

Achievement Goals, Observed Behaviors, and Performance: Testing a Mediation Model in a College Classroom

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Abstract

Achievement goals have been examined extensively in relationship to self-reported learning behaviors and achievement, yet very little work has observed the behaviors through which achievement goals might influence learning and performance. We collected fine-grained behavioral data to assess students' activities throughout the semester in a college psychology course, and then used one learning behavior, access to course outlines, to explain the relationship between self-reported achievement goals and grades. Results suggest that downloading course outlines partially mediates the relationship between goals and grades. Identifying how goals influence achievement through observable behaviors contributes to the theoretical understanding of achievement goals while also suggesting practical implications for instructors.

Keywords: achievement goals; instruction; learning; motivation; performance

Introduction

Past work examining students' achievement goals has produced robust theories regarding the ways goals influence students' motivations, feelings, behaviors, and achievement outcomes (Dweck, 1986; Ames & Archer, 1988; Elliot & McGregor, 2001; Harackiewicz, Barron, Tauer, & Elliot, 2002). The vast majority of work testing these theories had relied on self-reported data to capture potential correlates and mediators for the relationship between goals and performance outcomes.

While many self-reported measures of strategies and behaviors have been shown to be reliable (Elliot, McGregor, & Gable, 1999; Elliot & McGregor, 2001), there are problems with relying exclusively on self-reported data to explain how achievement goals influence achievement (Fulmer & Frijters, 2009). Critically, students tend to have difficulty thinking about or assessing their own cognitions and strategies, suggesting their self-reports may not accurately reflect their behaviors (Metcalf, Eich, & Castel, 2010). We propose that an important next step for achievement goal theory is to explore the use of behavioral data to better understand how goals impact performance outcomes.

Achievement goals

We base our current work on Elliot and colleagues' 2 x 2 achievement goal framework, which proposes four distinct goals based on two dimensions: definition (mastery or performance) and valence (approach and avoidance) (Elliot & McGregor, 2001; Elliot & Murayama, 2008). Mastery goals are defined by an absolute or intrapersonal standard, meaning achievement is compared against the standard of what it is possible to learn or what the learner knows. Performance goals are defined by a normative standard, meaning achievement is compared against what others learn or demonstrate. Approach goals focus on attaining positive outcomes while avoidance goals focus on evading negative outcomes. Past research has investigated the relationships between the four resulting goals (see Table 1 for examples) and a variety of performance outcomes as well as self-reported behaviors and attitudes, which we discuss in greater detail below.

Achievement goals and achievement outcomes Many studies have related achievement goals to achievement outcomes in laboratory and classroom settings, using measures such as grades and test performance (e.g., Belenky & Nokes-Malach, 2012; Harackiewicz et al., 2002). Some consistent patterns between achievement goals and outcomes have emerged from these studies, although there are also a large number of inconsistencies that likely stem from differences in how goals are framed (Hulleman, Schrager, Boddman, & Harackiewicz, 2010).

At a broad level, mastery-avoidance and performance-avoidance goals are most often negatively associated with achievement or not correlated with achievement at all (Hulleman et al., 2010; Linnenbrink-Garcia, Tyson, & Patall, 2008; but see Richey & Nokes-Malach, 2013, for an example of mastery-avoidance goals positively predicting achievement). On the other hand, mastery-approach and performance-approach goals are most frequently associated with positive outcomes or not associated with outcomes at all (Hulleman et al., 2010; Linnenbrink-Garcia, Tyson, & Patall, 2008). In a review of approximately 90 studies, Linnenbrink-Garcia, Tyson, and Patall (2008) found that mastery-approach and performance-approach goals were positively associated

with performance in 40 percent of all studies, negatively associated with performance in about 5 percent of studies, and not associated with performance in the rest.

While achievement goals are frequently found to predict achievement outcomes, this relationship is not generally hypothesized to be a direct one. In other words, simply having a mastery-approach goal should not directly improve one's test performance; rather, it is hypothesized that having a mastery-approach goal changes the way learners feel about a task and the behaviors they engage in during learning (Elliot, McGregor, & Gable, 1999). This, in turn, should affect performance. To understand the link between goals and performance outcomes, researchers must examine the behaviors hypothesized to mediate the relationship. Past work has taken two main approaches: assessing self-reported attitudes and behaviors, and much less frequently, measuring observed behaviors.

Achievement goals and self-reported behaviors To better understand how achievement goals might influence performance outcomes, many researchers have examined self-reported learning strategies and behaviors (Ames & Archer, 1988; Elliot, McGregor, & Gable, 1999; Middleton & Midgley, 1997). Mastery-approach goals have been positively associated with productive behaviors including deep processing, effort, persistence, task absorption, instrumental help-seeking, and even the percentage of hours students reported studying the weekend before an exam, while they have been negatively associated with self-reported behaviors like procrastination and studying the day of an exam (Elliot, McGregor, & Gable, 1999; Howell & Watson, 2007; McGregor & Elliot, 2002; Roussel, Elliot, & Feltman, 2011). Performance-avoidance goals have been positively associated with unproductive behaviors like surface processing and disorganization, and negatively associated with productive behaviors like deep processing, task absorption, and help-seeking (Elliot, McGregor, & Gable, 1999; McGregor & Elliot, 2002; Roussel, Elliot, & Feltman, 2011).

Mastery-avoidance and performance-approach goals have produced less clear-cut patterns. Mastery-avoidance goals have been positively associated with some productive self-reported behaviors, such as help-seeking, but also less productive behaviors like procrastination (Howell & Watson, 2007; Roussel, Elliot, & Feltman, 2011). Similarly, performance-approach goals have been positively associated with productive behaviors such as effort, persistence, and studying in advance, but also less productive behaviors like surface processing (Elliot, McGregor, & Gable, 1999; McGregor & Elliot, 2002).

Given the consistently positive behaviors associated with mastery-approach goals, one would expect them to predict positive achievement outcomes more consistently than they do. One possible explanation is that the behaviors students report engaging in are idealized (or

otherwise inaccurate) reflections of their actual behaviors. These errors in self-reporting could explain why achievement outcomes frequently fail to meet expectations based on self-reported behaviors associated with mastery-approach goals. Critically, all of the findings discussed in this section rely *exclusively* on self-reported behaviors. We now turn to work that has examined how achievement goals relate to observed behaviors.

Achievement goals and observed behaviors While the reliability of many of the measures used to capture self-reported strategies and behaviors have been well documented, there are also a number of problems with relying exclusively on self-reported data to explain how goals influence outcomes (Fulmer & Frijters, 2009). For example, students tend to demonstrate poor metacognitive awareness, suggesting they have difficulty thinking about or assessing their own cognitions (Metcalf, Teal, & Alan, 2010). Past work has shown that self-report data collected through surveys and interviews often are not consistent with observed behaviors (Elliott, 2004).

To better understand the processes that could explain how goals influence outcomes, these relationships must be validated with observed behaviors. A smaller number of studies have examined achievement goals in relation to behavioral outcomes other than performance, including subsequent course choices (Harackiewicz et al., 2002), diversity of course selection (Durik, Lovejoy, & Johnson, 2009), verbalizations during the task (Elliott & Dweck, 1988), academic cheating in a laboratory setting (Niiya, Ballantyne, North, & Crocker, 2008), pro-social and antisocial behaviors (Sage & Kavussanu, 2007), careless behaviors (Hershkovitz, Wuxon, Baker, Gobert, & Sao Pedro, 2011), and collaborative behaviors (Harris, Yuill, & Luckin, 2008). These studies provide a critical step toward understanding the direct behavioral effects of different achievement goals, but most do not relate behaviors to achievement or test whether behaviors mediate the relationship between achievement goals and achievement outcomes.

We know of only a handful of studies that have attempted to explain the relationship between goals and achievement outcomes using observed behaviors (e.g., Schoor & Bannert, 2011; Sins, van Joolingen, Savelsbergh, & van Hout-Wolters, 2008). Sins et al. (2008) used chat files of student dyads performing a computer-based modeling task to assess frequencies of deep processing (e.g., analyzing with a reference to knowledge) and surface processing (e.g., analyzing without a reference to knowledge), and then related those behaviors to self-reported mastery-approach and performance-avoidance goals. They found that dyads' deep processing behaviors mediated the relationship between mastery-approach goals and achievement on the task. Critically, they also found little consistency between log files of students' behaviors and their self-reported

behaviors, further calling into question the validity of self-reported behaviors.

The Present Study

To examine whether students' observed behaviors could explain the relationship between goals and achievement outcomes, we analyzed fine-grained behavioral data collected through online learning software for a college psychology lecture course. Specifically, we recorded the frequency with which students downloaded lecture outlines before each class. We chose this behavior because outline use was not a direct component of students' final grades, meaning a correlation between outline access and grades would not simply be a product of the way grades were calculated. Outlines were a prominent tool for studying, and because a new outline was posted for each lecture, they served as a measure of behavior across the entire semester.

We hypothesized that students would view outlines as a tool for pursuing achievement goals, either as a way to gain better understanding of the material or to perform well on the exam. Given that outline use was optional and did not directly affect grades, we tentatively predicted that students would more strongly view outlines as a tool for mastering course material, and that outline access would be predicted by students' mastery-approach goals.

Although performance-approach goals are frequently associated with grades, the instructor of the course in the current study was particularly focused on students' conceptual understanding of materials. Since deep processing facilitates conceptual understanding (Koedinger, Corbett, & Perfetti, 2012) and only mastery-approach goals have been positively associated with self-reported deep processing, we hypothesized that mastery-approach goals would predict final grades as much as or more than performance-approach goals (Senko, Hulleman, & Harackiewicz, 2011). We also predicted that students' outline access would positively predict final grades, and that outline access would mediate the relationship between goals and grades.

Methods

Participants

Data were collected from 191 college students (137 women, 54 men) enrolled in a cognitive psychology course at an urban, public university. The course, which was required for all psychology majors and had one

prerequisite, consisted primarily of upperclassmen (3 freshmen, 43 sophomores, 88 juniors, 57 seniors) and had slightly more psychology majors (106 students) than non-majors (85 students). Students completed all activities as part of the course.

Materials

Our measures of goals, behaviors, and outcomes came from three sources, respectively: questionnaires measuring self-reported achievement goals; Blackboard, an online learning management system through which students accessed all materials for the course; and final grades. We discuss the details of each measure below.

Achievement goals questionnaire Achievement goals were measured using Elliot and Murayama's (2008) Achievement Goals Questionnaire-Revised (AGQ-R), which consists of 12 items to which students respond on a 7-point Likert scale. Three items target each of the four constructs of mastery approach, mastery avoidance, performance approach, and performance avoidance (see Table 1 for examples). All four subscales were found to be reliable (mastery approach, $\alpha = .92$, mastery avoidance, $\alpha = .88$, performance approach, $\alpha = .95$, and performance avoidance, $\alpha = .94$).

Outline access Students' access of lecture outlines was tracked through Blackboard. Outlines contained main ideas for each lecture, with blanks for students to fill in during class. The instructor emphasized that outlines were an optional resource that could provide scaffolding for taking notes during lectures; however, students' outline access had no direct impact on grades. Students were given outlines on the first day of class to introduce them to the resource, but after the first day they could only access outlines through Blackboard. A total of 24 outlines were posted throughout the course, and each student was assigned a score that ranged from zero to 24 based on the number of outlines accessed.

Course grades Final grades were based on performance on three non-cumulative exams (20 percent each), two short papers (10 percent each), and activity points awarded for daily attendance and several homework assignments throughout the semester (20 percent). Each exam consisted of 33 multiple-choice questions, with the majority of questions targeting conceptual knowledge (i.e., requiring students to understand a theory, concept, or

Table 1: Example survey questions from the AGQ-R

Definition	Approach	Avoidance
Mastery	My goal is to learn as much as possible.	My aim is to avoid learning less than I possibly could.
Performance	My goal is to perform better than other students.	My goal is to avoid performing poorly compared to others.

phenomenon) and applied knowledge (i.e., requiring students to use knowledge of concepts or theories to reason about a novel scenario). To assess prior knowledge a 20-question pretest was administered on the second day of class. Eight questions focused on knowledge of research methods while 12 questions focused on cognitive psychology content and were similar in design to exam questions, with four questions targeting content from each of the three exams. Students completed the pretest in class for activity credit and were not given feedback on their scores.

Procedure

Data were collected over the course of 24 lectures during the fall semester. The three non-cumulative exams were spaced evenly throughout the course. The achievement goal questionnaires were administered immediately before each exam as a part of a larger motivation and study strategy survey. Each time, the surveys were posted to Blackboard. Students were told to print them, complete them at home after they had finished studying, and turn them in immediately before the exam. Students received extra credit for completing the surveys. For each exam, roughly 90 percent of students turned in a questionnaire. The goals used in all analyses were averaged across the three time points, reflecting students' average level of endorsement of each goal across the course of the semester. Forty-two students were missing one of the three questionnaires; to avoid losing a large portion of students who could potentially have different goals and behaviors from those who turned in all three surveys, we included the 42 students by averaging across the two goal surveys they completed¹. An additional 11 students were excluded for missing at least two of the three surveys. Outlines were generally posted two to three days before class, and we examined outline access data from the time each outline was posted through the day of the relevant lecture.

Results

Analyses focused on the predictive value of students' responses on the AGQ-R for outline access behaviors during the semester as well as final grades. We then tested a mediation model to see whether behaviors explained a significant part of the relationship between self-reported goals and performance outcomes.

Goals, pretest, and final grades

We examined whether students' achievement goals predicted their final grades. To determine whether pretest should be included in our models predicting outcomes with goals, we first assessed whether pretest scores were related to final grades. Analyses also showed that pretest

performance was strongly correlated with final grade, $r(182) = .23, p < .01$. We therefore include pretest scores in all models to control for the effect of prior knowledge on grades.

A multivariate regression analysis predicting final grades with students' average AGQ-R ratings and holding pretest scores constant explained 8.2% of the variance as indexed by the adjusted R^2 statistic, $F(5,162) = 3.99, p < .01$. Within the model, mastery approach and pretest score positively predicted final grades (Table 2).

Table 2: AGQ-R ratings predicting final grades

Achievement goal	<i>B</i>	<i>SE B</i>	β
Mastery approach	1.55	.67	.26*
Mastery avoidance	-.81	.66	-.14
Performance approach	.68	.83	.15
Performance avoidance	-.34	.82	-.10
Pretest score	9.46	3.75	.19*

* $p < .05$

Goals and outline access

We then examined whether students' achievement goals predicted their study behaviors, measured by the frequency with which they accessed lecture outlines through the day of the relevant lecture. Students accessed a mean of 15.14 outlines ($SD = 8.44$) out of the 24 posted, and access ranged from zero to 24. A multivariate regression analysis predicting the number of outlines students accessed with their average AGQ-R ratings and controlling for pretest explained 7.6% of the variance as indexed by the adjusted R^2 statistic, $F(5,162) = 3.76, p < .01$. Within the model, mastery approach was a significant, positive predictor of outline access (Table 3).

Table 3: AGQ-R ratings predicting outline access

Achievement goal	<i>B</i>	<i>SE B</i>	β
Mastery approach	2.75	.88	.36*
Mastery avoidance	-1.16	.86	-.15
Performance approach	.19	1.10	.03
Performance avoidance	.71	1.09	.12
Pretest score	-6.74	4.94	-.10

* $p < .05$

Testing the mediation model

Since models using achievement goals to predict outline access and final grades were significant, we tested a mediation model to see whether introducing outline access into the model of goals predicting grades significantly decreased the predictive value of goals. We focus our results on mastery approach, as this was the only achievement goal to predict both grades and outline access, but we continued to include all four goals and pretest scores in our model.

¹ Analyses of only the 140 students who completed all three surveys produced the same general findings and mediation model reported here.

The addition of outline access frequency resulted in a final model that explained 15.9% of the variance as indexed by the adjusted R^2 statistic, $F(6,161) = 6.26$, $p < .01$, and it accounted for significantly more variance than the model using only goals and pretest, $F(1,161) = 15.77$, $p < .01$. In this model the predictive value of pretest score remained significant, $\beta = .22$, $p < .01$, and outline access was significant, $\beta = .30$, $p < .01$. The mastery-approach goal effect was reduced in size and no longer significant, $\beta = .16$, $p = .16$, suggesting that the direct effect of mastery-approach goals on final grade was partially mediated through frequency of outline access (Figure 1). A Sobel test showed a significant mediation effect of outline access, $z = 2.46$, $p < .01$. As previously reported, the other conditions of mediation were also met: mastery-approach goals were a significant predictor in outline access and final grade, holding other goals and pretest score constant, and outline access was a significant predictor of final grade while controlling for all goals and pretest score.

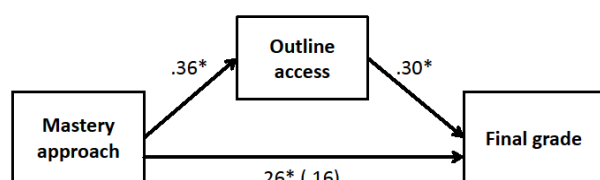


Figure 1: Standardized regression coefficients for the relationship between mastery-approach goals and final grade as mediated by outline access. The standardized regression coefficient between mastery-approach goals and grades controlling for outline access is in parentheses. Model holds constant all other goals and pretest score. * $p < .05$

Discussion

This work provides a first step in using behavioral data collected in a classroom setting to explain the relationship between achievement goals and achievement. Much of achievement goal theory has been based on relationships found between goals, behaviors, and achievement outcomes, but behaviors have been measured primarily through self-report questionnaires in classroom settings. Past work has provided a strong theoretical foundation that now must be validated using observed behavioral measures. This study is one of the first to show that behavioral data can mediate the relationship between achievement goals and outcomes in the classroom, and future work should continue to explore other behaviors thought to mediate this relationship. The outline access data demonstrate the rich opportunities for collecting behavioral data that online learning management systems now afford instructors and researchers (see also Bernacki, Alevén, & Nokes-Malach, 2013).

Unlike much prior work, these results are consistent with theory-driven predictions that mastery-approach

goals should relate to productive learning behaviors and successful outcomes. Senko, Hulleman, and Harackiewicz (2011) suggest the reason mastery-approach goals do not consistently predict achievement may be a misalignment between idealized learning behaviors and actual testing measures, such that less ideal behaviors like surface processing are actually beneficial for the kinds of shallow assessments many students encounter in academic contexts. Mastery-approach goals may have been more important in this sample because the instructor emphasized deeply understanding the material and structured exams and final grades to target deep, conceptual learning. Future work should compare class objectives, exams and grading structures to see if the content targeted on exams and the factors weighted for final grades explain whether mastery-approach or performance-approach goals are better predictors of achievement.

An open question concerns how students viewed the outlines, and what their frequency of outline access indicates. It could be that the act of downloading outlines itself (and then, presumably, using them to take notes in class) directly improves understanding and thus improves exam performance and final grades. Alternatively, it may be that outline access is a behavioral indicator of some other important construct such as organization or the use of resources. If this were the case, we would not expect outline access to mediate the relationship between goals and outcomes, unless that relationship were mediated by the attitude or learning strategy that was actually being measured with outline access. It would be informative to ask students about their beliefs regarding the outlines and how (or if) they believed they could be useful.

In addition to validating hypotheses previously supported using self-reported data, this sort of investigation can provide fruitful information for instructors. It may be that certain study strategies and behaviors show stronger relationships to achievement outcomes than others, suggesting that instructors should focus their attention on facilitating students' uses of those tools. It may also suggest multiple pathways to success, which could inform instructors of the different kinds of tools most useful to students based on their goals.

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References

- Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, 80, 260–267.
- Belenky, D. M., & Nokes-Malach, T. J. (2012). Motivation and transfer: the role of mastery-approach

- goals in preparation for future learning. *Journal of the Learning Sciences*, 21, 399-432.
- Bernacki, M. L., Nokes-Malach, T. J., & Alevén, V. (2013). Fine-grained assessment of motivation over long periods of learning with an intelligent tutoring system: Methodology, advantages, and preliminary results. In R. Azevedo and V. Alevén (Eds.), *International handbook of metacognition and learning technologies*. Berlin: Springer.
- Durik, A. M., Lovejoy, C. M., & Johnson, S. J. (2009). A longitudinal study of achievement goals for college in general: Predicting cumulative GPA and diversity in course selection. *Contemporary Educational Psychology*, 34, 113-119.
- Dweck, C. S. (1986). Motivational processes affect learning. *American Psychologist*, 41, 1040-1048.
- Elliott, E., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54, 5-12.
- Elliott, A. J., & McGregor, H. A. (2001). A 2 x 2 achievement goal framework. *Journal of Personality and Social Psychology*, 80, 501-519.
- Elliott, A.J., McGregor, H.A., & Gable, S.L. (1999). Achievement goals, study strategies, and exam performance: A mediational analysis. *Journal of Educational Psychology*, 91, 549-563.
- Elliott, A. J. & Murayama, K. (2008). On the measurement of achievement goals: Critique, illustration, and application. *Journal of Educational Psychology*, 100, 613-628.
- Elliott, A. J. (2004). Multimethod approaches in educational research. *International Journal of Disability, Development & Education*, 51, 135-149.
- Fulmer, S. M., & Frijters, J. C. (2009). A review of self-report and alternative approaches in the measurement of student motivation. *Educational Psychology Review*, 21, 219-246.
- Harackiewicz, J. M., Barron, K. E., Tauer, J. M., & Elliott, A. J. (2002). Predicting success in college: A longitudinal study of achievement goals and ability measures as predictors of interest and performance from freshman year through graduation. *Journal of Educational Psychology*, 94, 562-575.
- Harris, A., Yuill, N., & Luckin, R. (2008). The influence of context-specific and dispositional achievement goals on children's paired collaborative interaction. *British Journal of Educational Psychology*, 78, 355-374.
- San Pedro, M. O. C. Z., Rodrigo, M. M. T., & d Baker, R. S. (2011). The relationship between carelessness and affect in a Cognitive Tutor. In *Affective Computing and Intelligent Interaction* (pp. 306-315). Springer Berlin Heidelberg.
- Howell, A. J., & Watson, D. C. (2007). Procrastination: Associations with achievement goal orientation and learning strategies. *Personality and Individual Differences*, 43, 167-178.
- Hulleman, C. S., Schrager, S. M., Bodmann, S. M., & Harackiewicz, J. M. (2010). A meta-analytic review of achievement goal measures: Different labels for the same constructs or different constructs with similar labels? *Psychological Bulletin*, 136, 422-449.
- Koedinger, K. R., Corbett, A. T., & Perfetti, C. (2012). The knowledge-learning-instruction framework: bridging the science-practice chasm to enhance robust student learning. *Cognitive Science*, 36(5), 757-98.
- Linnenbrink-Garcia, L., Tyson, D.F., & Patall, E.A. (2008). When are achievement goal orientations beneficial for academic achievement? A closer look at moderating factors. *International Review of Social Psychology*, 21, 19-70.
- McGregor, H. A., & Elliot, A. J. (2002). Achievement goals as predictors of achievement-relevant processes prior to task engagement. *Journal of Educational Psychology*, 94, 381-395.
- Metcalf, J., Eich, T. S., & Castel, A. D. (2010). Metacognition of agency across the lifespan. *Cognition*, 116, 267-282.
- Middleton, M. J., & Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal theory. *Journal of Educational Psychology*, 89, 710-718.
- Niiya, Y., Ballantyne, R., North, M. S., & Crocker, J. (2008). Gender, contingencies of self-worth, and achievement goals as predictors of academic cheating in a controlled laboratory setting. *Basic and Applied Social Psychology*, 30, 76-83.
- Richey, J. E., & Nokes-Malach, T. J. (2013). How much is too much? Learning and motivation effects of adding instructional explanations to worked examples. *Learning and Instruction*, 25, 104-124.
- Roussel, P., Elliott, A. J., & Feltman, R. (2011). The influence of achievement goals and social goals on help-seeking from peers in an academic context. *Learning and Instruction*, 21, 394-402.
- Sage, L., & Kavussanu, M. (2007). The effects of goal involvement on moral behavior in an experimentally manipulated competitive setting. *Journal of Sport and Exercise Psychology*, 29, 190-207.
- Schoor, C., & Bannert, M. (2011). Motivation in a computer-supported collaborative learning scenario and its impact on learning activities and knowledge acquisition. *Learning and Instruction*, 21(4), 560-573.
- Senko, C., Hulleman, C. S., & Harackiewicz, J. M. (2011). Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educational Psychologist*, 46, 26-47.
- Sins, P. H. M., van Joolingen, W. R., Savelsbergh, E. R., & van Hout-Wolters, B. (2008). Motivation and performance within a collaborative computer-based modeling task: relations between students' achievement goal orientation, self-efficacy, cognitive processing, and achievement. *Contemporary Educational Psychology*, 33, 58-77.