The effects of feedback protocol on self-regulated learning in a web-based worked example learning environment

Kevin Biesinger [a],*, Kent Crippen [b,1]

[a] Clark County School District, 5100 West Sahara Ave, #147, Las Vegas, NV 89146-3406, United States
[b] University of Nevada Las Vegas, Box 453005, 4505 South Maryland Parkway, Las Vegas, Nevada 89154-3005, United States

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ABSTRACT

The current research investigated the effects of differing feedback protocols in a Web-based worked example learning environment to determine if changes would occur over time in goal orientation, self-regulation, self-efficacy or achievement. Participants from an undergraduate chemistry course were assigned to either a norm-referenced or self-referenced feedback group to receive feedback in relation to their performance on a weekly quiz administered via the Web. Results revealed that participants did not significantly change their goal orientation type or magnitude as a result of the differing feedback protocols, even with the addition of learning environment perception as a potential mediating variable. However, participants made significant decreases along the mastery approach and performance approach goal orientation sub-scales, regardless of the type of feedback received. While this was not anticipated, the results are consistent with other recent research within this context. An unanticipated trend also emerged, as those from the norm-referenced feedback group with a class-task perception of the learning environment were less likely to use worked examples but also demonstrated the greatest gains in self-efficacy. These were unanticipated outcomes and contrary to prior research. Recommendations for future research within this context such as authenticating participants' perceptions of their assigned treatment condition, introducing additional feedback protocols such as a combined, choice, or control condition and building in a better gauge to track the time and context of changes within the constructs of interest are also discussed.

1. Introduction

The application of multimedia learning has made it possible to deliver continuous, timely, individualized and pedagogically relevant feedback to learners while maintaining an efficient use of limited cognitive resources. However, the effects of feedback as well as the optimal conditions that make best use of it represent a fairly new research direction. Investigations that aim to establish a framework for optimal feedback delivery systems within multimedia learning applications represent a practical undertaking. For example, it was recently established that accounting for learner preferences in regard to the type of feedback provided was not an empirically fruitful endeavor, and can even serve as a deterrent in some cases (Bower, 2005). Motivation theory is not sufficiently robust to offer an *a priori* mechanism for determining an optimal form of feedback based upon personal characteristics, nor does the theory predict well how the form of feedback might interact with achievement goal motivation. Winne, Muis, and Jamieson-Noel (2004) "urge researchers to further examine whether tasks, feedback, or both change students' goal orientation framework" (p. 39) and Linnenbrink (2005) states "a developmental perspective assessing personal goals and underlying dispositions and using objective measures of the goal context would allow one to more carefully trace the unique effects of these predictors to learning-related outcomes and the potential of a given classroom goal context to alter personal goal orientations over time" (p. 209). The debate in regard to the malleability of goal orientation over time and learning context has also seen a recent resurgence due to the work of Pintrich and course management and assessment systems now available via the Web. Electronic course management systems now make it possible to trace not only the perceptions of the learner, but the actions taken to master course content.

* Corresponding author. Tel.: +1 702 855 3131.
E-mail addresses: kdbiesin@gmail.com (K. Biesinger), kcrippen@unlv.nevada.edu (K. Crippen).
[1] Tel.: +1 702 895 2517.

A need exists for experimental investigations with feedback protocol, goal orientation, self-efficacy, self-regulation, and achievement in multimedia learning environments. While the effects of feedback on achievement and motivation have been mostly inconclusive, a majority of these studies provided the same type of feedback for all learners (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Winne et al., 2004; Winne, Muis, & Jamieson-Noel, 2006). Furthermore, other research which did manipulate feedback protocol failed to include motivational variables (Bower, 2005) or implemented large scale environmental differences (Bong, 2004; Linnenbrink, 2005) making it difficult to attribute empirical findings to one single condition (i.e., an entirely different classroom and instructor as opposed to changes in feedback alone). In addition, the lack of a pre-test in one of these related studies (Linnenbrink, 2005) adds additional spurious possibilities to treatment effects.

A better understanding of the interaction between the form of feedback and motivation would have important practical implications. Conclusions could offer instructors, software companies, and instructional designers empirically sound advice for effectively building feedback protocols into multimedia learning programs. As such, this study sought to measure changes in goal orientation, self-regulation, self-efficacy, and achievement as a result of differing feedback protocol with learning environment perception as a potential mediating variable.

1.1. Theoretical framework

This research was framed within social cognitive theory (Bandura, 1997) which depicts the learner as a deliberating agent in the learning process who approaches academic tasks based on motivational dispositions. The results of a path analysis by Zimmerman and Bandura (1994) contributed more predictive power to this model only when a goal setting measure was introduced, thus substantiating a need for additional investigation with motivational constructs. Therefore, this theory assumes that a clear and well-defined goal or desired outcome is necessary in order for the learner to effectively monitor, compare and regulate learning activities, thus making goal orientation a paramount component of the theory. Additionally, self reports alone do not provide a comprehensive depiction of self-regulated learning (SRL) and should be used in conjunction with distinct data points obtained through other methods such as trace to best triangulate a more complete scenario of self-regulated learning (Winne & Hadwin, 1998).

The following section reviews the literature related to the relevant constructs of goal orientation, worked examples as a self-regulated learning strategy, self-efficacy, and the relationships among these variables and academic achievement.

1.2. Goal orientation

The categories of goal orientation utilized in the current study are derivative of a two by two matrix (Table 1) which outlines two dimensions, perceived task definition and valance (Elliot & McGregor, 2001). This theoretical construct has evolved from the work of Dweck (1986), who suggested that individuals possess either a learning (i.e., mastery) goal orientation where the goal of learning is to master the material, or a performance goal orientation where individuals strive to obtain favorable evaluation from others. Later research added valance to the theory, conceptualized by approach versus avoidance. Approach behaviors are those that strive to achieve successful judgments from others or themselves and are thought of as having a positive valance. Conversely, avoidance behaviors refer to intrinsic motivations that stem from the evasion of failure and appearing incompetent in front of others. Avoidance orientations are regarded as containing a negative valance. Therefore, the four categories are (a) mastery approach (where a person is driven to achieve for the sake of learning how to successfully complete a task), (b) mastery avoidance (where a person strives to avoid misunderstanding or making an error), (c) performance approach (marks the goals of achievement to outperform others) and (d) performance avoidance (individuals who are most likely motivated for the sake of avoiding embarrassment compared to others on the same task).

While a majority of research has demonstrated consistent empirical evidence of stronger relationships between a mastery approach goal orientation and intrinsic motivation, self-efficacy and deep processing cognitive strategies (Ames, 1992), its predictive power for self-regulated learning has been restricted to self-reported measures (Pintrich, 2000). The discussion of performance goal orientation as an antecedent of the same outcomes however, has received a mixture of results. While some research has focused on the maladaptive patterns that follow from a performance approach goal orientation (Dweck & Leggett, 1988), recent research has challenged this position when other factors such as context and motivation are considered. While VandeWalle, Brown, Cron, and Slocum (1999) found a positive relationship between performance goal orientation and sales commissions, Harackiewicz, Barron, Pintrich, Elliot, and Thrash (2002) have also noted positive relationships with task value, academic concept, effort and performance. Furthermore, Pintrich (2000) demonstrates some adaptive patterns for performance approach goals under a revised theory that allows for learners to progress through different goal orientations dependent upon the context and desired outcome. Elliot and Church (1997), Elliot and McGregor (2001) also identified performance approach goals as a significant predictor for graded performance with subjects high on performance approach goal orientation and low on mastery approach goal orientation receiving the highest grades. In fact, Harackiewicz et al. (2002) have gone so far as to claim that in a typical academic setting mastery approach goals will only predict interest and enjoyment of a course but performance goals will predict grades and subsequent grade point average.

Table 1
Goal orientation definitions (Elliot & McGregor, 2001).

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