

Researchers

Emma Naslund-Hadley
Inter-American Development Bank

Juan Hernández-Agramonte
Senior Director, Embedded Labs

Horacio Alvarez
Inter-American Development Bank

Cynthia Hobbs
Inter-American Development Bank

Humberto Santos
Inter-American Development Bank

Ana Grigera
Inter-American Development Bank

Carmen Albertos
Inter-American Development Bank

Staff

Gabriella Wong
Research Associate

Pilar Ouro Paz
Research Associate, Panama

Marcia Ruiz Pulgar
Research Associate

Maria Luisa Zeta Valladolid
Senior Research Associate

Carolina Magnet
Research Coordinator

Juan Hernández-Agramonte
Senior Director, Embedded Labs

Timeline

2018-2020

Study Status

Results

Study Type

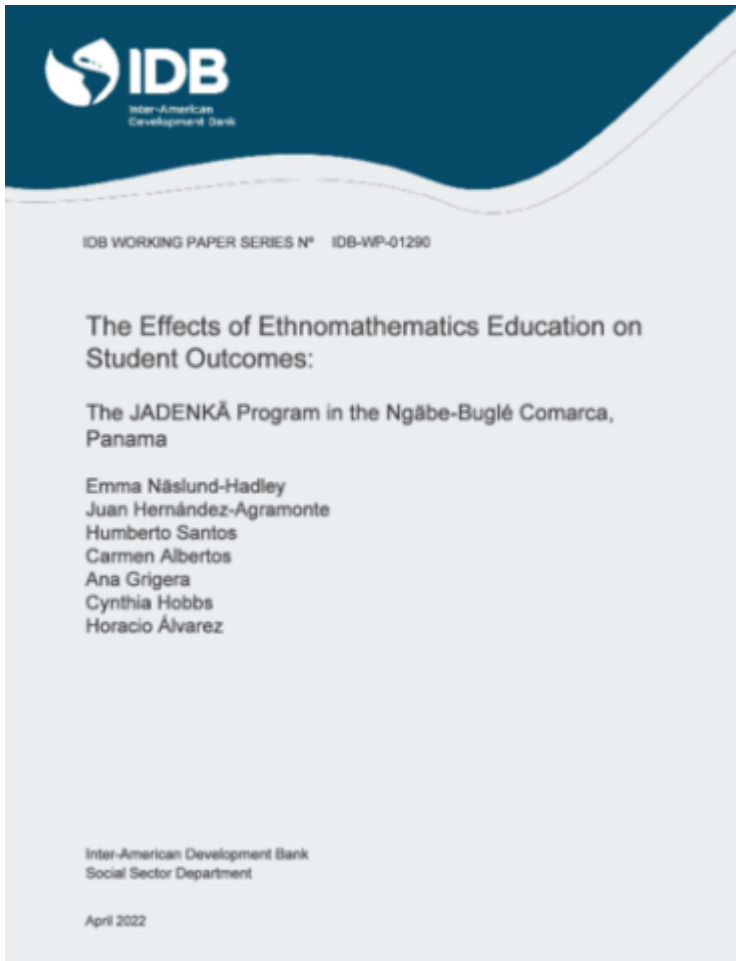
Randomized Evaluation

Sample Size

373 schools in and around Panama's Ngäbe-Buglé comarca 3589

Research Implemented by IPA

Yes



Final Paper

The Impact of Bilingual Mathematics Education in Panama



A photo of children in Panama. This photo was used in a [2018 blog post on the IADB website](#) about JADENKÄ, co-authored by Emma Näslund-Hadley, Carmen Albertos, and Cynthia Hobbs. © 2018 IADB / Emma Näslund-Hadley

Abstract

Ethnomathematics, an approach to teaching mathematics that incorporates local cultural understandings of mathematics, may improve student learning in indigenous communities. Researchers worked with IPA and the Inter-American Development Bank to conduct a randomized evaluation of an ethnomathematics program called JADENKÄ developed by Panama's government for preschool students in the country's Ngäbe-Buglé region. The program improved students' mathematical and ethnomathematical skills, with the most salient positive impacts for Ngäbe students, suggesting that well-designed ethnomathematics programs can reduce achievement gaps between indigenous and nonindigenous students without asking students to choose between their academic learning and their identity, culture, and language.

Policy Issue

Education policymakers often assume that mathematics is “universal” across languages and cultures. However, researchers working in a field called ethnomathematics argue that different cultures approach mathematical ideas differently and that there may be important benefits to teaching mathematics using indigenous students’ languages and cultural elements in educational settings where indigenous students struggle compared to nonindigenous peers.[1] Education practices that take these differences into account may improve students’ abilities to learn by allowing them to build on the informal cultural knowledge that they bring prior to their formal education, increasing their self-esteem and motivation to learn, affirming their cultural heritage, and giving them a sense of self-efficacy that improves their overall learning. Skeptics, on the other hand, caution that ethnomathematics may limit the extent to which students are able to learn mathematical knowledge they will need outside their own local contexts, that implementing ethnomathematics approaches may prove difficult in practice, and that the outside perspectives students bring to the classroom are less important than their propensities to learn new knowledge. Little rigorous evidence, however, exists about how effective ethnomathematics approaches are at spurring student learning, particularly at the preschool level, and through which mechanisms such effects might operate.[2]

Context of the Evaluation

The students participating in this project were preschool-aged Ngäbe children, from an indigenous group in and around the Ngäbe-Buglé comarca (region) of Panama. Ngäbe mathematics differs in important ways from the mathematics taught as part of Panama’s national preschool curriculum. For instance, the Ngäbe numbering system includes many different “roots,” which are applied when counting based on the characteristics of the thing being counted. Many preschool teachers in Ngäbe-Buglé, however, do not come from the region or speak Ngäbere. Students, meanwhile, may be bilingual or speak only Ngäbere or Spanish: among students in this study, about 73 percent spoke Spanish at home, while the remainder spoke Ngäbere or both languages.

Nationally, Panamanian students score below average in mathematics among Latin American countries.[3] Within Panama, indigenous students tend to have lower scores than nonindigenous students; in the Ngäbe-Buglé comarca, 83 percent of students scored at a level designated either “very low” or “low” on a 2018 national standardized test, compared with 49 percent of students nationally in Panama.[4] A 2019 study, meanwhile, found that Ngäbe-Buglé had lower preschool enrollment, and higher rates of grade repetition and dropout, than other provinces.[5]

Details of the Intervention

Researchers worked with IPA and the Inter-American Development Bank (IDB) to conduct a randomized evaluation of JADENKÄ, an intercultural bilingual mathematics program for Ngäbe students designed and implemented by Panama’s government. The program’s designers

worked with elders from the comarca to understand the role of mathematics in Ngäbe culture, and with an expert in Ngäbe mathematics and language to integrate ethnomathematical ideas with Panama's national preschool mathematics curriculum.

To enable bilingual education in classrooms where teachers did not speak Ngäbere, the curriculum included 108 45-minute audio lessons recorded by Ngäbe actors and singers in both Ngäbere and Spanish, with teachers instructed to spend the last 15 minutes of mathematics classes reinforcing concepts from the audio recordings.

The program was implemented during two school years, in 2018 and 2019. To measure the impacts of the program, researchers compared schools that implemented the program to those that continued mathematics education as usual. Researchers first grouped the schools into different strata, and within these strata, randomly assigned schools to one of two groups:

JADENKÄ group (248 schools): These schools received the full program in both 2018 and 2019.

Comparison group (125 schools): These schools did not implement the program in either year.

In both years, the program faced numerous implementation challenges. In 2018, participating classrooms implemented about 25 of the intended 108 lessons, while in 2019 the average rose to about 36 lessons. These limitations were due both to external factors like flooding and power outages, and internal factors such as varying levels of interest in the program.

Conducting surveys at each school year's beginning and conclusion, the research team measured the program's impacts on student learning (with both a standardized mathematics assessment and a set of questions specific to Ngäbe mathematics), oral comprehension in Spanish and Ngäbere, and cultural knowledge and identity.

Results and Policy Lessons

Overall, JADENKÄ improved students' mathematical skills, with particularly salient impacts for Ngäbe students—suggesting that a well-designed ethnomathematics program may be an effective approach to reducing achievement gaps in preschool classrooms.

Students who received JADENKÄ had higher scores on mathematics and ethnomathematics assessments. On average, these students performed 0.12 to 0.18 standard deviations higher than their peers in the comparison group on standard mathematics assessments, and 0.23 standard deviations higher in ethnomathematics.

The impacts were particularly strong for Ngäbe students. Researchers saw the largest improvements in ethnomathematics among students who spoke Ngäbere either primarily or equally with Spanish, and whom teachers identified as being Ngäbe.

The program changed teachers' skills and perceptions. Teachers who participated in

JADENKÄ knew more about ethnomathematics and Ngäbe culture than those who did not.

The program had beneficial impacts for students' engagement with their cultural identities. Students who received the program scored higher on an index measuring Ngäbe cultural identity, and qualitative evidence suggests that Ngäbe cultural elements were more frequently used and valued in these classrooms.

Qualitative evidence suggests that classroom improvements drove the positive impact. Observers noted, for instance, that classrooms using the program worked with more difficult content, had more varied discussions, and improved attitudes toward mathematics through increased critical thinking and play-based activities.

Sources

- [1] O. Arda Cimen, "Discussing Ethnomathematics: Is Mathematics Culturally Dependent?" *Procedia - Social and Behavioral Sciences* 152 (2014), 523-528.
<https://doi.org/10.1016/j.sbspro.2014.09.215>.
- [2] Prior studies include Shehenaz Adam, "Ethnomathematical ideas in the curriculum," *Mathematics Education Research Journal* 16 no. 2 (2004), 49-68,
<https://doi.org/10.1007/BF03217395>; Miriam Amit and Fouze Abu Quoder, "Weaving Culture and Mathematics in the Classroom: The Case of Bedouin Ethnomathematics," in Milton Rosa, Lawrence Shirley, Maria Elena Gavarrete, and Wilfredo V. Alangui (Eds.), *Ethnomathematics and Its Diverse Approaches for Mathematics Education* (ICME-13 Monographs, Springer, 2017); and Ellen Eliason Kisker, Jerry Lipka, Barbara L. Adams, Anthony Rickard, Dora Andrew-Ihrke, Eva Evelyn Yanez, and Ann Millard, "The Potential of a Culturally Based Supplemental Mathematics Curriculum to Improve the Mathematics Performance of Alaska Native and Other Students," *Journal for Research in Mathematics Education* 43 no. 1 (2012), 75-113, <https://doi.org/10.5951/jresmetheduc.43.1.0075>.
- [3] UNESCO (2015). Informe de resultados TERCE: logros de aprendizaje. Tercer estudio regional comparativo y explicativo. Logros en los aprendizajes. Laboratorio Latinoamericano de evaluación de la calidad de la educación.
- [4] H. Sánchez-Restrepo, Resultados educativos Crecer 2018. Las habilidades de los estudiantes panameños de tercer grado (Agencia Latinoamericana de Evaluación y Política Pública, 2019).
- [5] UNICEF Panamá, Situación de los derechos de la niñez y la adolescencia en Panamá. A 30 años de la Convención sobre los Derechos del Niño (2019),
<https://www.unicef.org/panama/informes/sitan-panama>.

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