-economically varied settings. The implementation of CBL in Latin American contexts presents unique challenges, including limited access to resources, differing educational infrastructures, and socio- economic factors that influence student engagement and out- comes.

D. *Critical Analysis and Gaps in the Literature*

This study seeks to address these gaps by evaluating the influence of participation in the NASA Human Exploration Rover Challenge on the development of key competencies and the academic and professional opportunities of students at Tecnolo´gico de Monterrey. Furthermore, it critically examines the long-term impact of these experiences, particularly within the Latin American educational context, where such research is scarce. By incorporating a critical analysis of the literature and addressing these gaps, this research aims to advance the discourse on CBL and its applicability in diverse educational contexts. The findings are expected to provide valuable in- sights for educators, policymakers, and institutions seeking to implement or refine CBL programs to achieve more holistic and sustainable outcomes for their students.

III. METHODOLOGY

A. *Study Design*

This study follows a mixed-methods design, combining quantitative and qualitative approaches to evaluate the impact of the NASA Human Exploration Rover Challenge (NASA- HERC) on students at Tecnolo´gico de Monterrey. The quanti- tative part of the study focuses on comparing student grades and perceptions through surveys, while the qualitative part an- alyzes testimonials, academic and professional achievements, as well as documentation of the rover design and construction process. The qualitative results were used to contextualize and enrich the quantitative findings, providing a more holistic understanding of the project's impact.

B. Participants

The study included 201 students from various engineering and undergraduate programs who participated in at least one edition of NASA-HERC between 2013 and 2023. Of these, 67 students completed the surveys, representing a significant subsample. The sample is demographically diverse, with vari- ations in age, gender, and academic program, providing a broad representation of the student body at Tecnolo´gico de Monterrey, as shown in Table I. Additionally, 51% of the participants took part in the project more than once, allowing for an evaluation of changes in their performance over time.

The survey results indicated that 50% of the students had not participated in any other competition, while the remaining half were involved in various other challenges.

The data collected from the surveyed participants provides valuable insights into their involvement in various aspects of the NASA Human Exploration Rover Challenge. A signifi- cant portion of the students focused on manufacturing tasks (32.35%), reflecting the project's hands-on, technical nature. Additionally, other participants were engaged in telemetry (13.24%), design and manufacturing (11.76%), communica- tion (7.35%), and logistics (4.41%). This variety of roles

TABLE I
DISTRIBUTION BY ACADEMIC PROGRAM

Academic Program	Students	%
IC (Civil Engineering)	3	1.47
IDA (Automotive Design Eng.)	3	1.47
IDS (Sustainable Dev. Eng.)	30	14.71
IIS (Industrial & Systems Eng.)	32	16.18
IMA (Mechanical Engineering)	3	1.47
IME (Mechatronics Engineering)	6	2.94
IMT (Mechanical Eng. Tech.)	101	50.00
ITC (Computer Science Eng.)	9	4.41
LEM (Business Administration)	3	1.47
LMC (Communication Sciences)	9	4.41
Other Humanities Programs	3	1.47
Totals	**201**	**100.00**

highlights the multidisciplinary approach of the challenge, offering students a comprehensive learning experience that fosters the development of a broad range of competencies crucial for their academic and professional growth.

C. Instruments and Procedures

For data collection, various instruments and techniques were used:

1) **Surveys:** Surveys were administered to 67 students, with a 95% confidence level and a 10% margin of error. The surveys, specifically designed for this study and previously validated through a pilot test, measured students' perceptions of the project's impact on their academic performance and skill development.
2) **Academic Data:** Grades were obtained from participat- ing students and a non-participating control group, pro- vided by the Academic Services Department at the Cuer- navaca Campus. These data allowed for a comparison of academic performance before and after participation in the project.
3) **Process Documentation:** Visual and written evidence of the design, construction, testing, and competition participation processes were collected, as well as the academic and professional achievements of the students. These qualitative data include interviews, photographs, press releases, and participant testimonials.
4) **Comparative Analysis:** A comparative approach was used to analyze differences in academic performance between participating and non-participating students, considering cumulative GPA[1] averages before and after participation in the project.

D. Data Analysis

The data were analyzed using both quantitative and quali- tative methods:

1) **Statistical Analysis:** Descriptive and comparative anal- yses were conducted on the quantitative data obtained from the surveys and academic grades. Statistical soft- ware tools were employed to calculate averages, per- centages, and perform group comparisons, identifying significant improvements in academic

performance.

2) **Perception Analysis:** Survey results were examined to identify trends in student perceptions regarding the project's impact on their competency development and academic performance.
3) **Qualitative Analysis:** The process documentation and student testimonials were qualitatively analyzed to identify patterns and recurring themes related to competency development, professional achievements, and student motivation.
4) **Longitudinal Comparison:** A longitudinal analysis of academic grades and achievements was conducted to assess the long-term impact of the project on students who participated in multiple editions of the NASA- HERC.

IV. QUALITATIVE RESULTS

The qualitative data highlight the substantial curricular and professional value that students associate with their partic- ipation in the NASA Human Exploration Rover Challenge (NASA-HERC). Participants view this experience as not only a critical learning opportunity but also as a valuable enhance- ment to their professional development, boosting their resumes and distinguishing them in the job market.

Student Testimonials:

"The Rover Challenge is an excellent project that provides an experience you can't gain in the class- room. It's a fantastic way to apply engineering knowledge while developing interpersonal and com- munication skills. Participating in an international competition significantly strengthens your resume and opens unique opportunities. I consider it one of the best projects of my life."

"Solving problems under pressure and representing not just your university, but your country, offers perspectives and experiences that are hard to find elsewhere."

Participation in NASA-HERC also contributes significantly to the development of Disciplinary Competencies, which are the essential skills and knowledge specific to a student's field of study, crucial for their professional practice, such as design and manufacturing. Additionally, it fosters Transversal Compe- tencies like communication and teamwork. Testimonials reflect a high level of satisfaction, with students rating their involve- ment as extremely positive and strongly advocating for the continuation of the competition. This consensus underscores the positive impact of NASA-HERC on the student community and reinforces its value as an integral part of the academic curriculum.

A. Impact on Academic Performance and Professional Devel- opment

Participation in NASA-HERC has profoundly influenced students' academic performance and professional develop- ment. Many students reported that this experience significantly enhanced their curriculum vitae, making it a key differentiator in the competitive job market.

Furthermore, the project has opened doors to numerous professional and academic opportunities for participating stu- dents, including prestigious international internships, positions in leading companies, and participation in valuable exchange programs. Some students have also earned scholarships and gained admission to top postgraduate programs. Table II presents a detailed breakdown of the percentage of students who benefited from these opportunities directly through their involvement in NASA-HERC, illustrating the significant im- pact on their academic and professional trajectories.

TABLE II
OPPORTUNITIES RESULTING FROM NASA-HERC PARTICIPATION

Opportunity	**Students**	**%**
International Internship	38	19.1
Position in Intl. Company	38	19.1
National Internship	21	10.3
International Exchange	21	10.3
Exchange in Top 200 QS Univ.	9	4.4
Postgraduate Scholarship	9	4.4
Admission to Postgrad. Program	9	4.4
Totals	**145**	**72.1**

B. Student Recommendations and Perception of NASA-HERC

The vast majority of NASA-HERC participants strongly recommend the experience to their peers. An overwhelming 98.5% expressed that they would encourage other students to participate, emphasizing the positive

impact on their personal and academic growth.

Students unanimously recognized the significant value that NASA-HERC added to their resumes, with all respondents agreeing that the experience made them more competitive in the job market and better prepared for professional challenges. In addition to the positive personal outcomes, students universally supported the continued involvement of their cam- pus in NASA-HERC. All surveyed students advocated for the campus to maintain its participation in this international competition, highlighting the perceived benefits and long-term value of the program for both individual students and the institution as a whole.

C. *Development of Competencies*

Disciplinary and Transversal Competencies: Students reported significant growth in both disciplinary competencies, such as design and manufacturing, and transversal competen- cies[2], including communication and teamwork. These devel- opments align with the observed improvements in academic performance, particularly among students with previously moderate grades.

The development of competencies is central to the Tec21 Educational Model at Tecnolo´gico de Monterrey. This model emphasizes the importance of both disciplinary and transversal competencies as essential for preparing students to meet real- world challenges. The Tec21 model ensures that graduates are not only technically proficient but also equipped with critical soft skills, enabling them to collaborate effectively, lead teams, and communicate ideas clearly in diverse and dynamic environments, as shown in Table III. NASA-HERC serves as a powerful platform for applying this educational phi- losophy, allowing students to enhance their technical expertise while simultaneously developing the transversal competencies crucial for their professional success [11].

TABLE III
TRANSVERSAL COMPETENCIES DEVELOPED BY PARTICIPANTS

Competency	**Students**	**%**
Communication	106	52.9
Innovative Entrepreneurship	35	17.6
Digital Transformation	83	41.2
Social Intelligence	157	77.9
Ethical & Civic Responsibility	77	38.2
Self-awareness & Management	109	54.4
Reasoning for Complexity	151	75

TABLE IV
DISCIPLINARY COMPETENCIES DEVELOPED BY PARTICIPANTS

Disciplinary Competency	**Students**	**%**
Competencies in Manufacturing and Fabrication Processes		
Metrology and Standards	68	33.8
Machining Processes	59	29.4
SMAW Welding	95	47.1
GMAW Welding	38	19.1
GTAW Welding	17	8.6
Cutting and Metalworking	117	58.1
Manufacturing Quality	83	41.2
Computer-Aided Manufacturing (CAM)	68	33.8
Competencies in Design and Engineering		
Mechanical Systems Design	91	45.6
Mechatronic Systems Design	44	22.1
Computer-Aided Design (CAD)	137	68.3
Competencies in Electronics and Automation		
Sensors and Transducers	35	17.6
Wireless Transmissions	33	16.2
PCB Prototyping	24	11.8
Competencies in Digital Fabrication Technologies		
3D Printing	47	23.5
Laser Cutting	47	23.5
Competencies in Management and Organization		
Project Management	89	44.1
Logistics and Transportation	44	22.1
Sponsorship and Fundraising	24	11.8
Competencies in Communication		
Communication Campaigns	29	14.7

The data reveal that a substantial proportion of students developed critical transversal competencies through their par- ticipation in NASA-HERC. Notably, 77.9% improved their social intelligence, and 75% developed enhanced reasoning for complexity, both essential for navigating the challenges of the modern workplace.

Table IV presents the disciplinary competencies developed by students, along with the number and percentage of partic- ipants who acquired each competency.

The data illustrate that students acquired a wide range of disciplinary competencies through their involvement in NASA-HERC. The development of skills in areas such as CAD (68.3%), technical welding (47.1%), and cutting and metalworking (58.1%) reflects the hands-on, practical expe- rience that the project provides, which is central to the Tec21 Educational Model's goal of preparing students for real-world engineering challenges.

D. General Satisfaction

The overall satisfaction of students who participated in NASA-HERC was overwhelmingly positive. The majority of students rated their experience highly, with many giving the highest possible scores. This positive evaluation is strongly correlated with the observed improvements in both their grades and skills, further validating the effectiveness of challenge- based learning as a pedagogical approach. The impact of the project on students' GPA, performance in other projects, and overall academic progress is summarized in Fig.2.

The impact of NASA-HERC on students' university life and overall experience was predominantly positive. Most students described the project as highly beneficial, emphasizing its significant role in their educational journey. As shown in Fig.3, a large percentage of participants rated their experience as either "Highly Positive" or "Positive," with no respondents decreases in their grades, with a drop of 2.66% in the 96 to 100 range, as shown in Table V. This "ceiling effect" suggests that students already performing at a high level have limited potential for further numerical improvement. This effect warrants a focused and detailed investigation to better understand the effectiveness of Challenge-Based Learning (CBL) for high-achieving students and to explore strategies to enhance its impact in these cases.

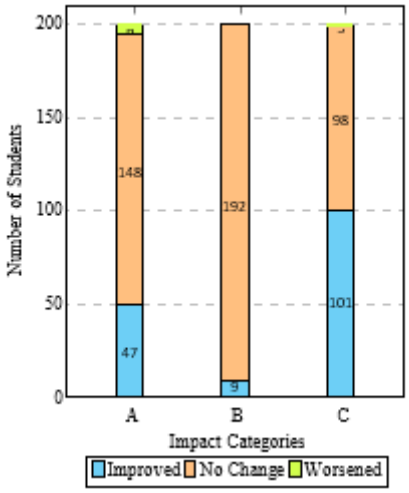

Fig. 2. Impact of NASA-HERC on Student Performance.
A: Impact on GPA, B: Impact on Other Projects, C: Overall Academic Performance

3. Comparison with Non-Participants:

Non-participating students showed insignificant changes in their grades, with minimal variations indicating a negative impact.

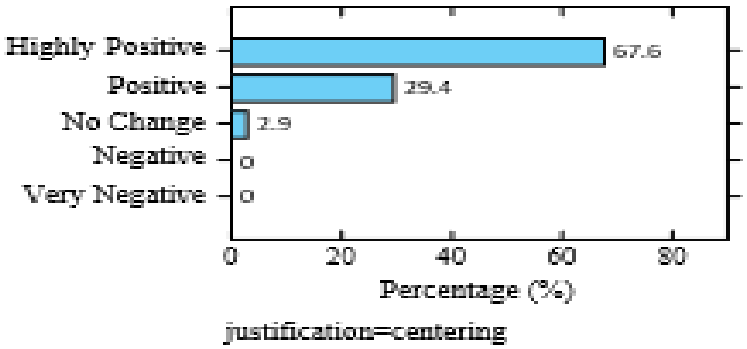

Fig. 3. Impact of NASA-HERC on University Life and Experience

Students who provided additional feedback emphasized the importance of continuing to promote this opportunity within the student community. When asked about what they liked most about NASA-HERC, participants highlighted teamwork and camaraderie (25.00%), the design and construction phase of the Rover (25.00%), and the overall learning experience (17.65%) as key positive aspects. Conversely, the most com- mon challenge cited was the difficulty in securing sponsorships (35.29%), followed by issues related to leadership and team commitment. Despite these challenges, the overall sentiment was overwhelmingly positive, with strong support for the continuation of the project.

The qualitative findings underscore the significant value of NASA-HERC in enhancing students' academic and profes- sional development. The positive feedback and the wide range of competencies developed reinforce the importance of such challenges within the Tec21 Educational Model. The strong support from participants confirms the program's essential role in preparing students for real-world success.

V. QUANTITATIVE RESULTS

This section presents the quantitative results of the study, focusing on the impact of participation in the NASA Human Exploration Rover Challenge (NASA-HERC) on students' academic performance. The analysis highlights improvements across various grade ranges, comparing the outcomes for students who participated in NASA-HERC with those who did not, providing insights into the effectiveness of Challenge- Based Learning in enhancing academic achievement.

1. Significant Improvement in Lower Grades: Students with lower grades (70 to 85 GPA) showed the most significant improvements after participating in NASA-HERC, with increases of 6.14%, 6.36%,
and 6.98%, respectively. This suggests that participa- tion in the project has a particularly positive impact on students with moderate academic performance, as seen in Table V.
2. Impact on Higher Grades:
Students with higher grades (91 to 100 GPA) ex- perienced marginal improvements or even slight suggesting that, in the absence of the NASA-HERC experience, students do not experience significant academic performance improvements over time, as seen in Table VI.

4. General Trend:
The data indicates that participation in NASA-HERC positively impacts academic performance, especially for students with moderate grades. This reinforces the effectiveness of Challenge-Based Learning as a methodology to improve academic performance and motivate students.

TABLE V
COMPARISON OF GRADES BEFORE AND AFTER PARTICIPATION IN NASA-HERC

Grade Range (GPA)	Before	After	Change (%)
70 to 75	74.54	79.12	**+6.14**
76 to 80	78.60	83.60	**+6.36**
81 to 85	83.10	88.90	**+6.98**
86 to 90	88.40	89.30	**+1.02**
91 to 95	92.60	92.90	**+0.32**
96 to 100	97.60	95.00	**-2.66**

TABLE VI
COMPARISON OF GRADES FOR NON-PARTICIPATING STUDENTS

Grade Range (GPA)	Before	After	Change (%)
70 to 75	71.73	71.84	**+0.15**
76 to 80	78.29	78.47	**+0.23**
81 to 85	83.26	83.02	**-0.29**
86 to 90	88.38	88.48	**+0.11**
91 to 95	93.28	93.16	**-0.13**
96 to 100	98.50	98.28	**-0.22**

Overall, the data suggests that participation in NASA-HERC has a positive effect on academic performance, particularly for students with moderate grades. The findings reinforce the value of Challenge-Based Learning as a powerful educational approach that not only boosts academic results but also moti- vates students to excel.

VI. DISCUSSION

Interpretation of Results: The findings of this study align with previous research, demonstrating that Challenge-Based Learning (CBL) not only enhances academic performance but also fosters the development of critical competencies.

This study offers a unique contribution by highlighting the emotional and motivational benefits of participating in the NASA Human Exploration Rover Challenge (NASA-HERC), underscoring the value of integrating such experiential pro- grams into the educational curriculum.

Contribution to Theory: The results from NASA-HERC provide strong evidence that a challenge-based approach can significantly enhance student motivation and academic per- formance, particularly within the context of Latin American education. This supports the broader applicability of CBL as an effective and holistic educational methodology.

Study Limitations:

- *Specific Context:* While this study provides valuable in- sights into the impact of NASA-HERC on students at Tecnolo´gico de Monterrey, the findings may not be directly applicable to other institutions with different educational environments, resources, or student demographics. The competitive and well-funded nature of Tecnolo´gico de Monterrey may have influenced the outcomes observed, making it necessary to validate these findings through additional studies in various contexts.
- *Sample and Methods:* Although the study's sample is representative within the institution, it includes a limited number of students who participated in NASA-HERC between 2013 and 2023. Additionally, the reliance on self-reported data from surveys and testimonials, while informative, may introduce response biases.

Implications and Recommendations:

- *Educational Practices:* Expanding initiatives like NASA- HERC across different educational institutions can significantly enhance students' overall development. The success of similar programs, such as the TecXotic team in the MATE ROV competition, highlights the value of such hands-on learning experiences.
- *Future Research:* It is essential for future research to conduct a more detailed analysis of how programs like NASA-HERC influence long-term professional trajecto- ries. This could include follow-up studies or longitudinal data collection if available. Moreover, discussing the unique challenges faced by students in Latin America and how NASA-HERC participation helps them overcome these challenges would provide valuable insights.
- *Practical Application:* Implementing CBL programs across a wide range of disciplines could broaden their effectiveness, ensuring that more students benefit from the practical and motivational advantages these programs offer.
- *Emotional Resilience and Motivation:* Further studies should also explore the impact of NASA-HERC on students' emotional resilience, their ability to manage stress, and their sustained motivation to achieve academic and professional goals. Understanding these aspects can deepen our comprehension of the holistic development that experiential learning programs like NASA-HERC facilitate.
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VII. CONCLUSIONS

This study highlights the significant impact of participating in the NASA Human Exploration Rover Challenge (NASA- HERC) on students at Tecnolo´gico de Monterrey. By en- gaging in this challenge-based learning

experience, students developed crucial competencies such as complex problem- solving, innovation, leadership, and English communication. These skills are vital for their academic achievements and fu- ture professional success. The unique environment of NASA- HERC not only enhanced these abilities but also opened doors to prestigious academic and professional opportunities, including internships, study abroad programs, scholarships, and improved job placements.

The challenge also profoundly influenced students' emo- tional competencies, motivation, and academic commitment, with many participants reporting increased dedication to their studies and a stronger sense of purpose. The long-term impact of NASA-HERC on students' personal and professional trajec- tories is particularly significant in the Latin American context, where such opportunities play a crucial role in shaping career paths.

The findings underscore the effectiveness of the TEC21 Educational Model in fostering both technical and non-technical competencies, highlighting the importance of in- tegrating challenge-based learning experiences into higher education curricula. This study contributes to the field of educational innovation, suggesting that challenge-based edu- cational models like TEC21 can effectively prepare students for the global job market.

Globally, institutions could benefit from implementing sim- ilar approaches tailored to their local contexts, especially as globalization and rapid technological advancements continue to reshape labor market expectations. Programs like NASA- HERC offer a replicable model that can be adapted across various disciplines and contexts, making them a valuable consideration for institutions aiming to enhance their students' professional readiness.

To ensure the sustainability and accessibility of such pro- grams, it is essential to consider strategies for expansion, including securing funding, establishing strategic partnerships, and developing supportive infrastructures within institutions. Integrating these experiences into the official curriculum could further ensure that a larger number of students benefit from these transformative opportunities.

In conclusion, participation in NASA-HERC has proven to be a powerful tool in preparing students to meet the demands of the global workforce, reinforcing the need for continued support and expansion of similar initiatives. Future research should explore the development of non-technical competen- cies, such as emotional and social skills, and investigate how these programs can be adapted across diverse educational contexts to create a more inclusive and globally relevant higher education system.

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