Modeling Wheel-spinning and Productive Persistence in Skill Builders

Shimin Kai
Teachers College Columbia University,
525 W125th Street, New York, NY 10027
+1 212-678-3000
smk2184@tc.columbia.edu

Ma. Victoria Almeda
Teachers College Columbia University,
525 W125th Street, New York, NY 10027
+1 212-678-3000
mqa2000@tc.columbia.edu

Ryan S. Baker
Graduate School of Education, University of Pennsylvania
3700 Walnut St., Philadelphia, PA 19104
+1 877-736-6473
ryanshaunbaker@gmail.com

Nicole Shechtman
Center for Technology in Learning, SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025
+1 650-859-2000
nicoleshechtman@sri.com

Cristina Heffernan
Worcester Polytechnic Institute
100 Institute Rd, Worcester, MA 01609
+1 508-831-5000
cristina.heffernan@gmail.com

Neil Heffernan
Worcester Polytechnic Institute
100 Institute Rd, MA 01609
+1 508-831-5000
nth@wpi.com

ABSTRACT
Research on non-cognitive factors has shown that persistence in the face of challenges plays an important role in learning. However, recent work on wheel-spinning, a type of unproductive persistence where students spend too much time struggling without achieving mastery of skills, show that not all persistence is uniformly beneficial for learning. For this reason, it becomes increasingly pertinent to identify the key differences between unproductive and productive persistence toward informing interventions in computer-based learning environments. In this study, we attempt to address this by using classification models to distinguish between productive persistence and wheel-spinning in ASSISTments, an online math learning platform. Our results indicate that wheel-spinning is associated with shorter delays between solving problems of the same skill, more attempts to answer problems, and the heavy use of bottom out hints except for the first problem. These findings suggest that encouraging students to engage in spaced practice and avoid over-using bottom-out hints is likely helpful to reduce their wheel-spinning and improve learning. These findings also provide insight on which students are struggling and how to make students' persistence more productive.