

Supporting Professional Learning to Advance Culture-Based Math Instruction in Standing Rock

Standing Rock Partnership Fact Sheet

Standing Rock Tribal Education Department (TED) and Sitting Bull College have partnered with Regional Educational Laboratory (REL) Central to identify best practices in culture-based math instruction and effective models of professional learning that empower educators of Lakota/Dakota students to implement culturally relevant and engaging instruction.

Why Math Instruction Matters

Math learning is a cumulative process. As such, a strong math foundation in elementary math is critical for students to successfully transition into and become proficient in later math levels, and to stay on track for high school graduation (Balfanz & Herzog, 2005; Claesens & Engel, 2013; Dougherty & Fleming, 2012). Studies in non-Indigenous settings show that a student's math achievement is related to a host of long-term outcomes, including life satisfaction, health, wages, and employability (Lipnevich et al., 2016). Equipping students with the mathematical skills to be successful is a unique challenge for students in Indigenous communities because Western math concepts and procedures dominate the curricular and pedagogical landscape. Balancing Western

and Indigenous ways of knowing and learning, and structuring math learning in particular, takes nuance and commitment by all involved. If implemented successfully, culturally relevant and culturally sustaining teaching can connect more students to learning in deeper ways, which can lead to gains in academic skills and can improve student motivation, interest in content area, and student perceptions of learning (Aronson & Laughter, 2016).

This fact sheet presents case studies and selected research to provide more context about how educators might work to Indigenize student learning in math classrooms. In addition, the fact sheet provides information about the kinds of professional learning supports educators and schools might need to shift instruction to better support Indigenous learners.

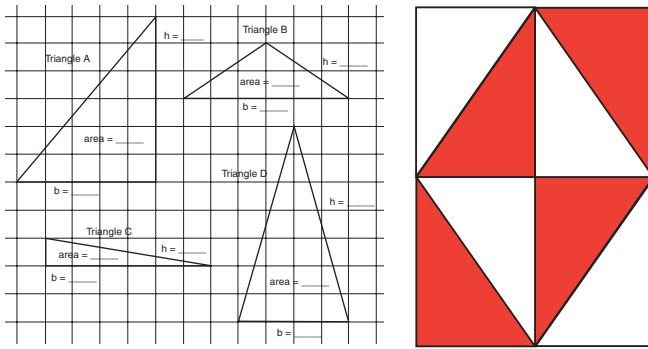
Evidence of Successful Culture-Based Education

Example 1: [Math in a Cultural Context Curriculum](#)

Alaska's [Math in a Cultural Context \(MCC\)](#) curriculum is a collaborative project created with Yup'ik elders, teachers, math educators, and Alaskan school districts to bridge Native students' culture, home, and community knowledge with school knowledge. In the MCC curriculum, math content integrates Yup'ik culture and traditions as a driver for student engagement and connection. For example, [a module for students in grades 1 and 2](#) about number concepts (emphasizing place value, grouping, and addition and subtraction strategies) centers on the Yup'ik process of eggging, which includes gathering eggs, counting eggs, and engaging with many forms of number representation. Students learn the Yup'ik base-20 number system and explore counting tools, such as an abacus that relies on the Western 10-base number



Example 1: Math in a Cultural Context Curriculum



Source: Math in a Cultural Context - Designing Patterns

system, to then create their own Yup'ik abacus. This example of inquiry-based learning represents how MCC modules center Yup'ik counting strategies through an expert-apprentice model that frames Western math within a cultural context. Rigorous studies have shown that use of the MCC modules improved student understanding of measurement, grouping, and place value (Kisker et al., 2012; Lipka & Adams, 2004). These results demonstrate the potential to improve student math outcomes by adapting Western math concepts around a student's culture, home, and community environment.

Example 2: Culture-Based Teaching Strategies in Hawai'i

A [case study](#) from Kamehameha Schools in Hawai'i found that the wide use of culture-based teaching strategies was associated with higher student achievement across all content areas (Kana'iaupuni et al., 2010). When teachers use culture-based strategies, students have the opportunity to demonstrate



learned skills in a variety of contexts, both in and out of the classroom. Kana'iaupuni et al. examined five components of culturally relevant strategies—language, family and community, content, context, and assessment and accountability—identified in prior research by Kana'iaupuni and Kawai'ae'a (2008). In the Kamehameha Schools case study, teachers self-reported their use of cultural-based education (CBE) strategies at varying levels and were then classified as high, moderate, and low CBE teachers. This work resulted in two promising findings. First, students with at least one high CBE teacher were more likely to show improved social-emotional development and greater cultural affiliation. Second, student reading and math outcomes were both positively influenced “when teachers’ use of culture-based strategies is supported by overall use of culture-based strategies in the school” (Kana'iaupuni et al., 2010, p. 16). This example highlights the importance of having educators use many CBE strategies, such as extending learning beyond the classroom setting, while also empowering students to apply learning in real-world contexts.

These two examples demonstrate what researchers suggest are important features of student learning: (1) engagement with culturally relevant content and (2) instructors’ ability to use culturally based teaching strategies (Aguirre & del Rosario Zavala, 2013).

Effective Professional Learning in Culture-Based Education

Effective professional learning is most often led by experienced educators who can draw on their teaching expertise and real-world insights (Kennedy, 2005). Effective professional learning is often designed to demonstrate the following:

- Be content focused.
- Incorporate active learning opportunities based on adult learning theory.
- Support collaboration that is connected to the work of the school.
- Model effective practice.
- Provide coaching and expert support, including opportunities for reflection and feedback.
- Be sustained in duration to provide teachers time to learn, practice, implement, and reflect on new strategies (Darling-Hammond et al., 2017).

Research shows that high-quality professional learning takes time. Extended teacher professional learning totaling more than 14 hours and occurring over three months to a year is associated with improved teacher knowledge and skills, and with better student learning

outcomes (Yoon et al., 2007). Specifically, professional learning that promotes culture-based approaches to student learning should include opportunities for educators to self-reflect and create learning materials (Parkhouse et al., 2019). For example, the Transformative Professional Development (TPD) Model provides educators with culturally responsive teaching strategies through a process of co-development. Unlike traditional professional learning programming, which is pre-planned with little participant input, TPD relies on teacher input to drive programming (Johnson & Fargo, 2010). TPD is effective when it is characterized by the following:

- Is intensive, including whole-school participation.
- Is premised on relationship building across interest groups (teachers, students, researchers/university affiliates).
- Promotes a positive culture of achievement.

Preparing teachers to engage with culture-based math instruction requires an approach known in literature and practice as culturally responsive mathematics teaching (CRMT), which motivates educators to engage with both culturally responsive pedagogy and pedagogical content knowledge (Aguirre & del Rosario Zavala, 2013). Aguirre and del Rosario Zavala (2013) designed a [CRMT lesson analysis tool](#)¹ to guide teachers to consider questions around mathematical thinking, language, culture, and social justice when lesson planning. The CRMT lesson analysis tool has been used for professional learning and is

recommended for educators to reflect, discuss, and create lesson plans that address the needs of culturally and linguistically diverse students.

Equipping teachers to be culturally responsive mathematics instructors is not without challenges. There are opportunities for math educators to cultivate learning experiences that are culturally affirming and centered on cultural identity. But first, educators from all backgrounds must be invited to engage with culturally sustaining and relevant practices through high-quality professional learning. Teaching in an Indigenous context requires educators to confront and challenge Western views of education by stepping outside their comfort zone to authentically engage with Indigenous communities. Therefore, teachers must be willing to engage in self-reflection, expand their beliefs about incorporating culturally diverse content, and consider the various dimensions in which local communities find that math meets the needs of Indigenous students (Civitillo et al., 2019). Teacher professional learning, pedagogical approaches, and curriculum all function to influence student achievement in math. For Indigenous students to feel connected to math instruction, educators, community members (for example, elders, parents, knowledge keepers), and curriculum designers must be willing to come together to evaluate the state of math instruction, consider its impact through student performance data, and lean on one another to create learning opportunities that engage and inspire mathematical thinkers.



¹ This resource might not be accessible to all readers without a fee; consider checking with your local library for access.

References

- Aguirre, J. M., & del Rosario Zavala, M. (2013). Making culturally responsive mathematics teaching explicit: A lesson analysis tool. *Pedagogies: An International Journal*, 8(2), 163-190. <https://doi.org/10.1080/1554480X.2013.768518>
- Aronson, B., & Laughter, J. (2016). The theory and practice of culturally relevant education: A synthesis of research across content areas. *Review of Educational Research*, 86(1), 163-206. <https://doi.org/10.3102/0034654315582066>
- Balfanz, R., & Herzog, L. (2005, March). *Keeping middle grades students on track to graduation: Initial analysis and implications*. Presentation at the second Regional Middle Grades Symposium, Philadelphia, PA.
- Civitillo, S., Juang, L. P., Badra, M., & Schachner, M. K. (2019). The interplay between culturally responsive teaching, cultural diversity beliefs, and self-reflection: A multiple case study. *Teaching and Teacher Education*, 77, 341-351. <https://doi.org/10.1016/j.tate.2018.11.002>
- Claesens, A., & Engel, M. (2013). How important is where you start? Early mathematics knowledge and later school success. *Teachers College Record*, 115(6), 1-29. <https://doi.org/10.1177/016146811311500603>
- Darling-Hammond, L., Hyster, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute. <https://eric.ed.gov/?id=ED606743>
- Dougherty, C., & Fleming, S. (2012). *Students on track to college and career readiness: How many catch up from far behind?* ACT. <https://eric.ed.gov/?id=ED542022>
- Johnson, C. C., & Fargo, J. D. (2010). Urban school reform enabled by transformative professional development: Impact on teacher change and student learning of science. *Urban Education*, 45(1), 4-29. <https://doi.org/10.1177/0042085909352073>
- Kana'iaupuni, S. M., & Kawai'ae'a, K. K. C. (2008). E lauhoe mai na wa'a: Toward a Hawaiian Indigenous education teaching framework. *Hūlili: Multidisciplinary Research on Hawaiian Well-Being*, 5, 67-90. <https://eric.ed.gov/?id=ED523184>
- Kana'iaupuni, S., Ledward, B., & Jensen, U. (2010). *Culture-based education and its relationship to student outcomes*. Kamehameha Schools, Research & Evaluation. <https://fpcc.ca/wp-content/uploads/2020/11/Culture-Based-Education-and-Its-Relationship-to-Student-Outcomes.pdf>
- Kennedy, A. (2005). Models of continuing professional development: A framework for analysis. *Journal of In-Service Education*, 31(2), 235-250. <https://doi.org/10.1080/13674580500200277>
- Kisker, E. E., Lipka, J., Adams, B. L., Rickard, A., Andrew-Ihrke, D., Yanez, E. E., & Millard, A. (2012). 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(1), 75-113. <https://doi.org/10.5951/jresmetheduc.43.1.0075>
- Lipka, J., & Adams, B. (2004). *Culturally based math education as a way to improve Alaska native students' math performance* (Working Paper No. 20; Working Paper Series). Appalachian Collaborative Center for Learning. <https://eric.ed.gov/?id=ED484849>
- Lipnevich, A. A., Preckel, F., & Krumm, S. (2016). Mathematics attitudes and their unique contribution to achievement: Going over and above cognitive ability and personality. *Learning and Individual Differences*, 47, 70-79. <https://doi.org/10.1016/j.lindif.2015.12.027>
- Parkhouse, H., Lu, C. Y., & Massaro, V. R. (2019). Multicultural education professional development: A review of the literature. *Review of Educational Research*, 89(3), 416-458. <https://doi.org/10.3102/0034654319840359>
- Yoon, K. S., Duncan, T., Lee, S. W. Y., Scarloss, B., & Shapley, K. (2007). *Reviewing the evidence on how teacher professional development affects student achievement* (Issues & Answers Report, REL 2007-No. 033). U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southwest. https://ies.ed.gov/ncee/edlabs/regions/southwest/pdf/rel_2007033.pdf