# Proposal of Teacher Training in DEI + STEM: A Collaborative Work in Latin America and the Caribbean

**Juan Sebastián Sánchez-Gómez, Universidad de los Andes**

Doctoral student of PhD in Industrial and Systems Engineering at Universidad de los Andes (Colombia).

**Laura Eugenia Romero Robles, Tecnológico de Monterrey**
**Maria Catalina Ramirez**
**LIBIS DEL C VALDEZ C**
**Luis Alberto Cruz Salazar, Universidad Antonio Nariño,Colombia; Technical University of Munich, School of Engineering and Design, Germany**

# Proposal of Teacher Training in DEI + STEM: A Collaborative Work in Latin America and the Caribbean

Juan Sebastián Sánchez-Gómez[1,6], Laura Eugenia Romero Robles[2,6], María Catalina Ramirez Cajiao[3], Libis Valdez Cervantes[4,6] y Luis Alberto Cruz Salazar[5]

[1] Universidad de los Andes, Engineering School, Colombia, js.sanchez14@uniandes.edu.co
[2] Tec de Monterrey, School of Engineering and Sciences, Mexico, romero@tec.mx
[3] Universidad de los Andes, Engineering School, Colombia, mariaram@uniandes.edu.co
[4] UNITECNAR, Engineering School, Colombia, decano.fadi@unitecnar.edu.co
[5] Technical University of Munich, Munich, Alemania
[6] Latin American and Caribbean Consortium of Engineering Institutions (LACCEI)

## Abstract

As a result of growing student mobility and globalization, higher education institutions now host a more diversified student body comprising individuals of varying ages, races, ethnicities, nationalities, linguistic/cultural backgrounds, and sexual orientations. An inclusive, diverse environment promotes social progress and justice in higher education. It empowers students and staff, encouraging the generation of novel ideas and fostering higher levels of achievement and a better sense of belonging among students. Recently, one of the key premises in higher education has been the importance of educators being proactive rather than reactive in addressing cultural issues. It is a reality that the professional development and training of teachers that train them authentically and effectively on issues of diversity, equity, and inclusion, effectively and respectfully with all vulnerable groups, is still incipient despite being the key to creating a climate in which all students truly feel part of the learning community. Integrating Diversity, Equity, and Inclusion (DEI) into the curriculum is complex and may not be seen as essential in teacher education, especially in contexts with low or no diversity. However, one of the educators' responsibilities historically is to provide students with the basic skills to become successful members of our society. To be successful in any social or professional group, it is necessary to be tolerant of differences, to be accepted, and to accept others. By providing professional development and formal training in DEI, teachers could have the tools to teach students to truly understand the characteristics of others and create an inclusive environment. This study proposes to define a research methodology whose data collection and analysis tools will allow us to answer our research question on how to train teachers in Latin America and the Caribbean in DEI from the educational approach in Science, Technology, Engineering, and Mathematics (STEM). Following a multiple case study methodology, this paper presents the results of teacher training in DEI+STEM in the context of higher education institutions in Latin America and the Caribbean, which are directly related to some advances in compliance with Sustainable Development Goals (SDG) number 4 on quality education of the countries of this region in the SDG Index. The obtained data allow us to understand the existence of educational needs of university professors from Latin America and the Caribbean, who wanted to learn not only about STEM and migration but also about the intersectionality of DEI with other minorities, such as black communities, natives, Hispanics in the United States, and LGBTIQ+.

## Introduction

Significant efforts have been made to promote gender equality in higher education. However, addressing broader projects on Diversity, Equity, and Inclusion (DEI) issues in higher education, particularly engineering education, presents significant challenges [1].

Although many institutions support DEI policies, they often lack a formal DEI organization and specific policies that prioritize and define areas related to DEI. Additionally, educators and staff may not be adequately prepared to represent DEI groups.

Based on the definition that diversity is the presence of differences within a given environment, both in education and in the workplace, that can mean differences in gender, ethnicity, race, sexual orientation, mental and physical ability identity, gender, age, and socioeconomic class, which is why it is presented as a multidimensional concept, depending on the cultural context and the level of awareness of the difference [2].

On the other hand, the term equity refers to the guarantee of impartial, fair, and unbiased processes and programs that can produce equal results for each individual. Equity must go beyond equality, based on leveling out relative disadvantages. Therefore, it is often accompanied by positive action or discrimination measures.

Finally, inclusion is the practice of ensuring that all individuals feel a sense of belonging, respect, and value in a particular place and community. This means that each person within the community should feel comfortable and supported by the organization, free from implicit or explicit discrimination. Inclusion requires an awareness of the various aspects of diversity [2], [3], [4].

### Diversity, equity, and inclusion in the university environment

The DEI on university campuses has become a central concern in higher education. Universities have implemented various initiatives to enhance DEI in recent years, ranging from reactive to proactive. Although the reasons for developing these initiatives are diverse, there is a consensus that the desired outcomes are to promote self-awareness, facilitate conversation, learn about bias and oppression, and provide an opportunity to promote better understanding [5], [6], [7].

Efforts are being made at higher education institutions to increase inclusivity in Science, Technology, Engineering, and Mathematics (STEM) departments for all student populations. This includes reviewing programs, policies, and methods of student engagement. As student diversity is expected to increase in the coming decades, university institutions must respond to this call to action and intentionally address inequalities by removing barriers to academic momentum and advancement that students experience [8], [9]. However, DEI initiatives in universities have focused primarily on the student body, with no projects targeting faculty, tutors, and university staff, creating a bias that increases change and decreases inequality daily.

In general, the three main points to achieve DEI consider the following tasks: recruiting, hiring, and training faculty in DEI and ensuring equity for all university members, including students, teachers, tutors, and managers [9].

Teacher Development with a DEI Approach for University Professors

Although it is a fact that faculty development focused on DEI is increasing in higher education, there is little or no research on the breadth and depth of these efforts or their effectiveness in facilitating change [10].

Recent initiatives of faculty development related to DEI have mainly concentrated on introducing faculty to inclusive and multicultural teaching theories and practices.

To address this gap, higher education professionals have reevaluated the role of faculty as change agents who can transform learning experiences into equitable ones. Therefore, university managers must involve teachers who actively or tacitly resist inclusive practices and incorporate inclusive pedagogy into teacher training. This can be achieved through university professional development programs such as workshops, events, courses, and additional resources that have a DEI perspective. In addition to adopting inclusive teaching practices that reflect the basic principles of diversity, equity, and inclusion [11], [12], it is important to ensure clear and objective language, conventional structure, and precise words.

In the STEM field, the issue of teacher development with a DEI approach can be particularly challenging. STEM teachers often encounter additional obstacles in identifying authentic goals, objectives, and tasks related to DEI [13], [14]. There is often a lack of consensus or understanding regarding the definition of DEI activities, who should participate in them, how STEM teachers perceive their involvement, and what level of support is appropriate. Educators are also concerned that DEI work is disproportionately shouldered by underrepresented racial and ethnic groups, which exacerbates what is known as the minority tax [15]. It is important to acknowledge that while there are some teacher development initiatives in DEI, they may not be adequate and may not address all of the fundamental needs of the environment. A DEI Model of Faculty Development in Engineering is shown in Figure 1.

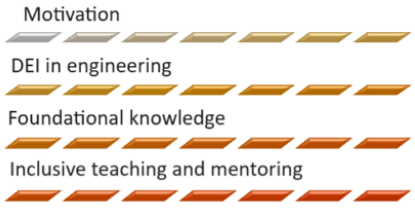


Figure 1. DEI Model of Faculty Development in Engineering Edited figure for reference [14].

The implications of all the above lead us to the urgent need for faculty development programs and initiatives on issues of diversity, equity, and inclusion that allow for the assessment and alignment of DEI efforts among academic faculty in STEM.

The objective of this study is to define a research methodology whose data collection and analysis tools allow us to answer our research question:

How can teachers from Latin America and the Caribbean be trained in Diversity, Equity, and Inclusion (DEI) using an educational approach in Science, Technology, Engineering, and Mathematics (STEM)?

Following a multiple case study methodology, this paper presents the results of teacher training in DEI+STEM in the context of higher education institutions in Latin America and the Caribbean, which are directly related to some advances in compliance with Sustainable Development Goals (SDG) number 4 on quality education of the countries of this region in the SDG Index. The obtained data allow us to understand the existence of educational needs of university professors from Latin America and the Caribbean, who wanted to learn not only about STEM and migration but also about the intersectionality of DEI with other minorities, such as black communities, natives, Hispanics in the United States, and LGBTIQ+.

## Methodology

Within the framework of the Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) mission, the need to generate collaborative work between different higher education institutions has been established. This collaboration seeks the continuous improvement of engineering and technology education in the Latin American and Caribbean region.

### Research approach

Understanding that the research question is related to the understanding of the studied phenomenon, it is proposed to align this question with a hermeneutic research approach. The hermeneutic approach allows relating the understanding of the object of study, in this case, teacher training in DEI + STEM with its subsequent interpretation, without considering the generalization and representativeness of the results since it is important to delve into the context that seeks to interpret [16].

### Research method

The hermeneutic research approach presents qualitative research methods, such as narrative inquiry, ethnography, case study, grounded theory, and phenomenology. However, this research requires a method that allows a comparative study to validate teacher training in DEI + STEM. In this sense, the case study is proposed because it allows a detailed investigation of one or several cases where the phenomenon under study is manifested to interpret its nature [17]. The phenomenon studied occurs in its context, but the limits between this context and the phenomenon are not precise and must be studied in depth in each case [18]. The cases presented were 51 professors from different universities in Latin America and the Caribbean who participated in three workshops, the first at the International Meeting on Engineering Education (EIEI ACOFI 2023), held from September 18 to 22 in Cartagena, Colombia, the second at the World Engineering Education Forum (WEEF 2023), held from October 23 to 27 at the Tecnológico de Monterrey in Mexico, and the three at the IEEE INTERCON 2023, held from November 2 at the Universidad Peruana de Ciencias Aplicadas in Lima, Peru. These professors were 56% women and 44% men from countries such as Argentina, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Mexico, Peru, Dominican Republic, and Venezuela.

Therefore, a multiple case study is designed and implemented, in which the context is higher education institutions in Latin America and the Caribbean, the cases are the university professors of these institutions, and the unit of analysis is their learning acquired in teacher training in DEI + STEM.

## Results

Following the multiple case study methodology, the teacher training results in DEI + STEM are presented below as context, cases, and the unit of analysis.

The context of higher education institutions in Latin America and the Caribbean is related to some progress in meeting Sustainable Development Goals (SDG) 4 of quality education of the countries of this region in the SDG Index [19], [20], going from 70.7% in 2019 to 76.5% in 2021. It is important to remember that SDG 4 has four indicators in the SDG Index, within which we are interested in the indicator of gross enrollment rate in tertiary education, on which progress is presented from 46.24% in 2019 to 54.09% in 2021 [21].

The unit of analysis was the teachers' learning acquired in DEI + STEM teacher training, which they received in the "Migration & STEM" Workshop (see Figure 2a) of EIEI ACOFI 2023, "Teaching STEM Education for Migrants" of WEEF 2023 (see Figure 2b) and “Future engineers learning STEM education” of IEEE INTERCON 2023 (see Figure 2c).

Figure 2. Photos in workshops.

Teachers received the same training in the three workshops, and their knowledge was discussed through 4 open-ended questions (see Table 1).

Table 1. Contents and questions.

| Content | Question |
|---|---|
| STEM disciplines | How do you teach in each STEM discipline? |
| STEM approach as instructional, interdisciplinary, and didactic. | What’s STEM as an educational approach? |
| STEM skills in the inclusive classroom for migrants. | How do you design an inclusive classroom with a STEM approach? |
| STEM cases | Explain if the chosen case is aligned with the STEM disciplines, STEM definition, and STEM skills. |

### Enduring understandings

The enduring understandings are the underlying concepts derived from the fundamental ones that each participant is interested in learning during the workshops [22]. For this reason, the enduring understandings developed by the participants of the three workshops were classified into 4 topics according to the thematic analysis. The 4 topics were STEM integration in the curriculum, inclusive classroom, active learning, and STEM skills.

A. STEM integration in the curriculum

STEM integration in the curriculum includes the science from its scientific theories underpins the engineering design process, the technology as a product of science and engineering, and in turn, technological tools are used in science and engineering, the engineering using scientific and mathematical foundations as well as technological tools, and the mathematics using in science, engineering, and technology [23]. For the participants, integrating STEM into the school curriculum is important because it allows the disciplines of science, technology, engineering, and mathematics to be addressed in an interdisciplinary and holistic manner. This promotes the development of *soft skills* such as critical thinking, problem-solving, communication, collaboration, creativity, and research, among others, which are essential for success in the 21st century and necessary for the *Fourth Industrial Revolution* [24]. In addition, integrating STEM into the school curriculum contributes to creating new solutions to social problems, improving people's quality of life, and facing challenges such as climate change for a more sustainable world and social development [25].

B. Inclusive classroom

Inclusive education requires Information and Communication Technologies (ICTs) to ensure access to quality education and to overcome social, economic, and cultural barriers [26]. ICTs in inclusive learning spaces eliminate barriers between teacher and student because they facilitate interaction for students with special educational needs and make teaching more flexible [27]. By the participants, to design an inclusive classroom with a STEM approach, it is important to consider strategies such as universal design for learning, which seeks to address the diversity of students, as well as to be aware of the socioeconomic situation of students, ensuring that they have access to the necessary resources to participate in educational activities. In addition, it is fundamental to address the four STEM disciplines by solving problems and challenges proposed by design, prototyping, and evaluation, complying with the STEM definition by having an interdisciplinary and holistic approach.

According to the participating teachers, some strategies for designing an inclusive classroom that fosters learning in STEM. These strategies include:

1. Teaching through classes focused on solving real problems optimally using technological tools.
2. Various teachers describe classes differently to accommodate different learning styles.
3. Use of interactive equipment and devices according to the subject matter.
4. Incorporation of the mechanical part in the classroom, especially in the case of robotics or technology courses.
5. Application of a case study that applies what has been learned.
6. Training people, interests, didactic material, and varied examples.

These strategies can help create an inclusive environment promoting STEM learning.

C. Active learning

Participants discussed active learning methodologies such as Project-Based Learning (PBL), Problem-Based Learning, and dynamic teaching methodologies. These strategies allow students to actively engage in learning, fostering their critical thinking, problem-solving,

creativity, and collaboration. In addition, it is recommended to rethink how the STEM curriculum is integrated, involving the four disciplines in a holistic and interdisciplinary way in the resolution of real problems. The use of problem-based learning, which seeks to develop everyday problem-solving skills through active learning [28] project-based learning from the experiential learning approach, which is centered on the student and his practice [29], are highlighted.

D. STEM skills

STEM education promotes skills development that enables access to economic and social benefits [30] through learning science by doing science [31]. For participants, teaching robotics projects can help develop skills in mathematics and electronics. In addition, robotics projects can involve programming and sensor control, which can also develop technology and computer science skills. Overall, teaching robotics projects can effectively foster learning in STEM disciplines and develop skills in multiple areas.

Some courses proposed by participants to develop STEM skills are:

1. Sensor manipulation and control through programming by adjusting mathematical parameters according to requirements and their applications.
2. Development of functional prosthesis.
3. Courses of specific programs such as TIA Portal, ANSYS, or Rhinoceros.
4. Data Science with Functional Databases.
5. Robotics projects, which teach mathematics and electronics through projects.

These courses offer opportunities for the development of skills in STEM.

The validation of the workshop allowed us to understand the existence of educational needs of university professors from Latin America and the Caribbean, who were seeking to learn not only about STEM and migration but also about the intersectionality of DEI with other minorities such as black communities, Hispanics in the United States and LGBTIQ+. For this reason, the restructuring of a DEI division from LACCEI is also proposed.

## Conclusions

This paper highlights the critical need for teacher training in DEI within the context of STEM education in Latin America and the Caribbean. Through a multiple case study methodology, the study underscores the importance of integrating DEI principles into the STEM curriculum to create an inclusive and equitable learning environment that reflects the diverse student population of today's globalized world. The findings demonstrate a significant gap in the professional development of teachers in the region concerning DEI issues, which are essential for social development among all students and encourage the generation of new soft skills.

The research results show that participating teachers from various higher education institutions across Latin America and the Caribbean expressed a strong desire to learn not only about STEM and migration but also about how DEI intersects with other minority groups, such as black communities, natives, Hispanics in the United States, and LGBTIQ+. This underscores the necessity for educational programs that address the complexities of diversity and inclusion within the STEM disciplines, ensuring that educators are well-equipped to support all students, regardless of their backgrounds.

Workshops conducted as part of the study provided valuable insights into the educational needs of university professors in the region. They emphasized the importance of integrating STEM into the curriculum in an interdisciplinary and holistic manner, designing inclusive classrooms that cater to the diverse needs of students, employing active learning methodologies to engage students in the learning process, and developing STEM skills through practical and applied learning approaches.

In conclusion, this research aims to propose strategies focused on developing and implementing comprehensive teacher training programs in DEI+STEM across Latin America and the Caribbean. Such programs should not only provide educators with the necessary tools and knowledge to create inclusive learning environments but also promote the development of a curriculum that reflects the diverse society we live in. By doing so, higher education institutions can play a pivotal role in advancing social progress and justice, thereby contributing to the achievement of SDG 4 on quality education. The study also suggests restructuring a DEI division within LACCEI to support these initiatives further, highlighting the collaborative effort required to address these challenges effectively.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

## Funding

The authors received financial support from the Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) for the research, authorship, and/or publication of this article. The authors would like to acknowledge the financial support of the Writing Lab of the Institute for the Future of Education at Tecnológico de Monterrey (Mexico), and the Engineering School at Universidad de los Andes (Colombia) in the production of this work.

## References

[1] I. Direito *et al.*, "Diversity, Equity, and Inclusion in Engineering Education: an Exploration of European Higher Education Institutions' Strategic Frameworks, Resources, and Initiatives," in *SEFI 49th annual conference proceedings 2021*, SEFI-European Society for Engineering Education; Brussels, 2021, pp. 189–193.

[2] A.-L. Claeys-Kulik, T. E. Jørgensen, and H. Stöber, "Diversity, equity, and inclusion in European higher education institutions," *Results from the INVITED Project. Brussel: European University Association Asil*, vol. 51, 2019.

[3] S. Dobscha, "Connecting DEI to explicit and implicit gendered workplace discrimination, harassment, and assault: a commentary on 2019 Marketing Climate Survey," *Mark Lett*, vol. 32, no. 3, pp. 341–347, 2021.

[4] S. Zheng, "What is DEI?," 2022.

[5] E. N. Decker and L. Simpson, "Implementing Project READY at an academic library: Survey analysis of a DEI training experience," *The Journal of Academic Librarianship*, vol. 49, no. 2, p. 102634, 2023.

[6] H. L. Amonoo *et al.*, “Diversity, equity, and inclusion committee: An instrument to champion diversity efforts within a large academic psychiatry department,” *Psychiatric Services*, vol. 73, no. 2, pp. 223–226, 2022.

[7] J. P. Greene and J. D. Paul, “Diversity University: DEI Bloat in the Academy. Backgrounder. No. 3641.,” *Heritage Foundation*, 2021.

[8] L. Brancaccio-Taras, J. Awong-Taylor, M. Linden, K. Marley, C. G. Reiness, and J. A. Uzman, “The PULSE Diversity Equity and Inclusion (DEI) rubric: a tool to help assess departmental DEI efforts,” *J Microbiol Biol Educ*, vol. 23, no. 3, pp. e00057-22, 2022.

[9] B. M. Dewsbury, H. J. Swanson, S. Moseman-Valtierra, and J. Caulkins, “Inclusive and active pedagogies reduce academic outcome gaps and improve long-term performance,” *PLoS One*, vol. 17, no. 6, p. e0268620, 2022.

[10] M. Castillo-Montoya, L. A. Bolitzer, and S. Sotto-Santiago, “Reimagining Faculty Development: Activating Faculty Learning for Diversity, Equity, and Inclusion,” in *Higher Education: Handbook of Theory and Research: Volume 38*, Springer, 2023, pp. 415–481.

[11] H. J. Kim, Y. Kong, and R. Tirotta-Esposito, “Promoting Diversity, Equity, and Inclusion: An Examination of Diversity-Infused Faculty Professional Development Programs.,” *Journal of Higher Education Theory & Practice*, vol. 23, no. 11, 2023.

[12] S. P. Hundley and C. J. Keith, *Trends in assessment: Ideas, opportunities, and issues for higher education*. Taylor & Francis, 2023.

[13] M. Castañeda-Kessel, I. V. Alarcón, and R. Berke, “Research Development & Early-Career Faculty: Catalysts of Change for Diversity, Equity, and Inclusion in STEM,” *The Journal of Research Administrators*, vol. 54, no. 2, p. 105, 2023.

[14] S. E. Zappe, T. A. Litzinger, S. Cutler, and I. Esperragoza, “Work-in-Progress: A Faculty Development Response to Integration of Diversity, Equity, and Inclusion into the Engineering Curriculum,” in *2022 IEEE Frontiers in Education Conference (FIE)*, IEEE, 2022, pp. 1–5.

[15] J. L. Raphael, G. L. Freed, S. B. Ampah, H. Griffis, L. R. Walker-Harding, and A. M. Ellison, “Faculty Perspectives on Diversity, Equity, and Inclusion: Building a Foundation for Pediatrics,” *Pediatrics*, vol. 151, no. 4, p. e2022058394, 2023.

[16] M. Packer, “La investigación hermenéutica en el estudio de la conducta humana,” *American Psychologist*, vol. 40, no. 10, pp. 1–25, 1985.

[17] R. E. Stake, *Investigación con estudio de casos*. Ediciones Morata, 1998.

[18] R. K. Yin, *Case study research: Design and methods*, vol. 5. sage, 2009.

[19] CODS, “Índice ODS 2019 para América Latina y el Caribe,” Bogotá, 2020. Accessed: Aug. 31, 2022. [Online]. Available: https://cods.uniandes.edu.co/wp-content/uploads/2020/06/%C3%8Dndice-ODS-2019-para-Am%C3%A9rica-Latina-y-el-Caribe-2.pdf

[20] CODS, “Índice ODS 2021 para América Latina y el Caribe,” Bogotá, 2022. Accessed: Aug. 31, 2022. [Online]. Available: https://cods.uniandes.edu.co/wp-

content/uploads/2022/08/I%CC%81ndice-ODS-2021-para-Ame%CC%81rica-Latina-y-el-Caribe.pdf

[21] J. Sanchez, "Quality education in Colombia: From the lagging SDG 4 to the inclusive 2030 Agenda," in *Proceedings of the 21th LACCEI International Multi-Conference for Engineering, Education and Technology (LACCEI 2023)*, Latin American and Caribbean Consortium of Engineering Institutions, 2023. doi: 10.18687/LACCEI2023.1.1.1503.

[22] Á. H. Galvis Panqueva, *Diseño de cursos por Grandes ideas, con pedagogía activa e integración de tecnologías digitales*. Ediciones Uniandes-Universidad de los Andes, 2021.

[23] J. Botero, *Educación STEM: Introducción a una nueva forma de enseñar y aprender*. Bogotá: STILO Impresores LTDA, 2018.

[24] L. A. Cruz S. and L. S. Algarra L., "Habilidades blandas para la formación de profesionales en torno a la Cuarta Revolución Industrial," in *Estudios sobre innovación e investigación educativa*, 1st ed., Madrid, Spain: Dykinson, 2021, pp. 901–913.

[25] L. S. Algarra L., L. A. Cruz S., and A. Arbeláez-Soto, "Competencias Blandas Para La Mejora De La Educación Y El Desarrollo Social Sostenible," in *Proceedings of the 19th LACCEI International Multi-Conference for Engineering, Education, and Technology: "Prospective and trends in technology and skills for sustainable social development" "Leveraging emerging technologies to construct the future,"* Bogotá, Colombia: Latin American and Caribbean Consortium of Engineering Institutions, 2021, pp. 1–8. doi: 10.18687/LACCEI2021.1.1.659.

[26] P. Toledo, "Las tecnologías de la información, la comunicación y la inclusión educativa," in *Nuevos escenarios digitales*, J. Barroso and J. Cabero, Eds., Madrid: Ediciones Pirámide, 2013.

[27] J. Cabero, "Las nuevas tecnologías de la información y la comunicación, aportaciones a la enseñanza," in *Nuevas tecnologías aplicadas a la educación*, J. Cabero, Ed., Madrid: Síntesis, 2000, pp. 5–38.

[28] G. Polya, "On learning, teaching, and learning teaching," *The American Mathematical Monthly*, vol. 70, no. 6, pp. 605–619, 1963.

[29] J. Dewey, "Democracy in education," *The elementary school teacher*, vol. 4, no. 4, pp. 193–204, 1903.

[30] National Science Board, "Science and Engineering Indicators 2016," 2016. Accessed: Apr. 26, 2022. [Online]. Available: https://www.nsf.gov/statistics/2016/nsb20161/#/

[31] I. Uzcanga, M. Gómez, and M. Duque, "Llevando las ciencias, la ingeniería, la tecnología y la matemática a la escuela: Pequeños Científicos," in *13th LACCEI Annual International Conference:«Engineering Education Facing the Grand Challenges, What Are We Doing*, 2015.