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Jl. of Interactive Learning Research (2009) **20***(4)*, 385-403

The Role of Goal Orientation and Self-Efficacy in Learning from Web-Based Worked Examples

KENT J. CRIPPEN AND KEVIN D. BIESINGER
University of Nevada Las Vegas, USA
kcrippen@unlv.nevada.edu
biesinge@unlv.nevada.edu

KRISTA R. MUIS
McGill University, Canada
krista.muis@mcgill.ca

MARYKAY ORGILL
University of Nevada Las Vegas, USA
marykay.orgill@unlv.edu

The goal of this study was to understand the roles of goal orientation and self-efficacy when learning from worked examples. A Web-based learning environment, used as a component of a traditional undergraduate chemistry course, served as the context for the study. Goal orientations were derived from Elliot and McGregor's (2001) achievement goals framework. Structural equation modeling was applied to measures of individual goal orientation, self-efficacy, use of online worked examples and achievement (N=176). Results indicate that a mastery-approach orientation was the strongest predictor of achievement, but worked example use and self-efficacy were not related to either of the mastery orientations. For the performance orientations, worked example use was established as an antecedent to self-efficacy and achievement. Results are discussed in terms of goal theory and its application to the design of instructional materials.

Understanding the relationship among achievement motivation, self-efficacy, and self-regulated learning as well as the effects of each on academic achievement have become increasingly salient lines of research. Prior research has empirically established goal orientation, self-efficacy, and self-

regulated learning strategies as important performance antecedents (Bandura, 1997; Harackiewicz, Barron, Tauer, & Elliot, 2002). Although each has been established independently, the relationship among these variables and how they might work in concert have not been fully explored. Little research has examined how achievement goals and self-efficacy might influence the use of worked examples as a learning strategy, and how these might interact to affect achievement.

The use of worked examples is a recognized technique for providing instruction in well-structured domains (Atkinson, Derry, Renkl, & Wortham, 2000). Worked example instruction is based on the empirically supported technique of pairing a worked example with practice problems (Sweller, van Merrienboer, & Paas, 1998). However, in a process known as the expertise reversal effect, worked examples have been found to interfere with learning as domain expertise increases (Kalyuga, Ayres, Chandler, & Sweller, 2003; Kalyuga, Chandler, Tuovinen, & Sweller, 2001). We address the issue of expertise reversal by offering worked examples as an option and describe their use as a self-regulated learning strategy.

Recently, the predominant use of self-report measures of strategy use has been challenged and may present barriers for establishing worked example use as an effective self-regulated learning strategy (Winne, 2006). More specifically, Winne and Perry (2000) demonstrated key technical and conceptual issues that limit the contribution of studies that use only self-report measures. To address these issues, Winne, Jamieson-Noel, and Muis (2001) suggested the use of trace data, which include records of actual events recorded simultaneously as learners study and solve problems. In an electronic environment, trace data of students' use of various types of learning strategies can be programmed as part of the instructional design (e.g., log files).

Accordingly, the goal of this study was to explore the relationship between goal orientation, self-efficacy, and use of worked examples, and how these variables might influence academic achievement. Moreover, we used trace data in an online learning environment to address issues related to the use of self-report measures. Based on theoretical and empirical work, we hypothesized the relationship among the various constructs and tested these using structural equation modeling. We argue that goal orientation affects the use of instructional materials and may change how interventions such as worked examples are perceived and ultimately used. Before we present our specific hypotheses, we first review relevant theoretical and empirical literature.

LEARNER CHARACTERISTICS

Social cognitive theory recognizes the reciprocal relationship between a learner, the learning environment, and the learner's behaviors (Bandura, 1986). A highly self-regulated learner uses their motivation to select, imple-

ment, and maintain strategies in pursuit of a learning goal. Learner characteristics include such constructs as attitude, beliefs, and skills. These attributes dictate the level of self-regulation and are strong indicators of future learning (Martin, 2004; Zimmerman, 2000).

From a cognitive load perspective, the design of materials can influence learning by interacting with self-regulatory processes (van Merrienboer & Sweller, 2005). However, empirical models for the relationship of these variables as a systemic process remain a challenge. This study produced a model by focusing on the motivational beliefs of achievement goal orientation and self-efficacy coupled with the strategy of using worked examples as antecedents to achievement. We review each of these theoretical frameworks in turn and empirical work that support them.

Achievement Goal Orientation

Achievement goal orientation is a "set of behavioral intentions that determine how students approach and engage in learning activities" (Meece, Blumenfeld, & Hoyle, 1988, p. 514). Although there is some evidence to the contrary, established individual goal orientations are thought to be consistent across a range of academic situations and learning tasks (Ames, 1992). Initially, several motivational theorists proposed an achievement goal orientation framework that included two types of achievement goals – a mastery goal orientation and a performance goal orientation (Anderman & Young, 1994; Dweck & Leggett, 1988; Meece, 1991). Those more inclined to adopt a mastery orientation view knowledge as malleable and deem continuously high levels of effort and more challenging tasks to be most beneficial for learning. In contrast, those with a performance orientation usually see ability as a fixed construct and, therefore, fail to see value in additional effort.

Recent research further defines the goal construct based upon the operating motivation, identified as *valence* (Elliot & McGregor, 2001; Finney, Pieper, & Barron, 2004; Pintrich, 2000b) (Table 1). Valence is conceptually dichotomous as either positive or negative. Approach behaviors have a positive valence and are those in which a student strives to achieve successful judgments from others or themselves. Conversely, avoidance behaviors have a negative valence and refer to intrinsic motivations that stem from the evasion of failure and appearing incompetent. Emanating from an interpersonal perspective, a performance-approach goal orientation is defined as striving to demonstrate aptitude and seek favorable judgments, whereas a performance-avoidance orientation tries to avoid failure (Elliot & Church, 1997). From an intrapersonal perspective, a mastery-avoidance goal orientation seeks to avoid failure as a demonstration of incompetence (Elliot & McGregor, 2001). Conceptually, the mastery component of the mastery-avoidance goal orientation emerges from optimal antecedents (e.g., motive dispositions, implicit theories, socialization histories) that may facilitate

positive consequences (like mastery-approach goals; see Elliot & McGregor, 2001, for a complete discussion). The avoidance component, however, is hypothesized to emerge from non-optimal antecedents and may result in negative consequences.

The relationship between achievement goals and learning are well documented. A recent meta-analysis by Payne, Youngcourt, and Beaubien (2007) of 197 independent samples from 157 studies found that learning as a dependant variable was positively related to a mastery goal orientation, not related to a performance-approach goal orientation, and negatively related to a performance-avoidance orientation. When academic performance was used as the outcome variable, the findings were consistent to that of learning, though no relationship existed for the performance-avoidance orientation. These findings are consistent with previous meta-analyses (Utman, 1997).

Self-Efficacy

Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). The influence of self-efficacy as a significant predictor of behavior is well supported in the literature (Kennett & Keefer, 2006). Similar to a mastery-approach goal orientation, individuals with higher self-efficacy typically view successful task completion as highly dependent upon effort and persistence and will often choose more challenging tasks due to their perceived benefits (Pajares, 1996). Individuals with a lower self-efficacy may view increased effort as an indicator of lower ability and be drawn to the simplest of tasks as a coping mechanism to avoid failure (Dweck, 1999).

Research that has examined the relationship between self-efficacy and achievement motivation has found a consistent positive pattern with a mastery goal orientation, but mixed results for performance-approach and avoidance goals (Phillips & Gully, 1997). For example, VandeWalle, Cron, and Slocum (2001) found a positive relationship between self-efficacy and mastery orientation, a negative relationship with a performance-avoidance orientation, but no relationship between a performance-approach orientation and self-efficacy. Moreover, self-efficacy mediated the relationship between goal

Table 1
Goal Orientation Definitions (Elliot & McGregor, 2001)

Valence	Definition	
	Absolute/intrapersonal (mastery)	Normative/interpersonal (performance)
Positive (approaching success)	Mastery approach goal	Performance approach goal
Negative (avoiding failure)	Mastery avoidance goal	Performance avoidance goal

orientation and performance. In contrast, Anderman and Young (1994) found a negative relationship between performance-approach goals and self-efficacy, whereas Wolters, Yu, and Pintrich (1996) found a positive relationship.

Theoretically, a positive relationship between a mastery goal orientation and self-efficacy can be hypothesized to result from a mastery-oriented individual's tendency to believe that ability is incremental (Button, Mathieu, & Zajac, 1996) and effort is a primary cause of success (Ames & Archer, 1998). In contrast, those with a performance-avoidance orientation believe ability is fixed and may doubt that past success will lead to future success for a particular task.

Self-Regulated Learning

Schunk (2001) defines self-regulated learning as "learning that results from students' self-generated thoughts and behaviors that are systematically oriented toward the attainment of their learning goals" (p. 125). Self-regulated learners manage their learning, engage in more meta-cognitive monitoring and control, are more intrinsically motivated (Zimmerman, 1990), are more strategic, and perform better than less self-regulated learners (Pressley & Ghatala, 1990). Research examining the relationship between self-regulation and achievement goal orientation has found that individuals with high mastery orientations are willing to devote more effort to monitor learning and seek diagnostic feedback (Butler, 1993; VandeWalle et al., 2001; VandeWalle & Cummings, 1997), report using more deep processing learning strategies (Wolters et al., 1996), and persist in the face of negative feedback (Dweck & Leggett, 1988; VandeWalle, Brown, Cron, & Slocum, 1999). Although some researchers have found positive relationships between self-regulation and goal orientation (Archer, 1994), others have found a negative relationship (Wolters et al., 1996) or no relationship at all (Ford, Smith, Weissbein, Gully, & Salas, 1998).

Self-regulation in an academic setting implies an interaction between the student and some form of instructional message (Winne, 2001). Lacking a rich, integrated theoretical model, instructional designers are left with minimal guidance for addressing learner characteristics. However, cognitive load theory acknowledges the limited capacity of working memory and provides a framework for structuring materials (van Merrienboer & Sweller, 2005). In recent years, research on self-regulation strategies to aid in the reduction of cognitive load has seen resurgence for instructional design considerations (Pawley, Ayres, Cooper, & Sweller, 2005; van Merrienboer, Kirschnet, & Kester, 2003), particularly within the context of multimedia learning applications (Mayer & Moreno, 2003).

Cognitive Load

Cognitive load theory (CLT) emphasizes the need for learning activities that minimize processing requirements due to the limited capacity of work-

ing memory (Baddeley, 1992). Sweller, van Merrienboer, and Paas (1998) established three forms of cognitive load: intrinsic, extraneous, and germane load. Intrinsic cognitive load refers to the number of task components that require the learner's concurrent attention. Extraneous cognitive load involves additional task demands, often created by the design of instruction, that do not contribute directly to learning. Finally, germane cognitive load involves task demands intended for the sake of learning.

A current trend is to translate extraneous cognitive load into germane cognitive load by having students study worked examples in lieu of, or parallel to, problem solving practice (Paas & van Merrienboer, 1994; Sweller, 1988; van Merrienboer et al., 2003). In e-learning contexts, integrated worked examples with a non-specific goal format are recommended (Marcus, Cooper, & Sweller, 1996; Pillay, 1994; Tarmizi & Sweller, 1988). We contend that during the learning process, goal orientation and self-efficacy drive the choice for selecting worked examples as a self-regulation strategy. Specifically, goal orientation dictates the intent for choosing to use examples as well as how they are processed while self-efficacy determines the degree of engagement. Empirical research supports this hypothesis.

For example, Steele-Johnson, Beauregard, Hoover, & Schmidt (2000) examined the relationship between cognitive load, strategy use, self-efficacy, affect, and performance on a complex task. Participants were assigned to learning environments with differing goal orientations. Results indicated that when tasks were assigned requiring the learner to use elaboration strategies (high germane cognitive load), participants from the mastery-approach group reported higher levels of self-efficacy. Conversely, when the task conditions were best suited to rehearsal strategies (low germane cognitive load), participants from the performance-approach group indicated higher levels of self-efficacy.

These results support the argument that mastery-oriented learners prefer more cognitively demanding tasks, which they view as an opportunity to increase their knowledge (Ford, Smith, Weissbein, Gully, & Salas, 1998), whereas performance-oriented learners prefer simpler tasks, allowing them to demonstrate success (Bar-Eli, Tenenbaum, Pie, Kudar, Weinberg, & Barak, 1997). The predictability of self-regulated strategy use following from these motivational beliefs and any potential interactions with design of the learning materials remains a debated issue. Positive relationships between mastery-approach orientation and self-regulated learning (Wolters et al., 1996) and negative relations to a performance-approach goal orientation (Ames, 1992; Dweck & Leggett, 1988) have been demonstrated, but positive relations with a performance-approach orientation have also been found (Wolters et al., 1996). The role of self-efficacy for mediating achievement motivation and performance also is unclear. Learners with a performance-approach orientation and high self-efficacy can perform similarly to those with a mastery-approach orientation (Dweck, 1986; Vlachopoulos &

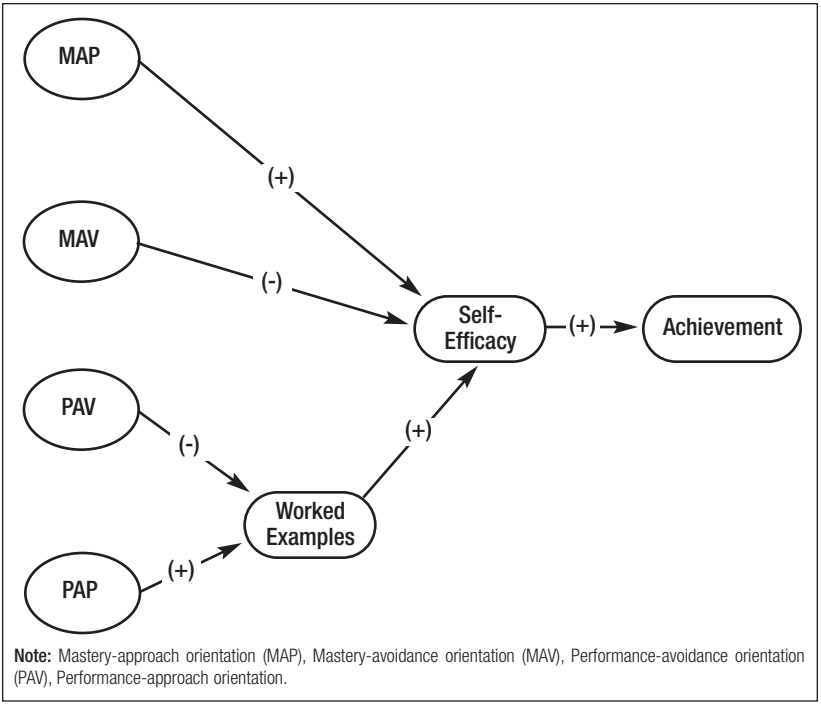
Biddle, 1997). Self-efficacy, therefore, may act as a buffer to the maladaptive possibilities of a performance-approach orientation.

Based on the theoretical frameworks and empirical studies we reviewed, we hypothesize that use of worked examples would not be related to mastery goals as these students would not perceive them as beneficial for learning. Instead, based on previous empirical work, we predict that a mastery-approach orientation will be positively related to self-efficacy, and that self-efficacy will mediate the positive relationship between a mastery-approach orientation and achievement. In contrast, a mastery-avoidance orientation should be negatively related to self-efficacy, and self-efficacy should mediate the negative relationship between a mastery-avoidance orientation and achievement. Consistent with the work of Wolters et al. (1996), we also predict that performance-approach goals will be positively related to the use of worked examples as an opportunity to perform better. Use of worked examples with performance-approach goals should increase self-efficacy and mediate a positive relationship to achievement, though to a lesser extent than mastery-approach goals. Moreover, given the negative relations found in the literature between a performance-avoidance orientation and learning strategies, we predict that performance-avoidance goals will be negatively related to the use of worked examples and, consequently, to self-efficacy. Finally, we hypothesize that worked examples would mediate relations between performance goals and self-efficacy and, subsequently, achievement. We present the hypothesized model in Figure 1.

THE CURRENT STUDY

The current study considers goal orientation as a continuous trait variable and uses structural equation modeling to identify relationships among goal orientation, worked example use, self-efficacy, and achievement. Consistent with the suggestions of Winne et al. (2001), worked example use as a self-regulated learning strategy was captured as trace data in the form of Web server logs of student activity. This design afforded a more naturalistic view of individual goal orientation as an emergent personal belief and allowed for isolation of its impact within a controlled learning environment.

This study is part of a larger project focused on the development of a Web-based learning environment for well-structured problem solving in the domain of chemistry. Our efforts involve a design theory approach to creating a learning tool that supports the development of fundamental strategies for improving well-structured problem solving. Well-structured problem solving involves formulating and applying one clear methodology that produces a known solution. Learning declarative and procedural knowledge in context through instruction and practice develops expertise (Ericsson, 1996). As such, worked examples with an accompanying self-explanation prompt



Note: Mastery-approach orientation (MAP), Mastery-avoidance orientation (MAV), Performance-avoidance orientation (PAV), Performance-approach orientation.

Figure 1. Hypothesized structural equation model.

are embedded within weekly quiz items for students to use of their own volition. Because worked examples are offered to students as an option, we define use of worked examples as an explicit self-regulated learning strategy.

The design of our system is detailed elsewhere (Crippen & Earl, 2004) but the basic design functioned as follows. Students had access to a Web-based, multiple-choice content quiz for one week. During this period, they may have modified their responses at any time as their skills and understanding of the material changed. At the end of the week, the quizzes were graded and correct answers were provided. Students who did not achieve at least 80% were offered a re-take. The re-take was identical in form and function, but included unique, yet conceptually similar, items. The item stems on the re-take quizzes were different, but the worked examples accompanying each item remained the same.

The items that required well-structured problem solving included three embedded worked examples in the form of buttons following the item stem. When a student clicked an example button, a new window opened presenting the worked example and additional information in the form of a self-explanation prompt. Like the content of the worked examples, the self-explanation

prompt for each example was unique. Quiz items were written and assigned based upon content, level of difficulty, and problem characteristics. Quiz content was matched with the weekly lecture topics and worked examples were built in support of techniques taught in lecture and described in the textbook.

Within the context of our Web-based learning system, previous research has shown that students make extensive use of the worked examples and self-report that these strategies are helpful for improving both their learning and performance (Crippen & Earl, 2004). Further, we have shown that the combination of a worked example with a self-explanation prompt positively impacts performance and self-efficacy (Crippen & Earl, 2007). This study sought to understand the roles of goal orientation and self-efficacy for learning from worked examples to influence achievement.

Structural equation modeling was applied to measures of individual goal orientation, self-efficacy, use of online worked examples, and achievement to address the following research questions:

- What is the relationship between achievement goal orientations and use of worked examples?
- How do goal orientation and self-efficacy interact with worked examples to positively affect achievement?
- What role does self-efficacy play in mediating strategy use for performance goals in promoting achievement?

METHODOLOGY

Participants

A sample of 176 undergraduate students from a large urban southwestern university consented to the current study. Participants were enrolled in a first semester introductory inorganic chemistry course for science majors.

Measures

The Achievement Goals Questionnaire (AGQ)

The Achievement Goals Questionnaire (AGQ) was developed over the course of several years and numerous experiments to assess individual goal orientation on four different, though not mutually exclusive, factors (Elliot, 1999; Elliot & Church, 1997; Elliot & McGregor, 2001). Sample items for this scale included: "It is important for me to do better than other students" (performance-approach orientation), "My goal in this class is to avoid performing poorly" (performance-avoidance orientation), "I want to learn as much as possible from this class" (mastery-approach orientation), "I am often concerned that I may not learn all that there is to learn in this class" (mastery-avoidance orientation). The instrument is a 12-item survey with three items grouped for each of four achievement goal factors. Responses were given on a 7-point Likert-type scale

(1 = *not at all true of me* to 7 = *very true of me*). Cronbach's alphas for the subscales were: mastery-approach (.88), mastery-avoidance (.83), performance-approach (.92), and performance-avoidance (.82). The target population for the instrument is potentially all learners from elementary school through adult, but current practices typically focus on undergraduate students.

Self-Efficacy for Chemistry Content

A 34-item author constructed instrument was used to measure self-efficacy. The instrument prompted students to rate their confidence in their ability to successfully complete tasks pertaining to the chemistry content of the worked examples. Sample items for this scale included: "Converting between number of molecules, the mass of a sample, and the number of moles of a sample," "Applying the ideal gas law to solve for an unknown pressure, volume, temperature, or amount of a known gas sample," and "Determine the percent yield of a reaction." Responses were given on a 6-point Likert-type scale (1 = *not confident* to 6 = *totally confident*). The reliability for this scale was .98.

Worked Example Use

Worked example use was defined as a self-regulated learning strategy measure and represents the cumulative number of times that a participant elected to view a worked example. Participants accessed the worked examples through the Web and a record of use was compiled on the server.

Achievement

Achievement was measured using the overall course raw score. This measure was computed as a non-weighted compilation of grades from three exams, a final exam, a cumulative online quiz score, laboratory work, and a cumulative in-class quiz score.

Procedure

The worked examples were progressively accessible with each weekly quiz and were available continuously once revealed. All survey instruments were administered electronically via the Web-based learning system. The raw data for the survey results, online quiz scores, and worked example use was stored on the Web server until the end of the semester when it was harvested for analysis. The overall final course score was computed at the end of the semester following completion of all course requirements.

RESULTS

Descriptive statistics for each of the measures were computed (Table 2), followed by a check of normality for each of the scales. Kline (1998) suggested using absolute cut-off values of 3.0 for skewness and 8.0 for kurto-

Table 2
Descriptive Statistics for Self-efficacy, Achievement Goal Orientation, Worked Example Usage, and Final Grade

Measure	Mean	SD
Self-efficacy	70.44	13.47
Mastery-approach	17.45	3.64
Mastery-avoidance	12.43	4.52
Performance-approach	13.78	5.24
Performance-avoidance	15.18	4.42
Worked example usage	69.36	55.96
Final grade (percentage)	72.24	18.96

Note: N = 176 for all but final grade (N = 175) and self-efficacy (N = 80). Self-efficacy scale min=0, max=204; Goal orientations subscales min= 0, max=21; Worked example usage min=0, max=300; Final grade (percentage) min=0, max=100.

sis. All items were well within these ranges (ranging from -1.14 to 1.58 for skewness and from -.70 to 3.07 for kurtosis). We then used EQS (Bentler & Wu, 1995) to calculate parameter estimates in a structural equation model testing our hypotheses about relations among goal orientation, use of worked examples, self-efficacy, and achievement. Correlations between constructs based on averaged scores are presented in Table 3. For our model, we included each of the two performance dimensions of goal orientation as an antecedent to worked example use, and then included self-efficacy, fol-

Table 3
Correlations among the Variables

	1	2	3	4	5	6
1. Self Efficacy	--					
2. Worked Example Use	.202	--				
3. Achievement	.173	.161*	--			
4. Mastery Approach	.023	-.033	.205**	--		
5. Mastery Avoidance	-.128	.100	-.205**	.124	--	
6. Perform Approach	.069	.188*	.282**	.162*	-.013	--
7. Perform Avoidance	-.010	.180*	.040	.232**	.466**	.359**

**p< 0.01 (2-tailed), *p< 0.05 (2-tailed)

lowed by achievement. For both mastery orientations, we included self-efficacy as a mediator between these orientations and achievement.

The hypothesized model displayed in Figure 1 is simplified in two ways relative to the described general model. First, for graphical simplicity, we show only the factors estimated and omit their respective indicator variables. For all analyses, however, indicator variables were used as measures of the factors in the model as is required in structural equation modeling. For example, for mastery-approach goal orientation, the three scale items on the AGQ (Elliot & McGregor, 2001) that measure a mastery-approach goal represent that latent variable. The same process was used for all latent variables. Since worked example use, self-efficacy, and performance are direct measures, however, no underlying variables were used.

We tested the model characterized by Figure 1 according to the framework outlined by Baron and Kenny (1986). Beyond testing the relationships between the predictor and mediating variables, two additional structural equation models were necessary. First, predictor variables needed to be related to the criterion variables. That is, mediator variables were removed from the model. Second, the effect of the predictor variables on the criterion variables was significantly reduced or eliminated when considered jointly with the mediator variables. Thus, both paths from the predictor variables to the mediator variables and predictor variables to the criterion variables were included in the model. Based on these criteria, no mediation paths were supported for our model.

Estimation of the hypothesized model resulted in a moderate fit, χ^2 (77) = 160.31, $p < .01$, and CFI = .87. Our general hypothesized model was not supported; some of the predicted paths were not statistically detectable. Accordingly, as Byrne (1998) suggests, when a model does not result in a good fit, one should continue to fit the model using theoretical considerations. Following this guideline, we present the final model in Figure 2. For simplicity, only statistically detectable paths with standardized coefficients are shown (all $ps < .05$). The final model resulted in a good fit, χ^2 (77) = 137.15, $p < .01$, and CFI = .91. As hypothesized, performance-approach orientation was positively related to use of worked examples, .20. Surprising, performance-avoidance orientation was also positively related to use of worked examples, .32. Also as predicted, use of worked examples was positively related to self-efficacy, .23, but self-efficacy was not related to achievement as we initially predicted. Rather, use of worked examples was positively related to achievement, .34. Finally, as predicted, mastery-approach orientation was positively related to achievement, .42, whereas mastery-avoidance was negatively related to achievement, -.32, but neither was related to self-efficacy.

To summarize, the higher students' performance orientation (whether approach or avoidance) the more likely they were to use worked examples, which positively influenced their self-efficacy and achievement. In contrast,

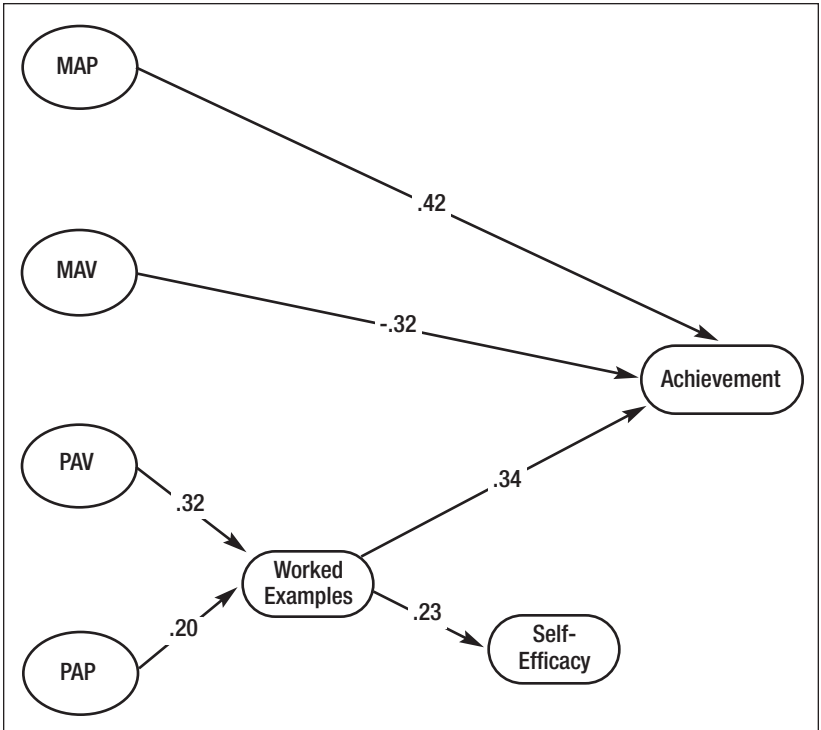


Figure 2. Final Structural Equation Model.

neither of the mastery orientations was related to use of worked examples or self-efficacy. Rather, the higher students' mastery-approach orientation, the higher their achievement, whereas the higher students' mastery-avoidance orientation, the lower their achievement. The following section provides a discussion of these results in the context of various theoretical frameworks.

DISCUSSION

The purpose of this study was to understand the roles of goal orientation and self-efficacy for learning from worked examples to influence academic achievement. In support of our predictions and consistent with the work of Wolters et al. (1996), a mastery-approach orientation was the strongest predictor of achievement and a mastery-avoidance orientation was negatively related to achievement. Contrary to our predictions, self-efficacy was not

related to either of the mastery orientations or to achievement. For the performance orientations, both avoidance and approach were positively related to use of worked examples, and use of worked examples was subsequently positively related to self-efficacy and achievement. These results suggest that the availability of worked examples as an instructional design consideration affords students with a performance orientation a strategy for improving achievement and increasing self-efficacy.

The use of worked examples as a strategy by both performance orientations but not by the mastery orientations supports the notion that students with a performance orientation prefer simpler tasks allowing them to demonstrate success (Bar-Eli et al., 1997). While motivated to achieve, mastery-approach students may not have perceived the worked examples as fruitful for developing the necessary depth of understanding for achievement.

Results from our study also indicate that for the performance orientations, using worked examples enhances self-efficacy. However, increases in self-efficacy were not related to increases in achievement. This finding is consistent with previous work where students demonstrated greater levels of self-efficacy when the cognitive load requirements of the task resembled their goal orientation condition (Steele-Johnson et al., 2000). In this case, the performance-oriented students likely perceived the reduced cognitive load of the worked examples as advantageous and made use of them to develop confidence.

The positive relationship of the performance-avoidance orientation with worked example use was unpredicted and requires theoretical interpretation. We hypothesize that although performance avoidance individuals do not value strategy use (Elliot & Church, 1997), in this case the worked examples may not have been perceived as a learning strategy but rather as an outlet to help reduce the anxiety associated with a feeling of a potential looming failure. Rather than adopt a learned helplessness position, these individuals may take advantage of a strategy that appears to be easy to implement and may even serve as a crutch. That is, rather than adopting a helpless strategy, such as effort withdrawal, the use of worked examples may have been a result of performance-oriented individuals attempt at strategy preservation (Robins & Pals, 2002). As such, the use of the worked examples translated into increased self-efficacy. However, due to the likely use of rehearsal strategies in processing the worked examples, this increase in self-efficacy was not positively related to performance.

Results from our study also shed light on the debate between the normative goals perspective versus the multiple goals perspective. Due to the interaction of learner characteristics and context, multiple goal theory recognizes that different goal orientations may be supportive of learning (Linnenbrink, 2005; Linnenbrink & Pintrich, 2001). This position is counter to the traditional normative goal perspective that only recognizes adaptive outcomes for a mastery orientation (Pintrich, 2000a). In this study, both performance

orientations were positively related to strategy use and increased self-efficacy. This outcome would not have been predicted by a normative goal perspective and lends credence to a multiple goals interpretation. In the context of this study, a performance orientation was adaptive.

Finally, contrary to our hypotheses, self-efficacy was not supported as a mediating variable between strategy use and performance for any of the orientations. Theoretically, the role of self-efficacy for mediating motivation and performance remains unclear. In this case, self-efficacy appears to be a by-product of the match between the nature of the worked example-based learning environment and the attraction of performance-oriented learners to rehearsal strategies (i.e., use of worked examples). Mediated by goal orientation, perception of the strategy predicts strategy use instead of efficacy, implying that instructional design can be used to leverage learner characteristics to produce engagement with scaffolds. This engagement could potentially create a positive cascade effect on self-efficacy. In effect, engagement with the learning strategy may reside more under the control of the instructional designer than the student.

In conclusion, learner characteristics like achievement goal orientation can be a strong predictor of students' use of instructional materials. Instructional design considerations that translate extraneous cognitive load into germane load may fundamentally change how those materials are perceived and ultimately used. Mastery-oriented students may not engage with worked examples unless they perceive them as fruitful for developing deep understanding. While performance-oriented students will likely use the worked examples, the content of the examples needs to encourage more sophisticated processing like the use of elaboration strategies. In essence, worked examples need to be designed such that all learners perceive them as useful, engage with the content presented, develop meaningful learning, and build confidence for applying their new knowledge.

A challenge related to the design of future Web-based learning systems involves engineering worked examples such that mastery-oriented learners will view them as fruitful strategies in service of content mastery. Atkinson and Renkl (2007) have recently described three design considerations intended to minimize passive processing of worked examples that may aid in engaging mastery-oriented students. They include: (a) provide faded examples that include missing solution steps (gaps) that must be completed, (b) include self-explanation prompts that must be answered, and (c) provide on-demand help for worked examples in the form of instructional explanations. Grobe and Renkl (2007) have also reported an error fixing strategy for worked example-based instruction that has potential as an adaptation for addressing this issue. An initial measure of goal orientation could be used to determine whether, or to what degree these adaptations are provided to students.

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