Brillantes:
Exploring Students Changing Perceptions of Mathematics and Engineering through an Integrated Engineering Design and Algebraic Program for Students in Honduras

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Abstract

Honduras is one of the poorest countries with one of the highest social inequalities in the world. According to the World Bank (year), 63% of Honduras' population lives below the poverty line and the most vulnerable groups are children who suffer even higher levels of poverty than adults. In 2017, 83% of children under 15 lived under the poverty line. Unfortunately, access to education is often determined by the social economic status of the families and most of the factors that challenge students' achievement are related to social inequality- opportunities for enrichment, greater access, and inspiration to improve their stance. With this motivation, a partnership was established with a faith-based community group in the US who carried out educational work in Honduras. After discussion of needs, and their interest in a STEM educational outreach effort, a hybrid intervention

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program was designed to integrate algebra and engineering activities in Spanish for a group of middle school students. The intervention curriculum was assembled, professional development was provided to the support team in Honduras, and it was deployed as a pilot program. A research case study presented in this paper explores the following questions:

a) What elements of a hybrid program are most valued by students and teachers, b) To what extent do students report changes in their perceptions of mathematics and engineering and c) What is the impact of instructors and family involvement in this community-based pre-engineering program?

Introduction

The Honduras project was designed to provide early motivating STEM engagement experiences for Spanish speaking students of need; to benefit an international audience (students in Honduras) with the intent of replicating the program of informal enrichment for other communities with Spanish speaking students in the United States or elsewhere; and to provide professional development to educators/facilitators, orientation and encouragement to parents, and direct learning opportunities to the participating students.

Growing Inequities in Mathematics Education in the United States

There is growing concern in the U.S. regarding student performance in national standardized tests due to 4th and 8th grade students' largest drop in math performance in thirty years (NAEP, 2022). Overall, in 2022, 38% of eighth graders scored below basic levels. Eighth grade students from minoritized groups scored even worse with 51% of Hispanic students, 55% of American Indian/Alaskan Native and 62% of Black students scoring below basic levels.[1]

Besides the low performance, the achievement gap between these minoritized groups and their White peers has persisted since more than a decade ago. Mathematics education researchers have long recognized that academic performance at the eighth-grade level, especially the exposure to early algebra skills and reasoning, is linked to academic success in college and pursuing a STEM career. [2] Although the exposure to early algebra concepts has increased in the last two decades around the country, for example, by offering Algebra I courses as early as seventh grade; these opportunities have not been equitable across all populations of student groups refer to the inequality of opportunity to learn as one of our time's most pressing civil rights issues. [3,4,5]

There have been several empirical studies aimed at explaining the racial and ethnic disparities in eighth-grade algebra opportunities to learn. Focusing on the differences between Black and White students, studies have found that Black students are less likely than White students to be placed or be enrolled in eighth-grade algebra when controlling for academic background. [6,7] In a more recent study using data from a large urban school district in the southwestern United States, Morton and Riegle-Crumb[8] found that in racially integrated schools, inequalities can be explained by what the authors

call a *reproduction of differences* in prior opportunities to learn from earlier grades. However, in predominantly Hispanic schools, they found evidence of an increase in inequality such that racial differences in access remain when controlling for academic background. These findings suggest that the access opportunities to gatekeeper courses, such as algebra in eighth grade, are partly a product of contextual factors and constructed by schools.

Inequalities in the opportunity to learn essential content that has lasting effects on students' academic and career trajectories are not just unique to the United States. Results from international assessments, the Trends in International Mathematics and Science (TIMSS) and the Program for International Student Assessment (PISA), reveal that there are differences in performance between and within countries with respect to gender [9], race and ethnicity[10] and socioeconomic status[11]. Since this is a global phenomenon, scholars and practitioners around the world can contribute to a viable solution by collaborating in co-developing and testing educational programs aimed at providing youth with opportunities to learn.

Middle School Mathematics in Honduras

Concerns have been raised regarding the quality of education received by students in Latin America. In a 2017 report on educational progress in Honduras, several studies and statistical information related to performance in education are reviewed. According to this report, regarding student academic performance, both national and international tests indicate that learning outcomes are deficient, particularly in mathematics from fifth grade and beyond. The results obtained from the tests in Mathematics and Spanish applied to national samples of students, from first to ninth grades, during the period 2007-2016 show that the results in Mathematics are low, with 71% of the students in the learning levels "Must Improve" and "Unsatisfactory." [12] In mathematics, the results were even more critical in grades 7 to 9; more than 90% of students are classified in the performance levels "Must Improve" and "Unsatisfactory." [13,14] Moreover, during 2015 and 2016, the Ministry of Education applied a pre-university test to a national sample of students upon finishing their last year of study. The obtained results for math were low, with an overall 39 % correct answers. In international test such as the First and Third Regional Comparative and Explanatory Studies of OREALC - UNESCO for Latin America and the evaluation Trends in International Mathematics and Science Study[15], students in Honduras have shown a low performance in mathematics test. [15,12,16]

There are many factors that might impact the achievement of students in areas such as math and science. Honduras is among the poorest and most inequitable countries worldwide. Nearly 63% of the population lives under poverty, and there is a remarkable division between wealthy and low-income population.[17] This inequality leads to difficulties to access and remain at school and causes difficulties in academic achievements. Accessing and remaining at school is more difficult in rural populations where nearly 47 % of the Honduran population is located (see Appendix B). According to Morales[18], a school grade failing and the conditions of how students live are among the factors that affect students' academic performance in math and reading in the first, second, and third year of secondary school. These results were obtained based on statistical evaluation of different factors such as the mentioned above among 256 educational centers/schools located in urban and rural areas throughout the country.

Gustafsson et al. evaluate through statistical methods that improve the relationship between Socio-Economic Status (SES) of schools and mathematics achievements in grade 8th based on data from 50 countries in TIMSS 2011. According to this study, schools that present low SES but have favorable characteristics such as healthy school climates (safe and orderly climate) have increased math achievement. From 2003 to 2015, there was a reform in the education system in Honduras in an attempt to comply with the primary goal to improve the academic performance in Mathematics and Spanish for middle and high school students. [15] This reform in the education system involved a change in the curriculum system, the inclusion of standardized national tests, and a change in textbooks. Palacios and Casas García [14] consider that in addition to the factors associated with the academics' performance found by other research studies, the knowledge of teachers' conceptions and beliefs is essential for the improvement of students' results. This study intended to explore the central beliefs and conceptions of mathematics teachers at the secondary level in Honduras (students from 13 to 18 years old) concerning teaching, learning, and mathematics evaluation. This study was assessed by an international questionnaire used in the TEDS-M study to know beliefs about teaching, learning, and mathematics performance. Nearly 10.6% of the mathematics teachers from different regions in Honduras take this questionnaire. The results show that academic achievement in math is related to learning mathematics following the teacher's instructions, learning mathematics through active participation, and the performance in mathematics depends on the student's natural ability. Finally, in a study conducted by Palacios & García[14] an examination of the alignment between the educational requirements and the activities suggested by the official textbooks for the teaching of Mathematics for the Algebra block in the 7th, 8th and 9th grades of Basic Education in Honduras is carried out at the level of cognitive demand. According to the authors, in the Algebra block, there is no adequate consistency between educational standards and activities proposed in the textbooks at the level of cognitive demand.

Honduras- Social Economic Overview

Inequality in income distribution (as measured by the Gini Index) is considered a significant hindrance affecting Latin American countries. According to World Bank statistics, Honduras is considered among the top five most unequal countries in Latin America. Furthermore, Honduras ranks third, after Haiti and Nicaragua, in the poorest countries in North America by GNI (Gross National Income) per capita. [19] In 2021, the World Bank estimated the poverty rate at 53.3%. This means that more than half the country in Honduras, 5.4 million people lived with less than US$6.85/day. Honduras ranked 137th in the World Human Development Index out of a list of 191. [20]

The rapid growth of the Honduran economy shown by its GDP quadrupling between 2000 and 2019, has contributed to a strong concentration of wealth and to a society built of inequality. According to Lopez[21] , the key to social analysis is no longer poverty, but inequality. Inequality leads to exclusion from fundamental rights such as education. Educational achievement is influenced by socioeconomic conditions, difficulty accessing education and high-level school dropout levels. Honduras has one of the highest dropout rates of the region at 49.2%, compared to El Salvador at 33.5% and Costa Rica at

23.6%. In addition, enrollment in middle school in Honduras is at 49.9%, which is at a lower level compared to its counterparts, El Salvador at 62.3% and Costa Rica at 77.4%. [22]

In addition to school attendance, there is a low level of academic performance in some subject areas in Honduras. Both national and international tests indicate that learning outcomes can be improved, particularly in mathematics from fifth grade and beyond. For instance, the results of the 2019 ERCE study shows that 53.5% of the Honduran 3rd graders obtained at least a level II in mathematics performance, which is directionally higher than the percentage obtained for the region (52.3%). However, further results indicate that 11.2% of Honduran 6th graders reached a level III (or above) in mathematics performance, which is lower compared to the regional level of 17.4% . [23]

Brillantes- The intervention program

The intervention program called Brillantes *(Brilliant Minds)* was designed to provide early engineering and mathematics career awareness and skill development for middle school students in a small Saturday program in partnership with a community organization in Honduras. The program was delivered as a four- week Saturday program with the support of local education aides using English/Spanish bilingual, hands-on curricular materials and special virtual sessions involving Latina/o professionals from various STEM fields with a special focus on engineering and mathematics careers.

The program was designed to support the learning needs of 7th-9th grade students as a series of four after-school/Saturdays in Honduras at a faith-based community center. Given that the program was designed in the U.S. but delivered in Honduras, local education aides were hired and trained to deliver the program in person. A program of hands-on curricular materials was designed and translated into Spanish to include mathematics and engineering design topics. In addition, special pre-recorded careers interviews with Latino/a professionals from various fields of STEM were integrated into the Saturday sessions. A special focus on electrical engineering and mathematics was intended and low-cost print materials and design/building materials for the engineering activities was considered to facilitate implementation.

Prior to launching the Brillantes Program, the US team conducted two four-hour remote training sessions with the Honduran staff. The training sessions were conducted in Spanish by the US lead professor and the graduate student training coordinator. The Honduran team was provided with a teacher's guide and a worksheet for each lesson detailing the following: objectives, expected duration, theoretical content, hand-on applied activities to STEM fields with instructions, materials, learning assessment, discussion, and references. During the training, each one of the lessons and activities were reviewed with the instructors using a set of questions that would help students understand the concepts based on their own reasoning. In addition, the training included a review on specific STEM methods and techniques for teaching middle and high school students.

On the last day of the program, the structure of the session was different from the rest of the program. The last session was opened to parents of the participating students, as well as other members of the

community in a hybrid format. While some guests were at the location, others were connected via Zoom. The Brillantes students were able to present their final engineering projects to their parents and to comment on their experiences with the Brillantes Program. In addition, the Program included a college fair, where three Honduran universities had representatives talking about the different majors offered at their universities.

The topics of mathematics, engineering, and specifically- electricity, electronics, and electrical safety were included in the curriculum and delivered in the following five themed workshops:

1. Why Do We Need Engineering and Mathematics?
2. How Can We Solve Problems with Mathematics and Engineering Processes?
3. What Can I Do To Improve my Algebraic Skills?
4. Engineering Design and STEM
5. Engineering Careers Virtual Visits

The Pilot Program

The Brillantes Program, was first piloted in October of 2021 using a hybrid format for twenty 7th, 8th and 9th grade students. The objectives of the Brillantes Program were to:

1) provide motivating and enriching STEM experiences to underprivileged students.
2) pilot the program with Honduran students with the potential to replicate the program in other Spanish speaking communities in the US and/or in Latin America.
3) provide professional development to Honduran educators and facilitators.

The Brillantes program was launched during a severe pandemic period in Honduras. Therefore, the program was designed to minimize face to face contact. A strong Honduran team was organized and included a lead mathematics teacher from the community school, a community organizer, an IT coordinator and two local university students (alumni of the community school). Orientation and all professional development was conducted online. Later, once the program was ready to be rolled out to students, four, half-day Saturday sessions were held at the community faith-based organization site.

The culminating hybrid event was held to include the Brillantes students, parents and team members attending in person and about 30 other students, parents and special guests attending via Zoom. During this culminating day, three regional university representatives from Danli were invited to participate in a career fair for all students. Invited administrators were encouraged to share their personal journeys, the learning environment and career opportunities at their respective universities. The Brillantes students presented their final science projects to an engaged and supportive audience.

Exploratory Research Questions & Participants

A qualitative study to explore the impact of the program was conducted in-country six months after the program had concluded and once in-person interviews were possible again. Twenty participating students were invited to attend these focus groups sessions. Specifically, the researchers intended to explore the following impacts on two kinds of participants:

Students:

- Explore students' attitudes towards mathematics and engineering after participation
- Identify students career interests and attitudes towards engineering as potential field of interest after participation

Instructors:

- Gain insights into potential application of curriculum/activities in regular classroom
- Discuss impact of the professional development program for instructors

Methodology

Qualitative Research

Qualitative research methods including semi-structured interviews and focus groups provide an in-depth understanding of human behavior. It focuses not only on the behavior itself, but also on its subjective meanings: individuals' own descriptions of their behavior, attitudes, and motivations[24,25] events and situations[26] and what people say and how they behave in specific places and institutions in social contexts.[27]

Qualitative data sources including an attitude survey and interviews have been used to evaluate the impact of an out-of-school science, technology, engineering, and mathematics (STEM) education program on student attitudes toward STEM disciplines and careers. Findings from qualitative methods showed that the program contributed to students' developing interest in STEM careers. [28]

Another study relied on a mix of qualitative and quantitative research methods [29]to determine the effects of STEM activities in seventh grade secondary students' STEM career interests, motivation, science process skills, science performance and their perspectives on STEM education. The findings from the qualitative in-depth interviews suggested that exposure to STEM activities helped students develop positive views towards interdisciplinary education and important skills such as creativity, collaboration, critical thinking, and problem solving. Furthermore, quantitative results revealed that STEM related activities can be implemented to improve students' science process skills, STEM career interests and perceptions related to STEM education [30].

Sherry Marx [31] presents a collection of empirical studies conducted by various researchers where she examines the use of qualitative research methods to address social justice, equity, and sustainability

in STEM. One of the issues addressed in her book is the high dropout rate among engineering students. Specifically, this study was able to capture students' points of view, decision making process and reasoning for leaving engineering through their narrative and lived experiences. These qualitative insights can be instrumental for engineering educators to find ways to improve retention rates. [32]

This exploratory study followed an interviewing/focus group phenomenological methodology to explore the rich insights of the Brillantes Program participating students. A total of 2 focus groups were organized based on grade-level bands from students who participated in the 2021 Brillantes Program. In addition, a third group was conducted with the Brillantes instructors.

Group 1: 9 Younger students who had been in 7th & 8th grades during the previous academic year (in 8th and 9th grades when participating in the focus groups).

Group 2: 3 Older students who had been in 9th grade during the previous academic year (in 10th grade when participating in the focus groups).

Group 3: Brillantes Program team of instructors including mathematics lead teacher, two education aides, and a community coordinator.

Additionally, six self-administered surveys among students who were not able to participate in the focus groups.

Findings and Discussion

Perceptions and Interest in Mathematics & Engineering

Perceptions and interest in mathematics and engineering varied by grade level. Among the positive perceptions in mathematics included agreeing with the statement that mathematics is related to all sciences and necessary for all aspects in life. One student commented "Las matemáticas están en todas las ciencias, en todo lo que hacemos; desde cocinar, hacer compras, construir una casa, en estadísticas, cuestiones demográficas, en todo." [Mathematics is in all the sciences, in everything we do; from cooking, shopping, building a house, statistics, demographic data, in everything.] Some upper grade students perceive mathematics as an activity that could be fun, requires practice and has rewards. They also mentioned that they enjoy the challenge of upper level grade mathematics because it is less boring and being challenged by their peers makes it interesting. The lower grade students shared the impact of what they call "a good teacher" on liking mathematics. For them a good teacher is someone who explains the problem step by step, is patient and has a good attitude towards the students' questions and teaching. As one student commented "Una buena maestra influye bastante y te motiva; alguien que explique bien, paso a paso. [A good teacher is very influential and motivates you; is someone who explains things well, step by step].

But not all perceptions were positive, some expressed negative feelings and emotions such as fear, stress, nervousness, embarrassment, frustration and tears when thinking about mathematics and or solving math problems. This particular comment was difficult to hear "Yo también lloro, pero cuando ya resuelvo el problema me siento aliviado, y satisfecho que lo pude hacer; me siento orgulloso, alegre.

[I also cry, but when I solve the math problem, I feel relieved and satisfied that I was able to do it; I feel proud and happy]. Finally, some students perceived mathematics with mixed feelings, "Matemáticas es positivo y negativo; cuando resuelves el problema es positivo, pero llegando a eso es un reto y puede ser negativo. [Mathematics is positive and negative; when you solve the math problem it's positive but getting to that point is a challenge and can be negative]. Another student expressed this with pride, "Me da pena cuando me llaman a la pizarra, y me hacen burla cuando no lo hago bien; pero me da orgullo cuando si lo hago bien. [I get embarrassed when they call me to the chalkboard, and they make fun of me when I don't do it right; but I feel proud when I do get it right].

In summary, the majority liked mathematics with the exception of a couple who noted mathematics and science did not draw their attention because it was hard, and they did not understand it. Teachers are seen as having a big impact and influence on the perception students have towards mathematics, their understanding and appreciation of it and whether they have a like/dislike for it. Hence, despite the challenges and frustrations mathematics presented to the students, it was also associated with feelings of pride, gratification, bravery, satisfaction, rewarding, excitement, joy and relief when they persevered in solving a math problem.

With respect to the perceptions and interest in engineering, upper level grade students had a very positive perception that seemed to have been driven by the pandemic and the increased need and use of technology. The younger students did not seem exposed to engineering at school and could not report about shifts in perception in the last few years. When asked to think of a word associated with engineering, students mentioned words that are positive and inspiring in nature such as creativity, fun, determination, travel, modernization, development, the future, and new opportunities. A student associated the word engineering with challenging aspects, "La palabra ingeniería me hace pensar en algo complicado, con muchos números que requiere mucho estudio para desarrollarla bien. [The word engineering makes me think of something that is complicated, with lots of numbers that requires lots of education to be able to do it well].

In relation to the engineering career, students have the perception that when doing engineering work, it had to be done correctly, that the work itself requires patience, determination and an investment of time to do it right, "Hacer trabajo de ingeniero requiere paciencia, empeño – de revisar el trabajo que todo este hecho bien, si no haces bien el trabajo, hay riesgos, hasta puede costar vidas." [Doing engineering work requires patience and determination – you have to review the work to make sure it's done right, if you don't do your job right there are risks, it could even cost lives].

In summary, engineering was seen as having an impact on modernizing society, and leading to positive things in the future, providing opportunities for growth and development.

Perceptions about Instructional Methods of Engineering

The majority of the students learned of the program via a web link that was sent to the WhatsApp chat group of student scholarship recipients, who were invited to participate. Mothers were highly influential in the student's decision to participate by providing words of encouragement, pointing out

the wonderful opportunity being presented at no cost and or simply making them aware of the program.The initial reaction to participating in the program among many students was fear and hesitancy because it was described as a mathematics program. Their perception was that they would spend time learning different types of math problems, that the mathematics would be too hard to understand, and the tests would be too much to handle. So, it was a positive surprise for students when they started the program and began to engage in active learning pre-engineering lessons with integrated mathematics.

The most favored feature of the program was the curriculum structure of putting theory into practice through the hands-on activities which were described as "dynamic". One student noted enthusiastically, "Era dinámico, primero concepto y después aplicación; esto era un proceso de aprender nuevo y me gustó mucho" [It was dynamic- first concept and then application; this was a new process of learning and I liked it]. The activities were seen as real-life situations and not just math problems to be solved on the chalkboard. This teaching/learning approach was new to them and caused a shift in perception that mathematics could be easier to understand when applied to easy to understand engineering tasks. Another student noted, "Me gusto la aplicación, la utilidad que tiene ingeniería y su aplicación in la vida real; el interés que tuve de ver cada proyecto me cambió mi perspectiva, me manera de pensar de ingeniería" [I liked the application, the utility and application that engineering has in real life; the interest I had in seeing each project changed my perspective, my way of thinking about engineering]. One student commented, "Yo no quería entrar al programa Brillantes, tenía miedo, pero mi mamá me dijo que era una buena oportunidad y que yo soy muy buena para las matemáticas." [I didn't want to participate in the Brillantes program, I was afraid, but my mom told me it was a very good opportunity and that I'm very good at math].

Working in groups was favored by students - sharing the load of completing the project made the process more relaxing and enjoyable. The career videos were perceived as inspiring, informative, and useful in learning about different types of engineering and the trajectory (education path) of how someone can enter that career. Students agreed that positioning the program as a dynamic (*dinámico*), practical (*práctico*), innovative (*novedoso*) and fun (*divertido*) way to learn about mathematics and engineering would help motivate participation. Statements referencing the practical theory-to-practice curriculum and communicating the program was more than a "*boring math class*" would eliminate fears and negative perceptions.

Perceptions of the Instructional Team

The teaching team was noted as creating a fun, learning environment where mathematics was less intimidating. When asked, a student said, "Me gustó mucho, las actividades, aprendí acerca de la ingeniería y me gustó la convivencia con los compañeros" [I like the activities very much, I learned about engineering, and I liked the camaraderie with my fellow classmates]. Another student noted that, "Me enseñaron que las matemáticas no son difíciles, como la Profe que nos explicaba bien y no se enojaba" [They showed me that mathematics isn't hard, by how the teacher would explain it so well to us and wouldn't get angry].

Similarly, instructors noted, “La parte práctica fue lo mejor; nuestra formación academica no es de esta manera, ver los estudiantes aprender desde tema a práctica era algo maravilloso de ver y de aprender yo mismo” [The practical part (of the program) was the best; our professional development is not like this, so seeing the students learn from topic to practice was something wonderful to see and I learned it as well.] Additionally, another instructor noted, “La parte del concepto acerca de las matemáticas de los estudiantes cambió; matemáticas era algo abstracto, seco – con la actividad vieron que matemáticas es simple y algo práctico” [The students' concept of math changed; math was something abstract, dry – with the use of these activities they saw that math can be simple and practical.]

The team felt strongly about allowing students to work at their own pace and at times this meant doubling the time suggested in the instructions to complete the activities. They learned that having the instructors complete the activities before each session was an important step to avoid not having the right materials and ensuring the task could be carried out as expected. The implementation team felt they acquired new skill sets in teaching, coordinating logistics, and benefited from other teaching styles and academic backgrounds each brought to the program. The best part of the program was seeing the students learn without fear; to have fun learning for the sake of learning. Seeing the students work so hard to make the experiments work and accomplishing this - some after several attempts - was gratifying; resulted in a contagious emotion of happiness among students and teachers.

Conclusions and next steps:

The program was repeated in the summer of 2022 with an additional instructional session for a total of five sessions involving the same lead instructors but a new group of middle school students. A full mixed methods data collection effort was launched to collect both field perceptions and career motivational data as well as algebraic concept understanding/performance data.

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References

1. National Assessment of Educational Progress (NAEP) 2022 School Survey, Institute of Education Sciences
2. Gamoran, A., & Hannigan, E. C. (2000). Algebra for everyone? Benefits of college-preparatory mathematics for students with diverse abilities in early secondary school. *Educational Evaluation and Policy Analysis*, *22*(3), 241-254.
3. Loveless, T. (2016). The 2016 Brown Center Report on American Education: How Well Are American Students Learning? With Sections on Reading and Math in the Common Core Era, Tracking and Advanced Placement (AP), and Principals as Instructional Leaders. Volume 3, Number 5. *Brookings Institution*.
4. Stein, M. K., Kaufman, J. H., Sherman, M., & Hillen, A. F. (2011). Algebra: A challenge at
5. Moses, R. P., & Cobb, C. (2001). Organizing algebra: The need to voice a demand. Social Policy, 31(4), 4-12.
6. Bodovski, K., & Youn, M. J. (2012). Students' mathematics learning from kindergarten through 8th grade. International Journal of Sociology of Education, 1(2), 97-122.
7. Faulkner, V. N., Stiff, L. V., Marshall, P. L., Nietfeld, J., & Crossland, C. L. (2014). Race and teacher evaluations as predictors of algebra placement. Journal for Research in Mathematics Education, 45(3), 288-311.
8. Morton, K., & Riegle-Crumb, C. (2019). Who gets in? Examining inequality in eighth-grade algebra. Journal for Research in Mathematics Education, 50(5), 529-554.
9. Provasnik, S., Kastberg, D., Ferraro, D., Lemanski, N., Roey, S., & Jenkins, F. (2012). Highlights from TIMSS 2011: Mathematics and Science Achievement of US Fourth-and Eighth-Grade Students in an International Context. NCES 2013-009. *National Center for Education Statistics*.
10. Cheema, J. R., & Kitsantas, A. (2014). Influences of disciplinary classroom climate on high school student self-efficacy and mathematics achievement: A look at gender and racial–ethnic differences. *International Journal of Science and Mathematics Education*, *12*, 1261-1279.
11. Kang, H., & Cogan, L. (2022). The differential role of socioeconomic status in the relationship between curriculum-based mathematics and mathematics literacy: The link between TIMSS and PISA. *International Journal of Science and Mathematics Education*, 1-16.
12. FEREMA. (2018). Informe de progreso educativo Honduras. Journal of Chemical Information and Modeling, 53(9), 51.
13. United Stated Aid. Honduras Proyecto MIDEH – Proyecto Mejorando el Impacto al Desempeño Estudiantil de Honduras [SE-MIDEH,2017]. March, 2017. https://pdf.usaid.gov/pdf_docs/PA00SXM5.pdf
14. Palacios, L. A. R., & Casas García, L. M. (2018). Conceptions and beliefs of Honduran teachers about teaching, learning and assessment of mathematics. Revista Latinoamericana

de Investigacion En Matematica Educativa, 21(3), 275–300. https://doi.org/10.12802/relime.18.2132
15. Gustafsson, J. E., Nilsen, T., & Hansen, K. Y. (2018). School characteristics moderating the relation between student socio-economic status and mathematics achievement in grade 8. Evidence from 50 countries in TIMSS 2011. Studies in Educational Evaluation, 57, 16–30. https://doi.org/10.1016/j.stueduc.2016.09.004
16. OECD. (2018). PISA for Development Assessment and Analytical Framework: Reading, Mathematics and Science. In Pro.
17. World Bank. (2019). Poverty and Equity Brief. https://databankfiles.worldbank.org/public/ddpext_download/poverty crossroads of policy and practice. Review of Educational Research, 81(4), 453-492.
18. Morales, R. (2015). Factores asociados al Aprendizaje de Español y Matemáticas en el Primer , Segundo y Tercer Ciclos del Sistema Educativo Nacional .
19. World Bank. (2020). Poverty and Inequality Platform. Index Gini. https://data.worldbank.org/indicator/SI.POV.GINI
20. United Nations Development Programme. (2021-2022). Human Development Index Report. https://hdr.undp.org/content/human-development-report-2021-22
21. López, Ramón and Alberto Valdés (2000) "Fighting Rural Poverty in Latin America: New Evidence of the Effects of Education, Demographics, and Access to Land", Economic Development and Cultural Change, Vol. 49, No. 1, pp. 197-211.
22. Banco Interamericano de Desarrollo [BID]. (2018). Portal de estadísticas educativas del BID. https://cima.iadb.org/home/efficiency
23. UNESCO. (2019). Estudio Regional Explicativo y Comparativo (ERCE). https://es.unesco.org/fieldoffice/santiago/llece/ERCE2019
24. McIntyre, Lisa J. (2005). Need to Know. Social Science Research Methods. Boston: McGraw-Hill.
25. Creswell, J. W. (2009). Research Design. Qualitative, Quantitative, and Mixed Method Approaches. 3rd ed. Thousand Oaks: SAGE Publications.
26. Bryman, Alan. (1989). Research Methods and Organizational Studies. London: Routledge
27. Morrill, C., & Alan Fine, G. (1997). Ethnographic Contributions to Organizational Sociology. Sociological Methods & Research, 25(4), 424–451. https://doi.org/10.1177/0049124197025004003
28. Baran, E., Canbazoglu, S., Bilici, Mesutoglu, C., Ocak, C. (2019). The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers. School Science and Mathematics. https://doi.org/10.1111/ssm.12330.
29. Creswell, J.W. & Plano Clark, V.L. (2011). Designing and Conducting Mixed Methods Research. Los Angeles: Sage Publications.
30. Higde Emarah & Aktamus, Hilal. (2022). The effects of STEM activities on students' STEM career interests, motivation, science press skills, science achievement and views. Thinking Skills and Creativity. https://doi.org/10.1016/j.tsc.2022.101000
31. Marx, S. (Ed). (2016). Qualitative Research in STEM. Studies of Equity, Access, and Innovation. New York: Routledge.

32. Shin, M., Calabrese Barton, A., & Johnson, L. (2016). “I am an Innovator:” Quahn’s Counternarrative of Becoming in STEM. Chapter in S. Marx (Ed). Qualitative Research in STEM. New York: Routledge.

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