Artificial Intelligence for Equitable Global Education: A Call for More Representative Adaptive Learning Research and Design Practices in Low- and Middle-Income Countries

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Keywords: Adaptive learning, artificial intelligence in education, low- and middle-income countries, educational technology, cultural context

Abstract:

Artificial intelligence in education (AIED) is an area of research in which the latest technological advances and the learning sciences meet. While this field encompasses multiple goals, one area where its potential has long been envisioned is in the use of personalized learning through software that is adaptive and responsive to the needs of individual students. This paradigm has dominated the design of intelligent tutoring systems (ITS) in the United States and other western, educated, industrialized, rich, and democratic (WEIRD; Henrich et al., 2010) countries. Not surprisingly, lower- and middle-income countries (LMICs) have yet to see much of the payoff from all the research these tools have sparked. And while the recent hype surrounding AI has led some researchers to be overly optimistic and uncritical about its educational prospects (such as Gyamfi et al., 2022; Zhang & Aslan, 2021), the rapidly growing interest and funding in these technologies—including their potential for helping to achieve the Sustainable Development Goal of quality education (SDG 4)—suggest that this area should not be ignored by scholars in the broader learning sciences community.

With this in mind, the current paper first presents an overview of previous research regarding AIED in LMICs, with a special emphasis on studies that highlight existing barriers and implementation challenges. Through this review, existing gaps are then brought to the fore. Finally, the paper presents a discussion of open questions that may serve as a starting point for future research. The benefits of opening up such a conversation can be gleaned from contemporary research that has focused on expanding the participation of non-dominant groups in fields such as mathematics, engineering, and computer science. A similar objective motivates this paper—investigating the actions and research required to properly bring the latest advances in AIED to global communities that have historically been ignored, and to do so in a culturally sensitive and informed manner.

One of the most challenging problems highlighted in this paper deals with observed cultural differences that have a fundamental impact on the way adaptive learning technologies are used. Numerous studies in LMICs (eg. Nye, 2015; Ogan et al., 2015; Ogan & Walker, 2012) have shown that many students in these contexts collaborate extensively while using ITS. Such practice goes in strict opposition to the paradigm of individualistic learning upon which most of these tools have been designed.

Indeed, adaptive learning systems present the opportunity to make a positive impact in LMICs due to common shortages in these locations of qualified teachers (Zualkernan et al., 2013) and other resources such as textbooks (Nye, 2015). However, as Holstein & Doroudi

(2021) have asked, the key question is whether the implementation of these systems will alleviate or rather amplify existing inequities in education. The only way to work towards an equitable future on this front is to carefully reflect on the problems that may be introduced and the paradigm shifts required to mitigate them (Holstein & Doroudi, 2021). This paper contributes to this goal by expanding the conversation in important directions deserving of more research and reflection.

References

Arnett, J. J. (2008). The neglected 95%: Why American psychology needs to become less American. *American Psychologist*, *63*(7), 602–614. https://doi.org/10.1037/0003-066X.63.7.602

Blanchard, E. G. (2012). On the WEIRD Nature of ITS/AIED Conferences. In S. A. Cerri, W. J. Clancey, G. Papadourakis, & K. Panourgia (Eds.), *Intelligent Tutoring Systems* (pp. 280–285). Springer. https://doi.org/10.1007/978-3-642-30950-2_36

Blumenstock, J., Cadamuro, G., & On, R. (2015). Predicting poverty and wealth from mobile phone metadata. *Science*, *350*(6264), 1073–1076. https://doi.org/10.1126/science.aac4420

Cohen, J. L., & Kharas, H. (2018). *Using big data and artificial intelligence to accelerate global development*. 18.

Gyamfi, N. K., Dayie, R., & Asiedu, E. K. (2022). Application of Artificial Intelligence Techniques in Educational Delivery; Ghana Perspective. *Webology*, *19*(1), 480–492. https://doi.org/10.14704/WEB/V19I1/WEB19034

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Beyond WEIRD: Towards a broad-based behavioral science. *Behavioral and Brain Sciences*, *33*(2-3), 111–135. https://doi.org/10.1017/S0140525X10000725

Holstein, K., & Doroudi, S. (2021). *Equity and Artificial Intelligence in Education: Will "AIEd" Amplify or Alleviate Inequities in Education?* 24.

Kulik, J. A., & Fletcher, J. D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. *Review of Educational Research*, *86*(1), 42–78. https://doi.org/gf4zrz

Nye, B. D. (2015). Intelligent Tutoring Systems by and for the Developing World: A Review of Trends and Approaches for Educational Technology in a Global Context. *International Journal of Artificial Intelligence in Education*, *25*(2), 177–203. https://doi.org/10.1007/s40593-014-0028-6

Ogan, A., & Walker, E. (2012). *Collaboration in cognitive tutor use in Latin America: Field study and design recommendations*. 10.

Ogan, A., Yarzebinski, E., Fernández, P., & Casas, I. (2015). Cognitive Tutor Use in Chile: Understanding Classroom and Lab Culture. In C. Conati, N. Heffernan, A. Mitrovic, & M. F. Verdejo (Eds.), *Artificial Intelligence in Education* (Vol. 9112, pp. 318–327). Springer International Publishing. https://doi.org/10.1007/978-3-319-19773-9_32

Roll, I., & Wylie, R. (2016). Evolution and Revolution in Artificial Intelligence in Education. *International Journal of Artificial Intelligence in Education*, *26*(2), 582–599. https://doi.org/10.1007/s40593-016-0110-3

UN Department of Economic and Social Affairs. (2020). *The Sustainable Development Goals Report 2020*. United Nations.

UNESCO. (2019). *Artificial intelligence in education: Challenges and opportunities for sustainable development*.

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist*, *46*(4), 197–221. https://doi.org/10.1080/00461520.2011.611369

Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, *2*, 100025. https://doi.org/10.1016/j.caeai.2021.100025

Zualkernan, I., Arroyo, I., & Woolf, B. P. (2013). Towards localization of automated tutors for developing countries. *Learning Technologies for the Developing World (LT4D) Workshop at AIED 2013*.