Estimating the Effect of Web-Based Homework on Student Learning in Middle School Math
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Abstract:
VanLehn’s recent meta-analysis suggests that the AI aspects of computer tutors are adding significant value beyond simple adaptive approaches. For example, the beneficial effects of human tutors and various computer-based interventions compared to regular classroom instruction have estimated values that range between 0.8 std and .31 std. At the upper end of effects are human tutors followed closely by computer tutors (0.74). At the lower end is simple computer-based practice with feedback systems (0.31 std). In this research we are concerned with estimating the effects of web-based homework (WBH) involving practice and feedback. An argument is made that this could serve as a more appropriate condition for comparing the benefits of additional AIED tutoring features. WBH gives students feedback on correctness only as they go. It does not offer hints, feedback messages on common wrong answers, or mastery learning in the problem selection algorithm (used in what VanLehn calls the outer loop). A second underappreciated aspect of WBH is that teachers can use the data to more efficiently review homework. Universities across the world are employing these WBH systems but there are no known comparisons of this in K12. In this work we randomly assigned 63 thirteen and fourteen year olds to either a traditional homework condition (TH) involving practice without feedback or a WBH condition that added correctness feedback and ability to try again. All students used ASSISTments to do their homework but we ablated all of the intelligent tutoring aspects of hints, feedback messages and mastery learning as appropriate to the two practice conditions. We found that students learned reliably more in the web-based homework condition and with a large effect size of 0.56. Given the small sample size and confidence interval for the effect, more studies are needed to better estimate the effect size of WBH. An argument is made that effects associated with the practice with feedback condition should serve as a more accurate baseline for comparing the benefits of additional AIED tutoring features. Future work will systematically compare conditions that add back in hints, feedback messages and mastery learning so that we can measure the value added by these components.