

Intelligent Tutors, Cultural Blind Spots: Implications of Underrepresentation in Adaptive Learning Research

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Abstract: As intelligent tutoring systems (ITS) continue to mature and spread to lower- and middle-income countries (LMICs), it is becoming clear that basing such tools around models of learning overwhelmingly studied in Western countries has left severe blind spots that need to be addressed. This paper aims to raise awareness of the disconnect between the collectivist value systems espoused by many cultures and the Western individualistic mentality of ITS developers and researchers, along with some implications.

Introduction

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.

While the current imbalance in representation is not exclusive to academia (UNESCO, 2019), it stems from the fact that AIED research has predominantly been undertaken in WEIRD countries. Building on a study that found studies in psychology to be overwhelmingly done in an American context (Arnett, 2008), several meta-analyses have come to similar conclusions regarding published research in AIED and ITS journals and conference proceedings (Blanchard, 2012; Nye, 2015; Roll & Wylie, 2016).

The starkness of this underrepresentation in LMICs carries serious implications and challenges. While some of the more obvious barriers, such as hardware access or electrical and internet reliability, are often presented as the foremost challenges to AIED adoption, cultural differences may prove to be more formidable obstacles in the long run. Yet it is difficult to say exactly what these barriers will look like without investing adequately in research within LMIC contexts. In this paper, I aim to raise awareness of some of the practical implications of our current cultural and social blind spots.

Cultural behavioral differences

Much AIED research has focused on using data to capture student behaviors. However, studies in psychology have found that an overreliance on WEIRD populations for research can lead to an overemphasis on psychological constructs and behaviors that are not representative of the general global population (Henrich et al., 2010). One of the significant behavioral differences that researchers have identified across cultural contexts is that of student collaboration (Nye, 2015; Ogan et al., 2015; Ogan & Walker, 2012). These studies have found that students in many LMICs often collaborate extensively while using ITS. This appears to be the case regardless of socioeconomic status, urbanicity, or experience level with ITS (Ogan et al., 2015; Ogan & Walker, 2012). In these contexts, students have been observed providing help to classmates through oral communication or in some cases physically taking control of another student's computer. Practices such as these deviate significantly from the way ITS and other adaptive learning systems are typically designed to be used in WEIRD classrooms.

Implications for research and practice

While increased collaboration is generally considered positive in the learning sciences, this behavior does not align with the intended individualistic practice espoused by much ITS work. The learner models commonly developed in WEIRD countries may not reliably transfer to these different cultures, in part because they function under an assumption of a one-to-one student-to-device ratio, which is the foundation of the personalized learning paradigm at the center of much AIED work. Suggested solutions to this problem have included modifications to the algorithms used for knowledge tracing, which create and update the learner models used by ITS (Ogan & Walker, 2012), though it is difficult to see this as anything more than a band-aid solution. Some promising work has instead been aimed at designing ITS that enable students to share hardware while still being able to use their own input devices—an approach that has the added benefit of lowering hardware costs (Nye, 2015). Still, the majority of research continues to work towards a vision of one-to-one, machine-to-human tutoring.

All of this paints a more complicated picture for the heavy emphasis that AIED research has placed on personalized learning, suggesting that such a focus may come in conflict with the more collaborative pedagogies espoused by some cultures (Ogan et al., 2015). There may be a disconnect between collectivist value systems in

some cultures and the Western individualistic mentality of AIED developers and researchers. Of course, I'm not claiming here that such values are the shared cultural heritage of all peoples in LMICs—a statement that would be reductionist at best. Instead, I am pointing out that it is problematic to assume that educational tools will always be used as intended.

Despite the difficulty of adequately addressing such a fundamental difference in how ITS are used in different contexts, the good news is that there does seem to be a growing interest on the topic. Roll & Wylie (2016) found that a much larger proportion of IJAIED papers from 2014 featured learner collaboration than a decade earlier, with not a single paper featuring it two decades earlier. To the best of my knowledge, such a systematic review has not been done in the ensuing years, which is the next phase of the current project. It is important to continue identifying the trajectory of this research as a form of accountability and because awareness of LMIC underrepresentation in ITS research is the first important step towards mitigating the issue. Suggestions on where to go from here include hosting more conferences such as AIED outside of WEIRD countries—which may help researchers in these contexts become engaged in the community—as well as a call for researchers to more consistently describe the relevant contextual factors of their samples (Nye, 2015). The latter suggestion has the added benefit of helping to address some of the algorithmic biases that knowledge tracing and learner behavior models often carry (Paquette et al., 2020)—another issue that may be negatively affecting underrepresented populations such as those in LMICs. However, truly addressing the blind spots highlighted in this paper may ultimately require entirely reimagining what personalized learning will mean in an ever-more-interconnected, information-overloaded world.

Conclusion

This paper has highlighted one of the key implications (and subsequent challenges) of work that aims to expand adaptive learning to populations in LMICs. However, there remain fundamental questions to ask that this paper has not touched on. For starters, it has not called into question the very premise that expanding AIED access to LMICs is desirable. As is true of any large-scale implementation of a new technology, such an effort will undoubtedly bring with it both predictable and unpredictable unintended consequences. One such issue is the potential for neocolonialist outcomes that supplant traditional local practices and paradigms.

One of the principal driving forces behind AIED is the desire to reduce inequalities in education by making learning more personalized to individual students and their needs. Adaptive learning systems present the opportunity to make an especially positive impact in LMICs due to common shortages in these areas of qualified teachers (Zualkernan et al., 2013) and other resources such as textbooks (Nye, 2015). Yet the only way to work toward an equitable future on this front is to carefully reflect on the problems that may be introduced and possible ways to mitigate them. This is precisely what this paper has attempted to do, though only as an entry point into the conversation.

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