

# The Effect of Precommitment on Student Achievement Within a Technology-Rich Project-Based Learning Environment

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**Abstract** This study investigated the effects of precommitment on college students' goal setting and academic performance, and students' attitude towards precommitment-related activities. Precommitment refers to a procedure in which students set up learning goals, possibly with a time limit at the beginning of a learning phase, then report the comparison between their goals and actual learning progress to their peers and teachers by the end of the learning phase. This study used a single-group repeated-measures design. 41 students from a large university in the southeastern United States participated in the study. Multivariate analysis of variance indicated that precommitment was significantly effective in optimizing students' goals and improving their academic performance, but the attitude survey result indicated that students could not fully recognize the value of precommitment-related activities.

**Keywords** Precommitment · Goal setting · Academic achievement

## Introduction

Current educational trends in colleges require students to engage in independent learning practices, wherein students set goals,

monitor their own progress, adopt strategies, and systematically reflect on their learning results. However, such requirements can be difficult to achieve for many students. One major reason for the difficulty is the high metacognitive demand. The skills in setting challenging yet reachable goals or implementing effective and suitable strategies usually need deliberate training and years of experience in certain subjects (Zimmerman and Schunk 2008). Another important reason is that many students grow up in a passive learning environment, where they have become accustomed to being told what to do and how to learn. Students who exhibit passive learning preference tend to have difficulties in adjusting to college requirements (Hung 2011; Rasku-Puttonen et al. 2003). The lack of adjustment to the independent learning practices often becomes a barrier to success in college.

The critical learning process by which students set goals, record progress, adopt strategies, and reflect on learning results is known as self-regulated learning (Zimmerman 2000; Loyens, Magda, and Rikers 2008). Goal setting, as the first step in self-regulated learning, is critical to the efficacy of other steps of self-regulated learning. Though many instructional models have been constructed on self-regulated learning, empirical studies exploring practical instructional design strategies on components of self-regulated learning, such as goal setting, appear to be scarce (Cleary and Zimmerman 2004; Choi and Chung 2012).

Aimed at filling this research gap, this study examined the effects of precommitment, as a practical instructional design strategy, on scaffolding goal setting in college-level classroom learning and teaching. Precommitment originally refers to a mechanism wherein people set up goals that might have costly consequences if unreached (Ariely and Wertenbroch 2002). For the purposes of this study, precommitment specifically refers to a procedure where students establish learning goals possibly with time limit, report and compare their goals and actual learning progress to their peers and instructors. Sharing learning goals and progress might apply social pressure to students, motivating

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them to study harder and optimize learning goals (Ariely and Wertenbroch 2002; Hollenbeck, Williams, and Klein 1989).

## Literature Review

### Goal Setting

Self-regulated learning can be viewed as a cyclic process with three phases: 1) forethought, 2) performance, and 3) reflection (Zimmerman 2008). Each of the three phases features different components, such as goal setting, self-evaluation and self-monitoring. Goal setting, as a key component of the forethought phase, is defined as setting the standard of proficiency, usually with a specified time limit (Locke and Latham 2002; van Den Hurk 2006; Zimmerman 2008).

Burton et al. (1998) and Zimmerman (2008) indicated the importance of goal setting to an individual's learning proficiency and academic performance. Setting goals gives students clear directions and engages them in learning activities. High-quality goals may also improve students' self-satisfaction and learning achievement (van Den Hurk 2006; Zimmerman 2008).

Bandura (1988), van Den Hurk (2006), and Zimmerman (2008) provide valuable information on features of effective goals. The features guiding this study's design include specificity, proximity, and hierarchical organization. Specificity refers to the degree of specificity of a goal. General goals like "try your best" usually do not improve learning; specific goals do because they make progress toward goals easier (Zimmerman 2008). Proximity refers to nearness in time between a goal and the current time. Proximal goals, such as a list of daily goals, are easier for learners to track and reflect on based on their progress. Proximal goals can help learners better regulate themselves than distal goals (Bandura and Schunk 1981). Hierarchical organization refers to the combination of long-term and short-term goals. Short-term goals can provide immediate feedback on progress, while long-term goals could stretch one's vision (Zimmerman 2008). Effective scaffolding strategies on goal setting should empower students by letting them set learning goals that are specific, proximal, and hierarchically organized.

There is a lack of empirical studies on helping learners set and utilize goals more effectively, though the features of effective goal setting have been studied extensively. Cleary and Zimmerman (2004), Hofer and Yu (2003), and Choi and Chung (2012) suggested students should learn together with self-regulation coaches or recommended stand-alone learning-how-to-learn courses. However, learning-how-to-learn courses or self-regulation coaches may not be available in many authentic settings, which necessitates research on goal setting facilitation during subject learning and teaching. If goal setting could be trained while the subject learning is going on, students may understand better what goals are challenging, yet reachable within certain subject contexts.

Therefore, it is necessary to explore scaffolding strategies for goal setting that can be integrated with subject learning.

### Precommitment as a Scaffolding Strategy for Goal Setting

Precommitment was chosen as the scaffolding strategy for this study. Precommitment refers to a mechanism that people set up goals that may bring them costly consequence if they fail to reach the goals (Ariely and Wertenbroch 2002). Efficacy of precommitment on self-control and procrastination has been confirmed empirically in behavioral economics and psychological studies (Ariely and Wertenbroch 2002; Kivetz and Simonson 2002; Kurth-Nelson and Redish 2010). However, precommitment has rarely been explored as a learning scaffolding strategy in educational settings.

Precommitment, in this study, specifically refers to a procedure where students establish learning goals possibly with time limits, and report and compare their goals and actual learning progress to their peers and instructors. The possible cost for students in such situations is being deemed as less competent if they set goals requiring no efforts or fail to reach their goals. Therefore, the awareness of others' judgment may give students more incentives to optimizing their learning goals and putting more efforts to maximize learning efficiency.

### Precommitment and Project-Based Learning Environments

Project-based learning was selected as the context of this study. Project-based learning, recognized as one of the best learning approaches in supporting students' self-regulated learning development, is defined as a teaching and learning approach that engages students through multiple stages of complex activities around authentic questions (Blumenfeld et al. 1991; English and Kitsantas 2013; Loyens, Magda, and Rikers 2008; Markham 2003).

Firstly, experience of project-based learning increases students' familiarity with precommitment. Learning in project-based learning environment may inevitably involve some forms of self-regulation, such as setting goals, selecting learning tasks and strategies, and monitoring progress toward goals (Blumenfeld et al. 1991; English and Kitsantas 2013; Kivela and Kivela 2005; Sungur and Tekkaya 2006). These activities related to goal setting are explicitly required by the precommitment. Therefore, precommitment is not expected to be totally strange to students who are accustomed to project-based learning.

Secondly, project-based learning augments the potential effect of precommitment by increasing familiarity among peers. Students are supposed to learn knowledge by forming small groups, designing collaborative projects, and deepening understanding through sharing, discussion, and reflection in project-based learning contexts (Blumenfeld et al. 1991; English and Kitsantas 2013). All these activities, depending on constant

communication, increase students' familiarity with each other, which in turn make students value more peers' opinions and judgment (Peters 2010). Theoretically, precommitment works best when students deem peers' negative judgments costly, which strengthen their motivations to set reasonable goals and work harder. Therefore, project-based learning provides an ideal environment for boosting the effect of precommitment.

## Research Questions

Research questions guiding this study include:

1. Is precommitment an effective scaffolding strategy for improving students' goal setting in project-based learning environment?
2. Is precommitment an effective scaffolding strategy for improving students' academic performance in project-based learning environment?
3. What are students' attitudes towards precommitment-related activities?

## Methods

### Participants

Participants were 41 undergraduate students (28 women and 13 men) enrolled in a course on instructional technology in a large research university in the southern United States. The course adopted project-based learning as one of the main learning and teaching approaches. Students learned instructional design and interface design through analyzing extensive worked-out examples in class. As time went on, the analysis of worked-out examples faded out, and students were required to construct their own projects.

### Research Design

A single-group repeated-measures design was used to answer the first two research questions regarding the effect of precommitment on goal setting and academic performance. All participants in the study were required to complete two individual projects on educational technology product design one after the other in one semester, and precommitment was applied as a treatment when participants started working on the second project.

Allowed projects types included app prototypes, social network designs, and multimedia pieces. Two project products developed by students are presented in Fig. 1. Along the way, participants must draw up budgets, set goals, build a portfolio, present their project details to others, create prototypes, and develop a social media presence.

Setting weekly goals online was required for all participants. An example weekly goal from one participant is as the following:

"I have decided to move forward with my original plan for the project for this class. I want to make a grocery shopping app because I know how frustrating it gets when you get to a store and forget your paper list or don't have a pen to mark things off. The most one with everything except the one thing I came for. I want to create an application for smartphone users that makes it easier to keep track of a grocery list."

Participants were instructed on the features of effective goals (Time limit, proximity, and hierarchical structure) by the beginning of the semester, and required to post their weekly goals on their individual portfolio. By the beginning of their second project, precommitment was introduced as a treatment, which required students to finish the following activities each week:

1. Post their weekly goals on their individual portfolio, and share the portfolio links with their other group members and the instructor
2. Give a brief presentation to their groups about their weekly progress in class
3. Compare their progress and their weekly goals in the presentation

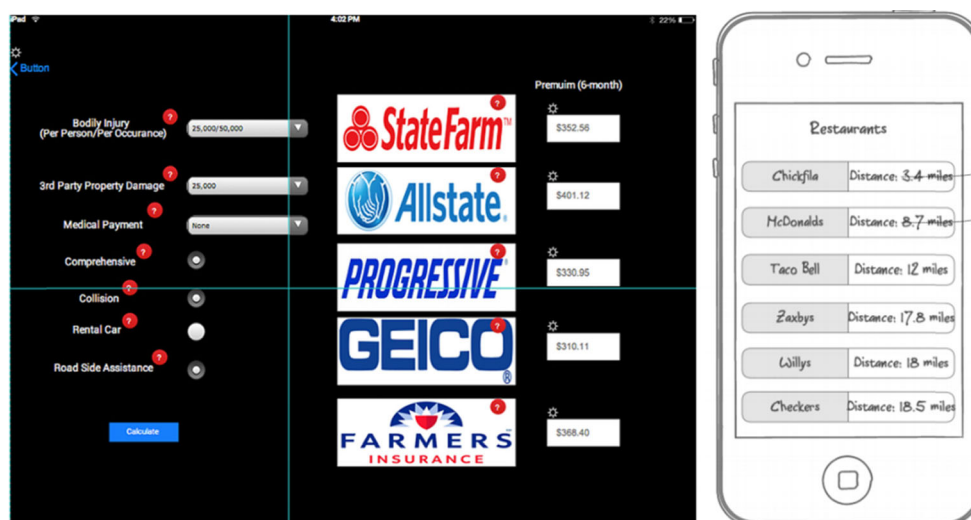
A modified version of the Intrinsic Motivation Inventory survey (see Appendix) was used to answer the third research question (attitude towards precommitment related activities). The survey was distributed to all participants to explore their attitudes towards precommitment related activities. The Intrinsic Motivation Inventory is a multidimensional measurement tool assessing participants' subjective experience about a target activity, particularly as it relates to their own motivation. This survey was developed and validated by McAuley, Duncan, and Tammen (1989) and Deci and Ryan (2000). Four dimensions of participants' attitude were explored in the survey:

1. *Interest*: whether participants are interested in the activity
2. *Perceived choice*: whether participants perceive that they are doing the activity because of the requirement or their willingness
3. *Value/Usefulness*: whether participants believe the activity is of value to them
4. *Relatedness*: whether participants like the interaction with others in the activity and feel connected to them

### Data Collection

The participants' grades of the two projects from the course, their weekly goals, and the survey data were collected in this

**Fig. 1** An app prototype developed by a student to compare insurance costs of major companies (*on the left*); An app design by a student to find nearby restaurants (*on the right*)



study. Rubrics developed by the authors (Table 1) were used to assess the quality of participants' weekly goals (scale: 0–4 points). Two trained raters (doctoral students) scored the weekly goals independently. Participants' goals that were rated with gaps (bigger than one) were identified and reevaluated. The inter-rater reliability (Pearson's  $r$ ) is .751. Average scores between the two raters were used for final data analysis.

## Results

### Is Precommitment an Effective Scaffolding Strategy for Improving Students' Goal Setting and Academic Performance in Project-Based Learning Environment?

Data from 41 students were collected and six of them were excluded from analysis due to missing major information in

their weekly goals. One-way within-subject MANOVA was applied to examine the effect of precommitment on students' academic performance and goal setting. Using Pillai's trace, a significant effect of precommitment on academic performance and goal setting was found,  $V=.938$ ,  $F(2, 23)=174.60$ ,  $p<.05$ . Within-group univariate analysis indicated significant effect of precommitment on students' academic performance ( $F(1, 24)=32.71$ ,  $p<.05$ ,  $\eta^2=.58$ ) and goal setting ( $F(1, 24)=326.27$ ,  $p<.05$ ,  $\eta^2=.93$ ) (Table 2).

When precommitment was introduced as the intervention, participants tended to exert more efforts in applying the effective goal principles to their goals, and write longer than before. As an example, before precommitment was introduced, a participant had his second weekly goal for his first project Mathematics 101 Learning Hub as:

"I want to keep the website simple and not overly artsy but pretty professional. I will also write an opening "blurb" on the front page."

The same participant had his second weekly goal for the second project Learning Chemistry Multimedia Repository as the following when precommitment was introduced:

"I plan to do the three following things in this coming week: 1). Develop the default theme for teaching and learning multimedia repository pages, 2) Research on how to use PowToon to develop basic multimedia products, and 3) Publish a 3-minute PowToon multimedia product. Of course, I will make sure to have the theme and product on my website."

Similarly, another participant had her third weekly goal for the first project Integrated Bill Payment App as the following:

**Table 1** Rubrics for grading quality of goals

Rubrics	Rationales
Specificity	Specificity refers to the degree of specificity of the goal. General goals like "try your best" usually do not improve learning, while specific goals do because they make the progress toward the goal easier (Bandura 1988; Schunk and Rice 1989; Zimmerman 2008).
Proximity	Proximal goals, such as a list of daily goals, are easier for learners to track and reflect on based on their progress. Proximal goals can help learners better regulate themselves than distal goals (Bandura and Schunk 1981).
Hierarchical Organization	Hierarchical organization refers to the combination of long-term and short-term goals. Short-term goals could provide immediate feedback on progress, while long-term goals could stretch one's vision (Zimmerman 2008). Their combination provides learners self-regulatory benefits (Zimmerman 2000)



**Table 2** Means, standard deviation for academic performance and goal setting and results of repeated-measures MANOVA

Measure	Scores of Two Projects				Repeated-measures MANOVA		
	1st Project		2nd Project		Precommitment		
	Mean	SD	Mean	SD	F (1, 24)	p	$\eta^2$
Academic performance	32.40	1.40	35.00	1.73	32.71	.00	.58
Goal setting	7.28	.71	8.98	.73	326.27	.00	.93

Full score of academic performance is 40; full score for goal setting is 12

“I’ll be honest, I’m a little scared of prototyping my app. I know that I’m a bit of a perfectionist and that I want to create a prototype that is as close as I can make it to a usable product. I look forward to using some tools to help me create a decent prototype.”

The quality of her third weekly goals for the second project Daily Checklist improved significantly:

“I will write a product comparison summary based on the 4 scheduling web services that I found. Doodle is probably the best, but there are some other good sites out there. I will also need to decide whether I am going to include a feature that locks users out of their social media outlets. I will write a benefit and cost analysis on this feature.”

### What are students’ Attitudes Towards Precommitment Related Activities?

Survey data from 41 students were collected and nine of them were excluded from analysis due to missing data. Four dimensions of participants’ attitude were explored in the survey:

1. *Interest*: whether participants are interested in the activity
2. *Perceived choice*: whether participants are doing the activity because of the requirement or their willingness
3. *Value/Usefulness*: whether participants believe the activity is of value to them
4. *Relatedness*: whether participants like the interaction with others in the activity

Students scored high on both value/usefulness (Mean = 4.00, *SD* = .89) and relatedness (Mean = 4.07, *SD* = 1.14), but lower on Interest (Mean = 3.11, *SD* = 1.25) and Perceived Choice (Mean = 4.00, *SD* = .89) (Table 3).

**Table 3** Means and standard deviations for attitude towards precommitment survey’s dimensions

Dimension	Mean	SD
Interest	3.11	1.25
Perceived choice	2.70	1.07
Value/Usefulness	4.00	.89
Relatedness	4.07	1.14

5-point scale was adopted for the survey

## Discussion

### Is Precommitment an Effective Scaffolding Strategy for Improving students’ Goal Setting and Academic Performance in Project-Based Learning Environment?

Precommitment was found to be effective in improving both students’ goal setting and academic performance in this study. This finding indicated that exposing learning goals and progress to classmates and teachers made students aware of judgment and progress of others, and therefore motivating them to work harder and improve the quality of their goals.

This unique contribution of this finding is the exploration of a more economical facilitation on goal setting is possible. Most prior studies recommended a stand-alone “learning to learn” course or learning coaches regarding facilitating skills of self-regulated learning, such as help seeking or goal setting, which demands a lot of resources and time from both teachers and students (e.g., Hofer and Yu 2003; Cleary and Zimmerman 2004; Choi and Chung 2012). The finding of this study indicates that precommitment can facilitate goal setting while the subject learning and teaching is going on. Therefore, precommitment can be considered as an alternative approach to facilitating self-regulated learning, especially when time and resources are limited.

This study also gained experience in the technology-rich implementation of precommitment that will be helpful for future studies. Personal blog was used as the platforms for participants to list their weekly goals. During the experiment, participants have to be frequently reminded to check others’ goals. Future studies may consider taking advantage of social media platforms that can push information to students, such as private group on Facebook, or Twitter with unified hashtags, which may further strengthen participants’ connections (Chatti, Jarke, and Frosch-Wilke 2007; Liu 2010).

### What are students’ Attitudes Towards Precommitment-Related Activities?

As for students’ attitude towards precommitment, the participants of this study expressed that precommitment might be important, but they did not have a strong interest in doing related activities, as evidenced by the results of the Intrinsic Motivation Inventory. Such reluctance suggested that students

either did not fully recognize the value of precommitment or the design of precommitment needed further refinement. In reality, it may be a combination of both of the two factors. A possible improvement of the design of this study is to capitalize on the pedagogical affordances of social media (McLoughlin and Lee, 2010; Dabbagh and Kitsantas 2012). For instance, allowing students to post their learning goals on Twitter with the unified hashtag will make the interaction among students easier and increase the study's transparency.

## Limitations

All participants of this study came from the same university. This study only lasted for 15 weeks. Data gathering over a long period and repeated observation are suggested for future studies on this topic. Some participation in this study failed to see the benefit of precommitment, so they did not fully commit to completing the required activities, which led to a high dropout rate of this study. Future studies may consider amplifying the benefit of precommitment and giving students extra grade-wise incentives to lower the dropout rate. The rubrics for grading projects were developed in class between the instructors and the students, but the "one-size-fits-all" approach might not be helpful to these projects, as they require a lot of creativity and are quite varied in nature. Benchmarking a board game against an app prototype is problematic, so, while the rubric is helpful in codifying student achievement, it might not be very generalizable from project-to-project, given the idiosyncratic nature of each project.

## Conclusion

Facilitation of self-regulated learning is important for many college students to adapt to academic life. This study focused on goal setting as an important component of self-regulated learning, explored the effect of precommitment as a scaffolding strategy on college students' goal setting and academic performance. The results indicate that, although students do not show strong interest in its related activities, precommitment may prove effective in improving both students' goal setting and academic performance in project-based learning environments.

## Appendix

Survey: Attitude towards Precommitment-Related Activity

1. I think weekly goal setting and progress report is quite enjoyable.

- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
2. I would describe weekly goal setting and progress report as very interesting.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
3. I felt like it was not my own choice to set weekly goals and progress report for this course.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
4. I set weekly goals and report progress to others for this course not only because of the course requirement but also because I wanted to.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
5. I believe weekly goal setting and progress report could be of some value to me.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
6. I think weekly goal setting and progress report is an important activity.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
7. I felt really distant to the classmates of this course.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True
8. I interacted a lot with my classmates of this course.
- A. Not at all true B. Slightly true C. About halfway true D. Most true E. True

## References

- Ariely, D., & Wertenbroch, K. (2002). Procrastination, deadlines, and performance: self-control by precommitment. *Psychological Science*, 13(3), 219–224.
- Bandura, A. (1988). Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. In V. Hamilton, G. H. Bower, & N. H. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (pp. 37–61). Dordrecht: Kluwer.
- Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology*, 41(3), 586–598.
- Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: sustaining the doing, supporting the learning. *Educational Psychologist*, 26(3–4), 369–398.
- Burton, D., Weinberg, R., Yukelson, D., & Weigand, D. (1998). The goal effectiveness paradox in sport: examining the goal practices of collegiate athletes. *Sport Psychologist*, 12, 404–418.
- Chatti, M. A., Jarke, M., & Frosch-Wilke, D. (2007). The future of e-learning: a shift to knowledge networking and social software. *International Journal of Knowledge and Learning*, 3(4–5), 404–420.
- Choi, J. H., & Chung, K. M. (2012). Effectiveness of a college-level self-management course on successful behavior change. *Behavior Modification*, 36(1), 18–36.

- Cleary, T. J., & Zimmerman, B. J. (2004). Self-regulation empowerment program: a school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychology in the Schools*, 41(5), 537–550.
- Dabbagh, N., & Kitsantas, A. (2012). Personal learning environments, social media, and self-regulated learning: a natural formula for connecting formal and informal learning. *The Internet and Higher Education*, 15(1), 3–8.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- English, M. C., & Kitsantas, A. (2013). Supporting student self-regulated learning in problem- and project-based learning. *Interdisciplinary Journal of Problem-based Learning*, 7(2), 128–150.
- Hofer, B. K., & Yu, S. L. (2003). Teaching self-regulated learning through a “learning to learn” course. *Teaching of Psychology*, 30(1), 30–33.
- Hollenbeck, J. R., Williams, C. R., & Klein, H. J. (1989). An empirical examination of the antecedents of commitment to difficult goals. *Journal of Applied Psychology*, 74(1), 18.
- Hung, W. (2011). Theory to reality: a few issues in implementing problem-based learning. *Educational Technology Research and Development*, 59(4), 529–552.
- Kivela, J., & Kivela, R. J. (2005). Student perceptions of an embedded problem-based learning instructional approach in a hospitality undergraduate programme. *International Journal of Hospitality Management*, 24(3), 437–464.
- Kivetz, R., & Simonson, I. (2002). Self-control for the righteous: toward a theory of precommitment to indulgence. *Journal of Consumer Research*, 29(2), 199–217.
- Kurth-Nelson, Z., & Redish, A. D. (2010). A reinforcement learning model of precommitment in decision making. *Frontiers in behavioral neuroscience*, 4, Article 184.
- Liu, Y. (2010). Social media tools as a learning resource. *Journal of Educational Technology Development and Exchange*, 3(1), 101–114.
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: a 35-year odyssey. *American Psychologist*, 57(9), 705–717.
- Loyens, S. M., Magda, J., & Rikers, R. M. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, 20(4), 411–427.
- Markham, T. (2003). *Project based learning handbook: A guide to standards-focused project based learning for middle and high school teachers*. Buck Institute for Education
- McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: a confirmatory factor analysis. *Research Quarterly for Exercise and Sport*, 60(1), 48–58.
- McLoughlin, C., & Lee, M. J. (2010). Personalised and self-regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology*, 26(1), 28–43.
- Peters, E. E. (2010). Shifting to a student-centered science classroom: an exploration of teacher and student changes in perceptions and practices. *Journal of Science Teacher Education*, 21(3), 329–349.
- Rasku-Puttonen, H., Eteläpelto, A., Arvaja, M., & Häkkinen, P. (2003). Is successful scaffolding an illusion?—shifting patterns of responsibility and control in teacher-student interaction during a long-term learning project. *Instructional Science*, 31(6), 377–393.
- Schunk, D. H., & Rice, J. M. (1989). Learning goals and children’s reading comprehension. *Journal of Literacy Research*, 21(3), 279–293.
- Sungur, S., & Tekkaya, C. (2006). Effects of problem-based learning and traditional instruction on self-regulated learning. *The Journal of Educational Research*, 99(5), 307–320.
- van Den Hurk, M. (2006). The relation between self-regulated strategies and individual study time, prepared participation and achievement in a problem-based curriculum. *Active Learning in Higher Education*, 7(2), 155–169.
- Zimmerman, B. J. (2000). Self-efficacy: an essential motive to learn. *Contemporary Educational Psychology*, 25(1), 82–91.
- Zimmerman, B. J. (2008). Goal-setting: a key proactive source of self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: theory, research, and applications* (pp. 267–296). New York: Taylor & Francis.
- Zimmerman, B. J., & Schunk, D. H. (2008). An essential dimension of self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: theory, research, and applications* (pp. 1–31). New York: Taylor & Francis.