Using Adaptive Learning Technologies to Personalize Instruction: The Impact of Interest-Based Scenarios on Performance in Algebra

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Abstract: Context personalization refers to the idea of adapting learning activities based on students' interests and experiences. While new learning technologies make such innovations feasible, little research supports whether and how context personalization may mediate important learner outcomes, especially in mathematics. Here, we present results of a experimental

though a problem is personalized to a general topic that interests the student

Results and Discussion

The output from the regression model of performance in Unit 6 is shown in Table 2. Personalization increased performance when students were solving problem parts with hard KCs (odds = 1.5228, $p < .001$) and easy KCs (odds = 1.5228*.9368 = 1.4266, $p < .001$). The effect of personalization on medium KCs did not quite reach significance (odds = 1.5228*.7689 = 1.1709, $p = 0.0601$). P

Several trends are apparent from Table 3 that provide insight into how personalization may support learning. First, personalization was not particularly helpful when the problem's topic was already relevant to students' lives and interests – like paying for their cell phone or getting paid at work. In these cases, the original problem could

Goldstone, R., & Son, J. (2005). The transfer of scientific principles using concrete and idealized simulations. *Journal of the Learning Sciences*, *14*(1), 69-110.

Heffernan, N. T., & Koedinger, K. R. (1997).The composition effect in symbolizing: The role of symbol production vs. text comprehension. In *Proceedings of the nineteenth annual meeting of the Cognitive Science Society* (pp. 307-312). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Hegarty, M., Mayer, R., & Monk, C. (1995). Comprehension of arithmetic word problems: A comparison of successful and unsuccessful problem solvers. *Journal of Educational Psychology*, **87**(1), 18-32.

Hidi, S. (2001). Interest, reading and learning: Theoretical and practical considerations. *Educational Psychology Review*, *13*, 191–210.

Hidi, S., & Harackiewicz, J. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research*, *70*, 151–179.

Kaput, J. J. (2000). *Teaching and learning a new algebra with understanding*. U.S.; Massachusetts: National Center for Improving Student Learning and Achievement.

Koedinger, K. R., & Aleven, V. (2007). Exploring the assistance dilemma in experiments with Cognitive Tutors. *Educational Psychology Review*, *19*, 239-264.

Koedinger, K., Alibali, M., & Nathan, M. (2008). Trade-offs between grounded and abstract representations: Evidence from algebra problem solving. *Cognitive Science*, *32*, 366-397.

Koedinger, K. R., & Corbett, A. (2006). Cognitive Tutors - Technology Bringing Learning Sciences to the Classroom. In R. K. Sawyer (ed.) *The Cambridge Handbook of the Learning Sciences*. St. Louis, Cambridge University Press: 61-77.

Koedinger, K., & McLaughlin, E. (2010). Seeing language learning inside the math: Cognitive analysis yields transfer. In S. Ohlsson & R. Catrambone (Eds.), *Proceedings of the 32nd Annual Conference of the Cognitive Science Society*. (pp. 471-476.) Austin, TX: Cognitive Science Society.

Koedinger, K., & Nathan, M. (2004). The real story behind story problems: Effects of representations on quantitative reasoning. *Journal of the Learning Sciences*, *13*(2), 129-164.

Ku, H., & Sullivan, H. (2000). Personalization of mathematics word problems in Taiwan. *Educational Technology Research and Development*, *48*(3), 49-59.

Loveless, T, Fennel, F., Williams, V., Ball, D., & Banfield, M. (2008). Chapter 9: Report of the Subcommittee on the National Survey of Algebra I Teachers. In *Foundations for Success: Report of the National Mathematics Advisory Panel*. Retrieved 14 October 2010 from http://www2.ed.gov/about/bdscomm/list/mathpanel/report/nsat.pdf.

McDaniel, M., Waddill, P., Finstad, K., & Bourg, T. (2000). The effects of text-based interest on attention and recall. *Journal of Educational Psychology*, *92*(3), 492-502.

Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of Educational Psychology*, *85*, 424–436.

Moses, R., & Cobb, C. (2001). *Radical Equations: Math Literacy and Civil Rights*. Boston: Beacon Press.

Nathan, M., Kintsch, W., & Young, E. (1992). A theory of algebra-word-problem comprehension and its implications for the design of learning environments. *Cognition and Instruction*, *9*(4), 329-389.

Renninger, K., Ewen, L., & Lasher, A. (2002). Individual interest as context in expository text and mathematical word problems. *Learning and Instruction*, *12*(4), 467-490.

Renninger, K., & Wozinak, R. (1985). Effect of interest on attentional shift, recognition, and recall in young children. *Developmental Psychology*, *21*(4), 624-632.

Snijders, T. & Bosker, R. (1999). *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*. Sage Publications.

Stacey, K., & MacGregor, M. (1999). Learning the algebraic method of solving problems. *Journal of Mathematical Behavior*, *18*(2), 149-167.

Walkington, C. (April, 2012). Context personalization in algebra: Supporting connections between relevant stories and symbolic representations. Paper presented at the 2012 Annual Meeting of the American Educational Research Association. Vancouver, Canada.

Walkington, C., & Maull, K. (2011). Exploring the assistance dilemma: The case of context personalization. In L. Carlson, C. Hölscher, & T. Shipley (Eds.), *Proceedings of the 33rd Annual Conference of the Cognitive Science Society* (pp. 90-95). Boston, MA: Cognitive Science Society.

Walkington, C., Sherman, M., & Petrosino, A. (2012). 'Playing the game' of story problems: Coordinating situation-based reasoning with algebraic representation. *Journal of Mathematical Behavior*, *31*(2), 174-195.

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