Blended Learning Research Brief No. 3 | Associations Between Teachers' Goals for Students' Math Software Use and Teachers' Perceptions of the Value of Software

Key Findings

- Teachers were more likely to report setting time-based goals for their students' use of math software (e.g., requiring students to use software for a certain number of minutes per week) than mastery-based goals (e.g., requiring students to demonstrate proficiency on a certain number of skills). However, there was considerable variability in goal-setting across teachers. Elementary school teachers were more likely to set time-based goals than secondary school teachers. Teachers who were novice users of math software were less likely to set mastery-based goals than teachers who were more experienced users.
- Teachers who routinely set mastery-based goals for their students' use of math software tended to view the software as more valuable than teachers who rarely or never set mastery-based goals. A similar relationship emerged for time-based goals, but the effect was weaker.

Background

Decades of research indicate that the goals students adopt for completing academic tasks can be important predictors of their school attitudes and performance. Students who adopt mastery goals – that is, goals to develop new skills and improve competence – have more positive achievement outcomes than students who adopt other types of goals, including goals to minimize effort (i.e., work-avoidance goals) or goals to avoid appearing incompetent (i.e., performance-avoidance goals) (Huang, 2016). One reason why mastery goals are so powerful is that students who adopt these goals tend to engage in more effective learning strategies, including viewing errors as a normal part of learning, seeking help when necessary, and persisting in the face of challenges (Disseth & Kobbeltvedt, 2010; Kaplan & Maehr, 1999; King & McInerney, 2014).

Teachers can play an important role in influencing students' achievement goal orientations, both generally (Shim, Cho, & Cassady, 2013) and in the context of specific academic tasks, including the use of learning software (Brizard, 2023). Teachers commonly adopt time-based goals for their students' software use. In part, this practice occurs because educators are following recommendations from software product providers, administrators, or program implementation personnel. For example, many learning software vendors recommend that students spend 30 minutes or more per week using their product.[i] Minutes of usage also remains a common proxy for student engagement in applied research focused on understanding whether educational technology is effective in improving student outcomes (e.g., Altermatt, Altermatt, Rorrer, & Moore, 2022; Cheung & Slavin, 2013). This focus on time may be problematic, however, as it fails to consider student learning needs (Altermatt, Rorrer, & Moore, 2022). For example, a student who spends 30 minutes per week "engaged" with the software and who masters few skills during that time may be fulfilling a "seat time" requirement but learning very little (An, Schonberg, & Bashkov, 2022). An alternative approach is for product providers and teachers to promote and set mastery-based goals wherein students are required to demonstrate proficiency on certain concepts, topics, or skills instead of, or in addition to, meeting time-based goals.

In Fall 2022, the Utah Education Policy Center (UEPC) partnered with the Utah State Board of Education (USBE) and Utah's STEM Action Center to contribute to the evidence base on best practices for creating "blended learning" environments that combine strong face-to-face instruction with effective use of new and emerging educational technologies. The UEPC is releasing its findings in a series of research briefs. The current brief focuses on two key research questions: 1. How likely are teachers in Utah to set time- and mastery-based goals for students using math learning software? 2. What is the relationship between teachers' goal setting and their perceptions of the value of math learning software?

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General Methods

In Spring 2023, 2,416 K-12 mathematics teachers in Utah completed a survey administered by the Utah Education Policy Center (UEPC) to assess teachers' general instructional strategies and use and perceptions of math learning software.[ii] The analytic sample for the current report includes the 1,379 teachers who consented to participate, indicated that they taught math, completed at least 20% of the survey using a personalized link, and reported using math learning software. This report focuses on two sets of survey items. First, respondents were asked to indicate the extent to which they "require students to spend a certain amount of time using math software" (a time-based goal) and the extent to which they "require students to demonstrate mastery of a certain number of concepts, topics, or skills when using math software" (a mastery-based goal). Teachers responded to both items on a four-point scale that ranged from 1 ("not at all") to 4 ("to a great extent"). Second, respondents were asked to respond to four items (e.g., "[Math software] helps my students improve their confidence in math.") tapping the degree to which they find value in the math learning software they are using in their classrooms. Teachers responded to all four items on a five-point scale that ranged from 1 ("strongly disagree") to 5 ("strongly agree"). Initial analyses indicated that the four items assessing teachers' perceptions of the value of math software formed a reliable scale (α = .85, mean = 3.81).

How likely are teachers in Utah to set time- and mastery-based goals for students using math learning software?

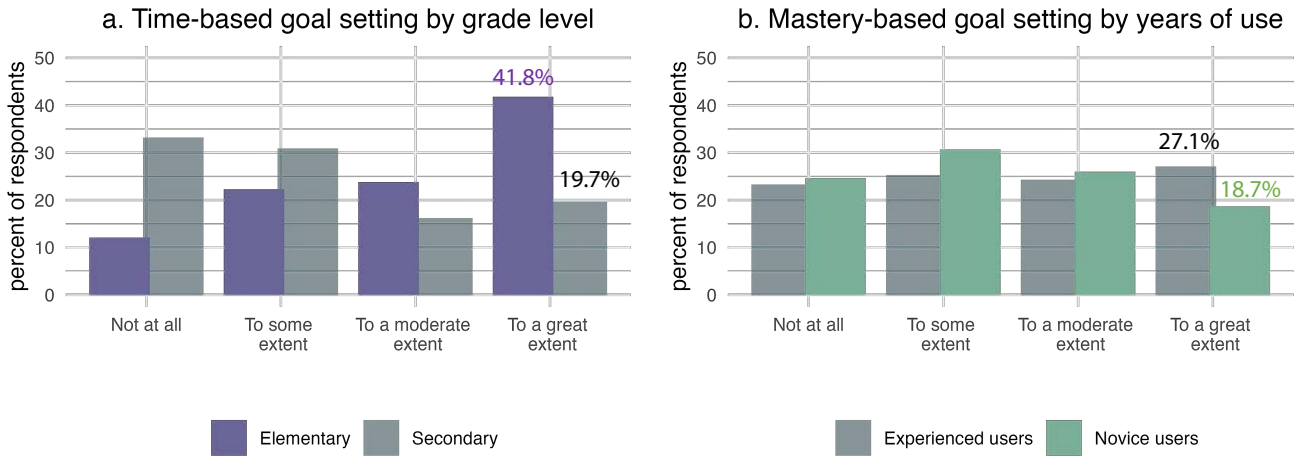
Analyses

Descriptive statistics were used to characterize the extent to which teachers set time-based and mastery-based goals for software use. Regression analyses were used to examine factors that predicted teachers' goal setting, controlling for potential confounding variables (e.g., # of years of teaching).

Findings

Overall, teachers were more likely to report setting time-based goals (mean = 2.81) than mastery-based goals (mean = 2.43). However, there was considerable variability across teachers in how much they reported setting these two types of goals. Two factors stood out in explaining some of this variability: grade level and number of years of math learning software use. As shown in Figure 1 (panel a), elementary school teachers were *more* likely to set time-based goals than secondary school teachers. Specifically, while 41.8% of elementary school teachers indicated that they set time-based goals "to a great extent," only 19.7% of secondary school teachers reported doing so. As shown in Figure 1 (panel b), novice software users (that is, teachers who had used their current math software for three years or less) were *less* likely to set mastery goals than more experienced software users (that is, teachers who had used their current math software for four years or more). While 27.1% of experienced teachers reported setting mastery-based goals "to a great extent," only 18.7% of novice users reported doing so.

Figure 1. Distribution of responses to items tapping time-based and mastery-based goal setting by group



What is the relationship between teachers' goal-setting and their perceptions of the value of math learning software?

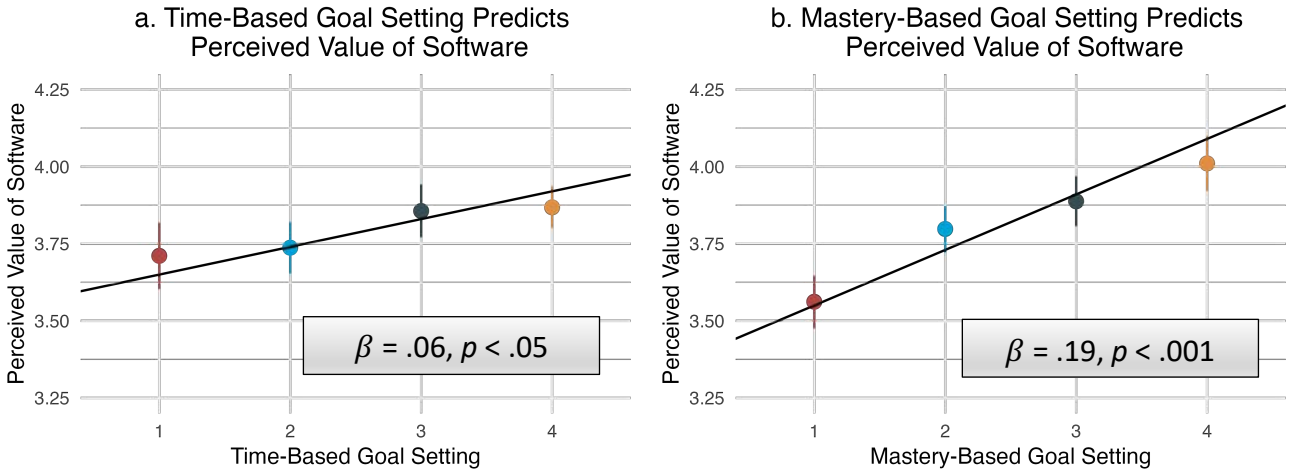
Analyses

Regression analyses were used to predict teachers' perceptions of the value of math software from their self-reported setting of time-based and mastery-based goals for their students' use of math learning software. Models controlled for potentially confounding variables, including grade level (elementary vs. secondary), teacher age, the number of years teachers taught math, the number of years teachers used math software, and the frequency with which teachers used math software in their classrooms. Analyses for time-based goal setting also controlled for mastery-based goal setting and vice versa. This allowed us to examine the independent effect of each type of goal, which was important given the weak, positive association between teachers' ratings of time-based and mastery-based goals ($r = .27$).

Findings

As shown in Figure 2, both time- and mastery-based goal-setting were positively related to teachers' perceptions of the value of math learning software. That is, as ratings for goal-setting increased from 1 ("not at all") to 4 ("to a great extent"), teachers' perceptions of the value of software also increased. However, the association was stronger for mastery-based goals ($\beta = .19$, $p < .001$) than for time-based goals ($\beta = .06$, $p < .05$), indicating that teachers were especially likely to perceive math software as valuable when they routinely required that students work toward demonstrating mastery of topics, skills, or concepts when working with math learning software.

Figure 2. Lines of best fit and estimated marginal means from regression analyses predicting teachers' ratings of the value of math software from teachers' self-reported use of time-based goals (panel a) and mastery-based goals (panel b)



Conclusions, Caveats, and Next Steps

The findings of the current study suggest that teachers vary widely in the degree to which they set time-based and mastery-based goals for software use. Elementary teachers were more likely than secondary teachers to set time-based goals and novice users were less likely than experienced users to set mastery-based goals. Differences in teachers' self-reported use of time-based and mastery-based goals are potentially important if teachers' goals for students' use of math software are associated with different outcomes for teachers and students. The analyses reported here indicate that both types of goal-setting are associated with stronger perceptions among teachers that math software has value. However, the association was stronger for mastery-based goals than time-based goals, suggesting that teachers who set mastery-based goals for their students are especially likely to view the software as valuable in building students' confidence and skills in math. This finding is consistent with a large research literature indicating that student outcomes are better when teachers create learning environments that foster mastery orientations (Ames & Archer, 1988; Patrick & Kaplan, 2022). The findings

are also consistent with the Utah State Board of Education's Personalized Competency-Based Learning Framework, which recommends that student progress be tied to evidence of mastery rather than seat-time (USBE, 2023)

The results of the current study provide promising evidence for promoting and setting mastery-based goals for students' use of math learning software. However, they should be interpreted with caution. Although we were able to control for several potentially confounding variables (e.g., grade level and number of years of software use) in regression models, we are not able to rule out the possibility that other variables might partially (or fully) explain the associations between goal-setting and perceptions of value. Likewise, we were not able to determine the directionality of the effect. It may be that mastery-based goal setting leads teachers to view math software as more valuable, or it could be that teachers who value math software are more likely to set mastery-based goals.

It is also important to note that mastery-based goal setting can take on various forms, some of which are more beneficial than others. Decades of research on Self-Determination Theory (Ryan & Deci, 2000), which highlights the importance of student control and choice, suggests that setting mastery-based goals for software use may lead to less student engagement with the software and to lower teacher perceptions of the value of software when teachers communicate – intentionally or not – that students have little personal choice in how they use math software or that math software has little relevance to regular classroom instruction or the development of strong math skills. Mastery-based goal setting is also likely to lead to poorer outcomes when it is accompanied by rewards, threats, or surveillance that students perceive as controlling (Benita, Roth, & Deci, 2013).

Beginning in Fall 2023, the UEPC will further analyze teacher survey data, student survey data, student achievement data, and student usage data to explore the degree to which teachers' self-reported implementation practices for math learning software are associated with positive student outcomes in mathematics. An important component of these future analyses will be examining associations between teachers' goals for students' use of learning software and students' level of proficiency on statewide, end-of-year math assessments.

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[i] https://stem.utah.gov/educators/funding/k-12-math-personalized-learning-software-grant/

[ii] A full report on survey results can be found on the Utah Education Policy Center website. An Appendix to the full report provides evidence that the sample of respondent is quite similar to the population of K-6 teachers and 7-12 grade math teachers in Utah who were invited to participate in the survey.