EXAMINING THE EFFECTIVENESS OF ACHIEVEMENT GOAL-BASED PERSONALIZED MOTIVATIONAL FEEDBACK IN ONLINE LEARNING

by

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ABSTRACT

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Current online learning approaches are sometimes criticized for a "one- size- fits -all" approach, low levels of interactivity, and insufficient feedback, which may result in low levels of learning satisfaction and high dropout rates. To mitigate these shortcomings, this study proposed a set of rules to design personalized motivational feedback based on students' personal achievement goals. The researcher expected this specially designed personalized feedback to be able to improve student motivation and learning outcomes.

To examine the effectiveness of such feedback, an explanatory mixed-methods study was implemented, which included two consecutive phases. The first phase was a quasi-experimental study. A 2018 online master's degree program course offered by a large R-1 University in the U.S. served as the study context. Twenty-eight students were selected as the test group where personalized motivational feedback based on the proposed rules was delivered along with regular instructor feedback. Another forty students were selected as the control group who only received regular instructor feedback. Students' motivation and perceived satisfaction were measured by using pre and post surveys. Students' learning performance was measured by using the collected assignment scores after the semester ended. The second phase was a set of post interviews, in which 13 students from the two groups were asked about their perceptions of the impact of the feedback they received and how they used feedback in their learning process during the study.

In the first study phase, ANCOVA F test results indicated the post-test scores of learner motivation and perceived satisfaction in the test group were significantly higher than those of the control group. The mean value of the cumulative assignment scores in the test group was somewhat higher than that of the control group, but this difference was not statistically significant based on the results of Wilcoxon Two-Sample test and ANCOVA F test. In the second study phase, the post-interviews showed that students in the test group expressed more consistently and strongly that they had an overall positive perception of the feedback received in

the course. The participants from the test group further explained the underlying mechanism of this personalized motivational feedback was that it affected students' learning positively by helping them set and regulate learning goals, activate self-regulation mechanisms, and adjust their learning behaviors.

Based on the results and the features of the study design, the researcher concluded that the personalized feedback designed by following the set of rules proposed in this study has the potential to improve learner motivation in the online learning context. While its effect on learning outcomes was not significant, the researcher speculated that learning outcomes might have been affected by more complex factors, such as ceiling effects and predominant class structures.

The researcher suggested online instructors and instructional designers consider students' achievement goals when conducting learner analysis and creating learner profiles. She also suggested developers of next-generation LMSs include achievement goals in the learner model and include such rules in a personalization mechanism. One primary limitation of this study was that a ceiling effect on learning performance emerged leading to insufficient variation for the researcher to detect a statistically significant difference in learning performance. Therefore, the researcher suggests future researchers in this area replicate this approach by using automated feedback delivery tools and consider employing personalized feedback in different types of classes and using specific instructional approaches, such as problem-based learning and competency-based learning. Future research should also consider achievement goal's mediating factors, such as students' self-regulation skills, in learner analysis.

CHAPTER 1: INTRODUCTION

The Research Problem

Online learning in higher education has been growing rapidly because of accessibility, convenience, and cost saving for both of learners and instructors (Allen, Seaman, Poulin, & Straut, 2016; Deming, Goldin, Katz, & Yuchtman, 2015; Futures, 2016; Kim, Olfman, Ryan, & Eryilmaz, 2014). With this rapid growth, the quality of online learning has received much attention from researchers and practitioners due to concerns about the effectiveness of online learning, such as mixed results of effects on learning outcomes (Nguyen, 2015), poor retention rates (Bawa, 2016; Kim et al., 2014), learner perceived isolation (Khalil & Ebner, 2014; Kim et al., 2014), and insufficient feedback (Sunar, Abdullah, White, & Davis, 2015). These concerns may be due to the fact that online learning often utilizes a "one- size- fits -all" approach (Brusilovsky, 2001; Khalil & Ebner, 2014), lacks adequate design to enhance motivation (Bawa, 2016; Kim et al., 2014), and sometimes offers low levels of interactivity (Khalil & Ebner, 2014; Sunar et al., 2015), which may result in low levels of learning engagement leading to high dropout rates in learning programs.

To mitigate these shortcomings, personalization is proposed as one approach to enhance learning efficiency, student motivation, and learning outcomes, especially in the online context (Fasihuddin, Skinner, & Athauda, 2016; Nguyen, 2015). Based on a review of existing literature, online personalized learning has the potential to be a powerful strategy to enhance learner interests (Aviram, Ronen, Somekh, Winer, & Sarid, 2008; Jung & Graf, 2008; Kim, 2009; Lim & Morris, 2006), improve learning efficiency (Graf, 2007; Popescu, 2009), create positive

feelings of learner control (Corbalan, Kester, & Van Merriënboer, 2006; Topping, 2003), and improve learning performance (Akbulut & Cardak, 2012).

However, despite the promise of personalized learning, the issues of low learning engagement and high dropout rates in online learning have not been solved even using current personalized learning approaches. More specifically, online personalized learning falls short of considering a range of learner characteristics, especially higher-level learner characteristics such as learning goals, orientations, and motivations (Martinez, 1999, 2001; Nakic, Granic, & Glavinic, 2015). Therefore, it fails to treat learners in a whole-person way. In other words, some important learner characteristics are missing from the current cognitive-rich learning constructs (Martinez, 1999, 2001; Nakic et al., 2015), and the learning environment design may not match learner characteristics very well.

Various online learning components can be or have been personalized, such as personalized presentation of instructional content, personalized learning materials, and personalized assessments (Brusilovsky, 2012; Fasihuddin et al., 2016). Targeting the unresolved drawbacks described above, this study explored specific learner characteristics and personalized online learning based on learning constructs that have been little explored to improve personalized online learning. Among different components of online personalized learning, this study focused on personalized feedback related to students' achievement goal orientation with a goal to design and validate rules of personalized instructional feedback to enhance the online learning process and outcomes.

A Summary of the Related Literature

Various aspects of personalized feedback have been studied including the characteristics of learners used to enable personalization, the methods used to measure learner characteristics,

the features of the learning content, and the models used to enable personalization of feedback (Narciss, 2008). Research related to learner characteristics is a relatively well-explored area. Learners with different characteristics process feedback in different ways leading to differing feedback efficiency and effectiveness, which makes it necessary to provide personalized feedback (Goldin, Narciss, Foltz, & Bauer, 2017a; Narciss et al., 2014). These learner characteristics may include cognitive factors (knowledge, cognitive style, and intelligence), affective factors (mood, certainty), and behavioral factors (help-seeking, self-regulation).

For example, boys benefit more from feedback messages that are fast to check, while girls do better when they receive feedback that is interactive and highly structured (Arroyo, Beck, Beal, Wing, & Woolf, 2001). Learners of a field-dependent style make fewer mistakes when their mistakes are explained in feedback that provide specific strategies for them to correct the mistakes. In contrast, learners of field-independent style make fewer mistakes when feedback with only the correctness/incorrectness of the answer is provided (Hedberg & McNamara, 1985). Students with a "sensing" learning style always request feedback on the correctness of their responses, while students with an "intuitive" learning style sometimes do not request any type of feedback (Vasilyeva, DeBra, Pechenizkiy, & Puuronen, 2008). Students who have lower levels of knowledge need more feedback than students who have higher levels of knowledge (Tobias, 1994).

According to the literature review, personalized feedback has been created and studied based on learners' characteristics including knowledge (Albert and Lukas, 1999; Hancock et al., 1995a; Stern, Beck, & Woolf, 1996), metacognitive status (Hancock, Stock, & Kulhavy, 1992), metacognitive skills (Aleven, Mclaren, Roll, & Koedinger, 2006), gender (Arroyo et al., 2001),

learner perception of correctness of their response (Mory, 1994), self-efficacy (Narciss, 2004), goal orientation (Senko & Harackiewicz, 2005) and learning styles (Vasilyeva et al., 2008).

Most current personalized feedback messages have been designed at the cognitive level or metacognitive level (Narciss, 2008). Feedback information, such as whether students made a correct response, what are the correct responses, and how to regulate learning processes through help seeking, are provided to students (Hancock, Stock, & Kulhavy, 1992; Hancock, Thurman, & Hubbard, 1995; Ido, Mclaren, Baker, & Koedinger, 2006). However, mixed patterns of results have emerged from the studies about the personalized feedback created based on different learner characteristics (Goldin, Narciss, Foltz, & Bauer, 2017b). For example, VanLehn (2011) found that personalized feedback based on students' responses to the questions is a powerful strategy to help students resolve the difficult or challenging problems in learning, track their learning progress, and facilitate the overall learning process. However, in a comparison study within which students received personalized feedback based on students' response correctness and their response certainty level, Mory (1994) found no significant effect of personalized feedback. The overall course efficiency was not significantly better than control group students. In the face of such mixed results, it necessary to ask the questions again: What are the effective/valid learner characteristics on which personalized feedback can be built? What personalized feedback messages will work effectively in an online learning context?

Deficiencies in the Existing Studies

Considering the mixed results of the effectiveness of personalized feedback, potential deficiencies can be identified through the literature review. First, certain learner characteristics on which personalized feedback is based may not be valid. For example, learning style is one of the most frequently used learner characteristics for personalization (Nakic et al., 2015;

Vasilyeva, Pechenizkiy, & DeBra, 2008). However, recently learning style has been criticized as an invalid learning construct, since no direct relationship has been found between this learning construct and desired final learning outcomes (An & Carr, 2017; Pashler, Mcdaniel, Rohrer, & Bjork, 2008).

Second, similar to studies about general personalized learning, current personalized feedback design does not consider a set of broad learner characteristics. Recently, some studies have considered motivational factors in designing personalized feedback, such as self-efficacy (Narciss, 2004) and achievement goals (Senko & Harackiewicz, 2005). Senko and Harackiewicz (2005) found different achievement goals promote different learning outcomes. For example, performance goals predict exam success, but they do not predict course interests, while mastery goals predict course interests but not success on exams. This study further suggests that the pursuit of achievement goals is responsive to feedback, and feedback may affect whether and how achievement goals are pursued. Therefore, it is feasible to design personalized feedback based on achievement goals to regulate the learning process and optimize outcomes in terms of reducing maladaptive learning experiences. However, there is little literature on the development and study of personalized feedback based on achievement goals.

Last, personalized feedback content is mostly provided at the cognitive level and sometimes at the metacognitive level (Narciss et al., 2014). To maximize the effectiveness to fully motivate learners, feedback ideally should lead students from cognitive level learning tasks, to metacognitive level for learning task processing, and finally should motivate students and enhance their self-regulation in the learning process (Hattie & Timperley, 2007). Based on this, it’s necessary to explore designing motivational feedback based on crucial learner characteristics.

The Purpose Statement

This study proposed and examined the effectiveness of a set of personalization rules for designing personalized feedback based on an achievement goal theory multiple goal perspective framework (Pintrich, 2000a) in the online learning context at the higher education level. Achievement goal orientation is a little-utilized learning construct in personalized online learning and personalized online learning feedback design. It deserves to be considered in the instructional design process since the learning goal is viewed as a primary learning construct (Martinez, 1999). The term "primary" means that goals have a comprehensive effect on driving learning from cognitive, metacognitive, emotional, and motivational aspects when compared to other derived or secondary learning constructs, such as learning styles, prior knowledge, etc. (Martinez, 1999).

Achievement goal theory multiple goal perspectives is a relatively new theoretical framework that has emerged in the literature (Barron & Harackiewicz, 2001; Daniels et al., 2008; Harackiewicz, Barron, Pintrich, Elliot, & Trash, 2002; Pintrich, 2000a). It is used for this study since it addresses complex, authentic situations related to learners' goal adoption during the learning process. According to this framework, different learners adopt different combinations of achievement goals and can be classified into four types: i.e., High-mastery/High-performance (HH), Low-mastery/High-performance (LH), High-mastery/Low-performance (HL), and Low-mastery/Low-performance (LL) goal orientations (Pintrich, 2000a). Different learners have different learning experiences -- either adaptive or maladaptive, different achievement related emotions -- either happiness or anxiety, and adopt different regulation and learning strategies (Daniels et al., 2008) that may lead to either positive or negative learning outcomes. To optimize learning experiences, and thereby to improve motivation and learning outcomes, this study

proposed to develop a set of rules to design personalized motivational feedback based on learners' achievement goals and test the implementation of the resulting feedback with online learners.

A set of basic rules was identified, summarized, and organized based on a review of previous studies (Daniels et al., 2008; Defalco et al., 2016; Harackiewicz & Linnenbrink, 2014; Pintrich, 2000a, 2000b; Senko & Miles, 2008). Learners who exhibit one of the four different types of achievement goal patterns, High-mastery/High-performance (HH), Low-mastery/High-performance (LH), High-mastery/Low-performance (HL), and Low-mastery/Low-performance (LL), were provided with different individualized feedback. Students have different emotional, motivational, and behavioral experiences in situations where they make a correct response or get a positive result in the learning process (advantageous situation) or the situations where they don't do well or get negative results (disadvantageous situation). Therefore, for each of the four types of learners, different personalized feedback was provided to them in two different situations (advantageous and disadvantageous). The design principles of personalized feedback for these eight situations were extracted from past literature that focused on feedback and are briefly summarized in Table 1. The supportive literature for these feedback design principles is described in Chapter 2. The specific feedback examples derived from these principles are described in Chapter 3 and Appendix D.

Different feedback elements of the proposed rules have been reported in the different previous studies either as interventions for specific types of students, as a method to shape the climate of the classroom, or just to examine the effectiveness of a specific individual type of

Table 1 Proposed Rules for Personalized Feedback Design

Goal	Situation	Additional feedback categories
HH	Adv	Normative, Self-referential feedback
	Disadv	Normative, Self-referential, Promotion-focused feedback
HL	Adv	Self-referential feedback
	Disadv	Self-referential, Task value- embedded feedback
LH	Adv	Task value-embedded, Normative, Promotion-focused feedback
	Disadv	Task value-embedded, Normative, Self-efficacy motivational feedback
LL	Adv	Task value-embedded, Self-referential, Promotion-focused feedback
	Disadv	Task value- embedded, Self-efficacy motivational feedback

Note. HH: High-mastery/High-performance goals. HL: High-mastery/Low-performance goals. LH: Low-mastery/High-performance goals. LL: Low-mastery/Low-performance goals; Adv: advantageous. Disadv: disadvantageous.

feedback (Daniels et al., 2008; Defalco et al., 2016; Pintrich, 2000a; Sarsar, 2017; Senko & Harackiewicz, 2005; Senko & Miles, 2008; Shin, Lee, & Seo, 2017). However, it is unknown what the effects will be if these rules are applied in a combined method in an online personalized learning context and how online students will perceive such feedback. To examine the effectiveness of these personalization rules and the personalized feedback designed following these rules, an explanatory mixed-methods design (Ivankova, Creswell, & Stick, 2006), including a quasi-experiment study and a set of post-interviews, was used to implement the study and collect data.

Research Questions

RQ 1: To what extent does personalized motivational feedback based on learners' achievement goals affect learning performance and motivation in online learning? Two research hypotheses were derived from this question: (1) After delivering the feedback intervention, scores on assignments in the test group will be higher than the scores in the control group; (2) The post-survey measurement scores for motivation in the test group will be higher than the scores in the control group.

RQ 2: What are online learners' perceptions of the feedback they received?

The Significance of the Study

Theoretical Significance

This study brought a little-used learner characteristic, achievement goal, into consideration for designing online personalized learning, online personalized feedback, and refining online learners' profiles. It also provided an empirical test of the Achievement Goal Theory Multiple Goals Perspectives (Harackiewicz & Linnenbrink, 2014; Pintrich, 2000a) and using learning feedback messages to regulate learners' goal adoption (Senko & Miles, 2008).

Practical Significance

This study investigated an attempt to optimize online learning experiences from a motivational perspective. Online students with different achievement goals may have adaptive or maladaptive learning experiences. Providing appropriate feedback information to different students to make learning adjustments may help their learning experiences to be optimized at least in terms of learning motivation. This approach also has the potential to increase students' perceived satisfaction and therefore to mitigate high dropout issues in traditional online learning.

This specially designed feedback may be personally valuable to individual learners to monitor their achievement goals, regulate their learning process, and enhance learning motivation. Online instructors, LMS developers, and instructional designers may wish to include this learning construct, achievement goal, into learner analysis and integrate personalized feedback into large learning management systems. In this way, personalized online learning systems can be designed to be more effective.

A Brief Overview of the Remaining Chapters

The remaining chapters are structured as follows. Chapter 2 reports a review of the relevant literature that supports this study. The reviewed literature provided necessary background information about three major topics: achievement goal theory, personalized learning, the theoretical framework and key design dimensions of instructional feedback, and the derived rules for designing personalized motivational feedback based on achievement goals. Chapter 3 provides a description of the research methods, study context, participants, and procedures. Chapter 4 presents the results of the study. Chapter 5 discusses the results, conclusions, and implications.

CHAPTER 2: LITERATURE REVIEW

Online Learning Growth and Related Concerns

Online learning is a significant trend in educational technology (Bawa, 2016). In higher education, online learning has been growing rapidly because of accessibility (Futures, 2016), convenience (Kim et al., 2014; Shay & Rees, 2004), and cost savings (Deming, Goldin, Katz, & Yuchtman, 2015) for both learners and instructors. According to the statistical data in the report *Grade Increase: Tracking Distance Education in the United States* (Seaman, Allen, & Seaman, 2018), 31.6% of all students at higher education level, more than 6 million in total, took at least one course in distance format in the fall semester of 2016. The growth rate was 5.6% over the previous year. With this rapid growth, the quality of online learning has received much attention due to concerns about its effectiveness (Bawa, 2016; Sunar et al., 2015). Various issues in online learning have been identified by previous studies, including insufficient feedback (Sunar et al., 2015), passive learner engagement caused by using video tutorials in MOOCs (Maio, Loia, Mangione, & Orciuoli, 2014), low levels of motivation (Fasihuddin et al., 2016; Sunar et al., 2015), lack of instructor understanding of online students (Bawa, 2016), and serious retention issues (Bawa, 2016).

These concerns may be due to the fact that online learning often utilizes a “one- size- fits -all” approach (Brusilovsky, 2001; Fasihuddin et al., 2016), lacks adequate design to enhance motivation (Bawa, 2016; Fasihuddin et al., 2016), and can produce learner-perceived isolation resulting from a lack of interaction (Hung & Chou, 2015). These problems may result in low levels of learner engagement and thus lead to high dropout rates in learning programs. To address the drawbacks of traditional online learning approaches, personalized learning with an

enhanced motivational design is proposed as a strategy (Fasihuddin et al., 2016; Sunar et al., 2015).

In this chapter, related literature about personalized learning, achievement goal theories, and feedback is reviewed. At the end of the chapter, a set of rules to design personalized motivational feedback based on achievement goals extracted from previous studies is described.

Personalized Learning

What is Personalized Learning?

Personalized learning has a long history, with many of the foundational ideas originating from the practice of providing specialized learning plans for special education students in the 1970s (Keefe, 2007). Through its developmental process, various terms have been used to express the principles similar to those used in personalized learning, such as individualized instruction, individually guided instruction, prescribed instruction, and adaptive learning (Keefe, 2007). By summarizing the major features of personalized learning, Keefe (2007) defined the term personalization at the school level as "a systematic effort on the part of a school to take into account individual student characteristics and effective instructional practices in organizing the learning environment" (p.219). Later, a report of the United States' Department of Education (2010) described personalized learning at the instructional level as "instruction paced to learning needs, tailored to learning preferences, and the specific interests of different learners. Under the fully personalized learning environment, the learning objectives, learning content, instructional method, and pace may all vary" (p. 12).

In this study, personalized learning is defined as a learning mode at the instructional level which is specially designed to fit the learner's individual characteristics, preferences, and interests. Throughout the learning process, the learner, instructor, and the learning system can

work together to control the learning process and provide learning resources with special features to individual learners with specific characteristics.

Major Features and Components of Personalized Learning Systems

In order to enable the process of personalization, systems for personalized learning have several important features and necessary components. Such learning systems should be able to diagnose individual learners' characteristics and learning status, create a learning environment which is interactive, allow flexible scheduling and pacing, provide assessments in an authentic style, and maintain a culture of collegiality (Keefe, 2007). Similarly, McLoughlin (2013) also highlighted critical factors for personalized learning, including dynamic learning and teaching (pedagogy), assessment, flexible curriculum, learning environment, support networks, personalized learning content, and responsive infrastructure.

To support the functioning of these features, most personalized learning systems have three core models (Graf, 2007; Papanikolaou, Grigoriadou, Kornilakis, & Magoulas, 2003). The learner model recognizes and stores a set of learners' characteristics related to learning in a specific learning context. The teaching model provides the most appropriate learning activities, tasks, materials, and feedback at a pace that is best for individual learners. The content model organizes learning content in a way that is convenient for the system to retrieve it and customize it for different individual learners. Through the mechanism of personalization, personalized learning systems can provide individualized learning content and activities for learners with different characteristics.

The learner model tries to capture each learner's critical characteristics and then create an accurate learner profile for each learner through learner modeling. The information on learner characteristics that is typically stored in a learning system includes the learner's prior knowledge

(Papanikolaou et al., 2003; Taminiau et al., 2015), learning styles (Fasihuddin et al., 2016; Papanikolaou et al., 2003; Viola, Graf, Kinshuk, & Leo, 2006), preference on learning pace (Shang, Shi, & Chen, 2003), preferred peer connections (Brouns et al., 2014), learning performance (Henning et al., 2014; Tseng, Chu, Hwang, & Tsai, 2008), personal learning goals (Papanikolaou et al., 2003), cognitive abilities (Samah, Yahaya, & Ali, 2011), and learning orientation (Martinez, 1999, 2001).

Although these factors are recorded in many learning systems, not all of them have actually been used as basic factors to enable personalization in specific personalized learning systems. Learning styles, prior knowledge and skills, learning goals, cognitive styles, preferences, and learning performance are the most common characteristics used to make learning personalized, especially in online learning contexts where learning is mostly controlled by computer systems. Some learner characteristics, such as affective or motivational learner characteristics, are not commonly considered and used in the mechanism of personalization (Nakic et al., 2015). Nakic et al. (2015) concluded that insufficient exploration had been made of affective learner characteristics to enable personalization in learning. This supports an old critique that a lot of personalized learning systems do not consider the complexity of learner characteristics well (Martinez, 1999, 2001). Therefore, current personalized learning systems fail to personalize learning in a comprehensive way and so may fail to bring about better learning effectiveness.

The content model refers to the components of the learning system designed to organize subject related topics, concepts, rules, or other kinds of knowledge elements (Brusilovsky, 2012). Usually, within a course or learning module, various learning objects are organized under different themes related to different learning objectives. Different personalized learning systems

use different means or structures to organize learning content. Some use a hierarchical structure; for example, a web-based personalized learning system named INSPIRE (Papanikolaou et al., 2003) uses a three-level structure to organize the learning content, including the level of learning materials, the level of major concepts, and the level of learning objectives. Groups of related learning materials are organized under different concepts. Then all the related concepts are organized under different learning objectives. In this way, the hierarchical structure organizes all the content resources. Some personalized learning system, like the Adaptive Educational Hypermedia System (Duitama, Defude, Bouzeghoub, & Lecocq, 2005; Karampiperis & Sampson, 2005) even use the technology of ontology to enhance this structure by including descriptions of the relationship among different concepts, which can represent the subject content more accurately. Ontology is used to represent all concepts within the knowledge domain. It helps the subject content to be organized more accurately so that the subject content can be restructured in a way that is more convenient to retrieve and sequence for specific learners.

Based on learners' key characteristics and features of course content, personalized learning systems can customize learning content and activities to individual students through the teaching model. Personalized learning systems can provide personalized learning materials (Karampiperis & Sampson, 2005), create personalized learning paths (Karampiperis & Sampson, 2005), or set a personalized learning pace (Shang et al., 2003) for the individual students. Personalized learning systems can also provide personalized learning activities (McLoughlin, 2013), personalized support for problem-solving (Hwang, Kuo, Yin, & Chuang, 2010), and content-related personalized feedback (Shatnawi, Gaber, & Cocea, 2014). Basically, most learning systems also provide personalized learning resources such as navigation support,

feedback, learning planners, instructional tips or hints, online discussion threads, tests, etc. Overall, personalized learning materials, personalized learning path, and personalized learning pace are the common elements that gain the most attention in existing personalized learning systems.

The personalization mechanism relies on the rules of personalization and the teaching agent that implements these personalization rules. The rules of personalization define how to match learners with specific characteristics with learning resources with specific features (Corbalan et al., 2006). Personalization rules derive, in part, from teaching practices. For example, one personalized learning system (Vassileva, 1997) generated courses and customized them dynamically to better fit learning progress and learners' preferences based on the teaching rules proposed by Van Marcke (1992). The teaching rules defined how the learning system selected content, teaching strategies, instructional tasks, and materials. This system also allowed users to edit these rules based on their own needs (Van Marcke, 1992). Some learning systems create personalization rules based on learning style theory. For example, Graf (2007) extended an existing LMS to provide personalization based on learners' learning styles according to Felder-Silverman learning style model. The module they developed was able to generate, customize and present course content that fit a learner with a specific learning style.

Once personalization rules are programmed, the agent of personalization will follow one or more rules to enable the personalization process. The teaching agent can be a human instructor, students themselves, or a computer system. As artificial intelligence technology is becoming more prevalent, computer systems are becoming more widely used as the agent for personalization (Brusilovsky, 2012). Moreover, with the increasing emphasis on learner-centered instruction, more and more personalized learning systems also allow learners to get involved in

personalization to control parts (Brusilovsky, 2012) or all of their own learning (Houchens et al., 2014).

Advantages of Personalized Learning

Multiple studies on personalized learning systems have shown that learners utilizing personalized learning approaches outperform traditional learners in multiple aspects due to the advantages of personalized learning, such as eliciting more learning interests by allowing students to choose their preferred learning materials and learning paths (Aviram et al., 2008; Jung & Graf, 2008; Kim, 2009; Lim & Morris, 2006), increasing learning efficiency by fitting learning to individual students' characteristics (Brusilovsky, 2012; Popescu, 2009), making learning more effective by having learners generate more positive feelings of control and responsibility over learning (Corbalan et al., 2006; Montessori & George, 1964; Topping, 2003), enhancing learning performance through facilitating the learning process (Akbulut & Cardak, 2012; Cracolice & Roth, 1996; Graf, 2007; Ketamo, 2014), improving learning outcomes (Bajraktarevic, Hall, & Fullick, 2003; Wang, Wang, & Huang, 2008), increasing the time students are involved in learning, supporting long-term learning retention, increasing exam scores, and thus finally enhancing learning program retention by helping students to deeply engage in learning and have better time management (Foss, Foss, Paynton, & Hahn, 2014).

Disadvantages of Personalized Learning

Although the advantages described above have helped to make personalized learning a fast-growing area, there is still huge space to improve this special approach of learning, no matter whether from the perspective of instructional system design or research method design. From the aspect of instructional system design, first, the mechanism of personalization relies on

the collected data of learners' characteristics. Therefore, such learning systems often require learners to take tests or complete surveys. However, one literature review (Sunar et al., 2015) reported that learners might lack the interest to take these diagnostic tests or surveys, which makes it difficult for personalized systems to collect data and determine learners' characteristics. Some personalized learning systems attempt to use advanced technologies to capture learners' characteristics automatically (Cabada, Estrada, Zatarain-Cabad, & Reyes-Garcia, 2009; Carmona, Castillo, & Millán, 2008; Latham, Crockett, & McLean, 2014). For example, Cabada et al. (2009) used a Fuzzy-Neural Network to automatically classify students in a web 2.0 and mobile learning environment based on their learning styles proposed by Felder-Silverman model but learning style was criticized later as invalid learning instruct. Most of this type of systems are at the stage of proposal or prototype (Sunar et al., 2015).

Second, since learners are unique individuals with various types of characteristics, personalized learning needs to consider the complexity of individual learners from multiple dimensions in the user modeling of learners to enable content personalization. However, current personalized learning systems have been criticized as falling short in considering the complexity of learners for learning personalization (Martinez, 1999; Nakic et al., 2015). Martinez (1999) pointed out that these learning systems mostly used incomplete learning constructs, focused on cognitive characteristics, and demoted other affective and conative factors to secondary or no roles. For example, most personalized learning systems use derived learner characteristics, such as learning style, learning preference, learning strategies, or skills to differentiate learners (Nakic et al., 2015), which are the secondary learning variables derived from more primary learning constructs, such as learners' goals, intentions, emotions, desire for autonomy, and so on. This drawback of the design of personalized learning systems means they fail to treat learners from a

whole person view (Martinez, 1999, 2001). What's more discouraging, in the paper of An and Carr (2017), learning style, a very popular learner characteristics used to enable personalization (Nakic et al., 2015), was criticized as an ineffective factor to explain learning and achievement because the theory lacks a clear explanatory framework and most related studies used inappropriate measurement methods. In sum, personalized learning design has insufficiently explored using effective learner characteristics to enable personalization (Nakic et al., 2015). Thus it needs to explore more effective learner characteristics which link to learning achievement closely.

Based on the features of current designs of personalized learning systems and their drawbacks, in the future, the complexity of learner characteristics should be considered during learner analysis and learner modeling to enable a more effective personalization mechanism. In the process of personalization, affective and motivational factors which can promote learning significantly should also be considered as important factors in learner modeling so that learning activities or resources provided by the system will match with individual learners better. The related literature about a little-utilized learner characteristic, achievement goal, that has been validated to affect learning from cognitive, behavioral, metacognitive, affective, and motivational aspects (Dweck & Leggett, 1988; Harackiewicz & Linnenbrink, 2014; Pintrich, 2000a), is reviewed in the next section.

Achievement Goal Theories

Introduction

Goals refer to "the internal representation of the desired states" (Austin & Vancouver, 1996, p. 338). From the goal content perspective, researchers have proposed taxonomies for analyzing goals (Cropanzano, James, & Citera, 1993; Ortony, Clore, & Collins, 1988). Under

these taxonomies, there are several categories of goals, such as competitive advantage, tranquility seeking, interpersonal concerns, transpersonal orientation, balanced success, personal growth, economic status, exploration-play, security, and intellectual orientation. Although goals vary from person to person and from situation to situation, the way that different types of goals work follow a similar dynamic process, which has four main steps including goal establishment; planning; goal striving and monitoring; and attainment, revision, and persistence decisions. During this process, an individual's current states tend to be disturbed away from the desired states by internal factors related to themselves and external factors related to environments and therefore eventual results could be affected (Austin & Vancouver, 1996).

In this study, the discussion of goals is focused on goals in learning achievement contexts. In this area, learners' goals greatly determine their learning behaviors (Wilkowski, Deutsch, & Russell, 2014). The setting of goals has been validated to be highly effective for learners to develop skills of self-regulation of their learning (Schunk, 1990, 1991; Zimmerman, 1990), and goal setting affects the appropriateness, timing, and quality of cognitive learning strategies learners used to manage the quality of their learning achievements (Covington, 2000). To achieve their learning goals successfully, learners need to be directed by their personal goals, regulate their learning process, and keep a high level of intentions and self-efficacy (Caplan, Choy, & Whitmore, 1992). Considering individual differences in learning goals among different learners, instructional design and course development and delivery should be personalized based on learners' goals (Wilkowski et al., 2014). Achievement goal theory is one major theory that focuses on the goals that can drive the learning process and goal-related motivational features. The related studies about achievement goal theories are reviewed in this section. At the end of

this section, the principles of designing personalized feedback derived from this theory are discussed.

Achievement Goal Theories

Achievement goals are special goals that reflect the purposes or reasons that drive an individual to pursue achievements (Dweck & Leggett, 1988). In achievement situations, an individual usually is driven by their achievement goals to approach specific tasks, experience task procedures, and react to task-related environments (Ames & Archer, 1988; Dweck & Leggett, 1988). Dweck and Leggett (1988) suggested that specific types of achievement goals can activate a mechanism of learning with distinct behavioral, cognitive and affective consequences. The quality of learning outcomes and the willingness of a learner to continue learning depend closely on an interaction between predominant reward structures in learning environments, specific achievement goals adopted by learners, and the motivating features of these achievement goals (Covington, 2000).

Achievement goal theory works as an important theoretical framework to guide researchers to study achievement motivation in learning situations (Midgley et al., 1998; Pintrich & Schunk, 1996). Up to now, achievement goal theory has evolved from an initial dichotomous framework (Ames, 1992), to a subsequent trichotomies achievement goal framework (Elliot & Church, 1997), 2×2 framework (Elliot & McGregor, 2001), and then a relatively new multiple goal perspective framework (Pintrich, 2000a). Each framework proposes different types of achievement goals, different ways to classify achievement goals, and the motivational effects of each type of achievement goal on the learning process and outcomes. Previous researchers presumed that each achievement goal works as a special perceptual-cognitive framework in achievement situations. These goals and the motivational features underlying the goals have

important impacts on learning processes and outcomes related to achievement (Elliot & McGregor, 2001). As the frameworks evolved, more subtle and complicated impacts of achievement goals on learning have been recognized, separated, and associated with different types of achievement goals. This will help instructional designers and instructors to consider the complexity of learner characteristics, analyze learners from the aspect of achievement goals, and provide new comprehensive instructional interventions.

The Dichotomous Framework

Achievement goals refer to the purposes or goals that motivate an individual to pursue achievement (Dweck & Leggett, 1988). Based on the criteria an individual uses to determine whether he or she has achieved success, two basic forms of achievement goals, mastery goals and performance goals, were identified originally (Ames, 1992). An individual with mastery goals focuses on increasing his or her competence, understanding, and appreciation for learning content. Performance goals are defined as ego-goals or goals that focus on self-enhancing. Learners with performance goals usually want to outperform their peers as a method to demonstrate ones' ability status (Ames, 1992).

There may be different "pathways" or trajectories in learning process, which are driven by different achievement goal orientations (Pintrich, 2000a). Pintrich (2000a) suggested "mastery and performance goals could set up and foster different patterns of motivation, affect, strategy use, and performance over time. Students who adopt different goals might follow different pathways, or trajectories, over time" (p. 545). Students who adopt different achievement goals may have the same learning performance or achieve the same learning outcomes. However, their learning experiences on the way to this overall result can be very different (Pintrich, 2000a).

Initially, Ames (1992) only supported the advantages of pursuing mastery goals over the benefits of pursuing performance goals, since performance goals were viewed as fostering maladaptive learning patterns. However, other researchers have pointed out that performance goals sometimes can positively influence learning, since these types of achievement goals can also motivate learners to make efforts and achieve competence and therefore can result in learning experiences which are adaptive (Dweck, 1986; Harackiewicz & Sansone, 1991). For example, students oriented by performance goals may achieve the same level of outcomes, or even get higher levels of achievement along with by high levels of self-efficacy, given the findings of Harackiewicz et al. (1998). However, as suggested by the theory about normative goals (Harackiewicz et al., 2002), given these performance-oriented students' concerns about doing better than others, they probably perceive less learning interests, more negative affect, and perhaps a higher level of anxiety. What's more, it is less likely for these types of students to make efforts because their goal is to appear smarter than their peers (Harackiewicz et al., 2002). The detailed effects of the two types of achievement goals are described as follows.

Mastery goals. A mastery goal is generally presumed to be able to foster students to get involved in learning and increase the probability that students will pursue additional learning tasks, and then improve learning increments (Ames & Archer, 1988). Mastery goal-oriented students have specific goals. As indicated by Barron & Harackiewicz (2001) "When pursuing mastery goals, an individual's purpose is to develop competence by acquiring knowledge and skills"(p.706). Mastery goal-oriented students view the effort as a key cause for success, so they actively get involved in challenging tasks and persist even when they meet difficulties or make mistakes (Dweck & Leggett, 1988). For this type of student, success is perceived when they feel they have achieved self-improvement. They get satisfied when they feel the learning tasks

completed by them have a high level of the inherent qualities, such as interests and challenges (Meece, Anderman, & Anderman, 2006). According to Elliot (1999) "The pursuit of mastery goals is portrayed as fundamentally appetitive, challenge-based, and is posited to elicit positive affective, cognitive, and behavioral processes that lead to a host of positive outcome…, including both quantitative (e.g., persistence, effort expenditure) and phenomenologically based variables (e.g., intrinsic motivation, self-determination)"(p. 177).

Research shows mastery goals increase high-quality and long-term involvement in the learning process (Harackiewicz, Arron, Tauer, Carter, & Elliot, 2000; Kaplan & Maehr, 2002). Learners oriented by mastery goals spend more efforts on learning, persist in learning for a longer time period (Grant & Dweck, 2003; Wolters, 2004), use more active strategies in learning that can help them understand concepts and recall what they have learned (Ames & Archer, 1988; Elliot & McGregor, 2001; Grant & Dweck, 2003; Wolters, 2004), also use surface learning strategies (Liem, Lau, & Nie, 2008), perceive higher levels of self-efficacy, perceive higher levels of academic ability (Meece et al., 2006; Midgley et al., 1998; Wolters, 2004), have more self-regulated learning (Ames, 1992; Dweck & Leggett, 1988), positively attribute failures to the efforts they have spent on learning or strategies they have used (Ames, 1992), perceive more pride and satisfaction in success (Ames, 1992), tend to take more risks by getting involved in learning tasks which are challenging (Meece, 1991), approach questions or problems in learning process with greater thoughtfulness (Schunk, 1996), perceive a higher level of personal control over their own learning (Covington & Omelich, 1984), and perceive a higher level of interests in the learning content (Bergin, 1995). They tend to show more enjoyment, report a greater desire to learn additional content (Barron & Harackiewicz, 2001), and perceive a higher level of

calmness at exam time (McGregor & Elliot, 2002). Mastery goals are negatively associated with the anxiety triggered by failure and the willing to give up the exams (Ames, 1992; Meece, 1991).

Regarding the controlledness that learners perceive during the learning process, there are no consistent conclusions across different studies. McGregor & Elliot (2002) found learners with mastery goals perceived a lack of controlledness during exam preparation. On the contrary, Bergin (1995) found learners with mastery goals perceived a higher level of personal control over learning events.

Performance goals. Performance goals refer to goals that lead to self-enhancing and outperforming others as a method to increase ones' ability status (Nicholls, 1989). For students oriented by performance goals, they perceive achievement when they feel they are doing better than others or surpassing normative standards (Meece et al., 2006). When pursuing performance achievement goals, students are concerned with their ability, comparing themselves with others and avoiding any challenges that may put them at risk of appearing incompetent. Therefore, this type of students may give up when they face challenges or difficulties (Barron & Harackiewicz, 2001) since they are driven by fears of incompetency (Covington, 2000).

Performance goals are generally reported to be positively associated with adoption of superficial and rote rehearsal strategies (Covington, 2000), which may not be beneficial for students to enhance conceptual understanding (Kaplan, Middleton, Urdan, & Midgley, 2002; Meece, Blumenfeld, & Hoyle, 1988). Because performance goals have some distracting effects, which is largely activated by students' worries of incompetency (Middleton & Midgley, 1997), these type of goals are not related or negatively related with learning strategies which involve of deep-level processing (Kaplan & Midgley, 1997; Karabenick & Collins-Eaglin, 1997). Learner-perceived incompetency also leads students to take some actions to protect themselves, which

can hurt the quality of learning and exam preparation. Performance goals are also associated with disorganization during learning, for example, inefficient use of study time. This usually tends to decrease subsequent academic performance and leads to reduced effort and task persistence. Specifically, for higher-level elementary school students with performance goals, they tend to have more self-handicapping behaviors, such as wasting time and procrastinating (Urdan, Midgley, & Anderman, 1998). Middle school students oriented by performance goals have more cheating behavior in academic activities (Anderman, Griesinger, & Westerfield, 1998). For college-level students, this pattern of goals leads to lower grades in assessments (Elliot & Church, 1997; Elliot & McGregor, 2001). One research study suggested that performance goals can also motivate students toward some critical learning outcomes because these goals can direct learners toward competence and the issues of inefficiency is offset by a tendency toward extra rehearsal (Harackiewicz & Sansone, 1991).

The results are not consistent across studies about the effects of performance achievement goals. Therefore, researchers have suggested that it is necessary to go further to distinguish the different forms of performance goals and divide the performance goal into performance-approach and performance-avoidance forms of goals (Harackiewicz et al., 2002). Some research evidence indicates that especially among college-level students, performance-approach goals, which direct learners to demonstrate abilities and outperform their peers or the normative criterion, are positively related with the time length of learning persistence and achievement scores (Elliot, McGregor, & Gable, 1999; Harackiewicz et al., 2002) and are negatively associated to the desire to escape from quizzes or exams (McGregor & Elliot, 2002). These findings motivated researchers to revise and refine the achievement goal theory to propose the trichotomies framework, described in the following section.

The Trichotomies Framework

The early achievement goal theory was revised by several researchers (Elliot & Church, 1997; Elliot & Harackiewicz, 1996), who separated the performance-focused achievement goal into performance-approach goals and performance-avoidance goals. Individuals oriented by performance-approach goals focus on obtaining favorable judgments of competence relative to others, while individuals oriented by performance-avoidance goals focus more on avoiding unfavorable judgments of competence. After researchers separated the two forms of performance achievement goals, performance-avoidance goals have been more closely associated with maladaptive learning experiences, whereas performance-approach goals have been more associated with adaptive learning experiences.

Performance-approach goals. Performance-approach achievement goals are reported to be closely related to several positive variables, such as learner-perceived task value (Church, Elliot, & Gable, 2001), effort/time spent in learning (Elliot et al., 1999; Wolters, Yu, & Pintrich, 1996), performance attainment (Barron & Harackiewicz, 2001; Elliot & Church, 1997; Elliot & McGregor, 2001; Elliot et al., 1999; Harackiewicz et al., 2000; Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997; Skaalvik, 1997; Tanaka & Yamauchi, 2000), the level of engagement in cognitive learning (Harackiewicz et al., 2002), completion of learning tasks (McGregor & Elliot, 2002), challenge appraisals prior to exams, both threat and challenge appraisals when students prepare for exams, grade aspiration, and perception of calmness during the exams (McGregor & Elliot, 2002). Performance-approach goals also affect social relationships in learning environments, since students with performance-approach goals tend to maintain an advantageous status of their competence compared to their peers in a learning group (Anderman & Anderman, 1999; Kaplan, 2004). To meet this goal, these types of students tend to interact with those peers

to whom they can show that they are more competent, but it is less likely for them to work with those classmates perceived as more competent since this situation would make it more difficult for them to demonstrate their own competence and stand out. This social pattern may inhibit those students with performance-approach goals from building positive and smooth social relationships in class (Anderman & Anderman, 1999; Kaplan, 2004).

Regarding the effects of performance-approach goals on adopting learning strategies, there are no consistent findings across studies. Liem & Nie (2008) found that performance approach goals did not affect how students use learning strategies at the cognitive or metacognitive level, which is consistent with traditional normative goal theory and mastery goal theories (Barron & Harackiewicz, 2001; Harackiewicz et al., 2002). In these theories, performance goals were described as detrimental to learners' cognitive engagement. Other researchers (Elliot & McGregor, 2001; Wolters, 2004) found that performance-approach achievement goals were associated with not only surface learning strategy adoption but also deep learning strategy adoption.

Performance-avoidance goals. According to the revised achievement goal theory (Elliot & Church, 1997; Elliot & Harackiewicz, 1996), the antecedent factor of performance-avoidance goals is negative, such as worries about failure, low levels of perceived competence, or fears of being rejected. Performance-avoidance goals are linked to various types of negative processes such as threat appraisals and anticipated test anxiety (Elliot, 1999). They are also positively related to aversive and maladaptive consequences, such as perceived controlledness, procrastination while preparing for an exam, anticipatory anxiety, desires to escape from exams or to give up quickly when tasks become difficult, no extra time spent voluntarily on additional learning, and low ability-related esteem. Performance-avoidance goals are negatively associated

with absorption when students are preparing for exams, feeling calm at exam time, grade aspiration, test preparedness, and time spent on studying (McGregor & Elliot, 2002).

Performance-avoidance goals do not affect adoption of learning strategies at the cognitive or metacognitive level. The students with performance-avoidance goals may not necessarily lack the cognitive skills that students need to address learning tasks to be successful, but they don't have motivational willingness to make efforts and to be successful (Middleton & Midgley, 1997). However, from a learning outcome perspective, students oriented by performance-avoidance achievement goals do not necessarily receive lower achievement grades than other types of students (Wolters, 2004).

A 2× 2 Framework of Achievement Goals

Considering the inconsistent conclusions of the previous studies, Barron and Harackiewicz (2001) went further and proposed that there are at least four patterns when students are pursuing different types of achievement goals. Elliot & McGregor (2001) advocated a 2×2 framework of achievement goals that was supported by several researchers (Elliot & Church, 1997; Elliot & Harackiewicz, 1996), which divides the mastery goal construct and so includes mastery-approach, mastery-avoidance, performance-avoidance, and performance-approach goals. This framework first included three types of achievement goals proposed by the previous work, namely "mastery-approach goals (in which competence is defined in absolute/intrapersonal terms, and it is positively valenced), performance-approach goals (in which competence is defined in normative terms, and it is positively valenced), and performance-avoidance goals (in which competence is defined in normative terms, and it is negatively valenced)" (Elliot & McGregor, 2001, p. 502). Then it added a new type of

achievement goal, "mastery-avoidance goals (in which competence is defined in absolute/intrapersonal terms, and it is negatively valenced)" (Elliot & McGregor, 2001, p. 502).

Mastery-approach goals. Self-determination, the learner-perceived value of competence (the extent to which a student feels competencies needed for a task are valuable), overall needs for achievement, and learner-perceived classroom engagement positively predict mastery-approach goals adoption. Mastery-approach goals can positively predict adoption of learning strategies that involve deep level processing, and negatively predict subsequent performance avoidance goals adoption and the numbers of students' health-center visits resulting from their maladaptive patterns during learning (Elliot & McGregor, 2001; Harackiewicz, 1989; Mcgregor & Elliot, 2002).

Mastery-avoidance goals. Mastery-avoidance achievement goals are caused by fears of failure, low level of self-determination, a belief that intelligence is fixed but not incremental (also called entity theory), parents' negative feedback which is person-focused, worry induction, perceived class engagement, and competence valuation (Elliot & McGregor, 2001; McGregor & Elliot, 2002). In other words, fixed mindsets, competence valuation, fear of failure, parents' negative feedback that is person-focused, and perceived engagement in classrooms were positive predictors of mastery-avoidance goals adoption. Self-determination and belief that intelligence is incremental are negative predictors of mastery-avoidance goals. Mastery avoidance goals themselves are positive predictors of disorganization in learning, test anxiety, emotionality, worry, subsequent adoptions of mastery-avoidance goals, subsequent adoption of mastery-approach goals, and subsequent adoption of performance-approach goals. However, mastery-avoidance goals are not negative predictors of scores of performance in exams nor positive

predictors of the number that students visit the health center (Elliot & McGregor, 2001; McGregor & Elliot, 2002).

Performance-approach goals. The overall needs for achievement, perceived competitiveness, worries of failure, previous SAT scores, parents' conditional approval, parents' negative feedback that is personal-focused, and competence valuation can positively predict performance-approach achievement goals (Elliot & McGregor, 2001; McGregor & Elliot, 2002). Specifically, parents' negative feedback focusing on behaviors is positively associated with performance-approach goals when parental identification is high (i.e., students identify their parents as positive models to them, and they admire their parents), but negatively associated when parental identification is low (i.e., students identify their parents as negative models to them, and they don't admire their parents). Performance-approach goals can positively predict exam performance, adoption of learning strategies that involve surface processing, and subsequence performance-approach goals adoption (Elliot & McGregor, 2001; McGregor & Elliot, 2002).

Performance-avoidance goals. The fear of failure, belief in entity theory/mindset that supports intelligence as fixed, parents' negative feedback that is personal-focused, worry, and competence valuation can positively predict performance avoidance goals adoption. Parents' personal-focused negative feedback is associated with performance-avoidance goals since this type of feedback is punitive, harsh, and probable to cause students to withdraw efforts at all cost. Self-determination and previous SAT scores can negatively predict adoptions of performance-avoidance achievement goals. Performance avoidance goals are a positive predictor of adoption of surface processing strategy, anxiety related to tests, emotionality, disorganized study, and students' health center visits. When students adopt performance avoidance goals but don't adopt

mastery-approach goals at the same time, the positive correlation is the strongest between performance avoidance goals and emotionality. Performance-avoidance goals are a marginally significant positive predictor of worry but a negative predictor of exam performance (Elliot & McGregor, 2001; McGregor & Elliot, 2002).

How Achievement Goals Work

Several researchers have found that achievement goals sometimes fail to directly affect actual performance scores in exams among undergraduate students, but achievement goals may operate through moderating factors (Elliot & Church, 1997; Harackiewicz et al., 1997). Therefore, it is necessary to investigate factors like characteristics of students, learning contexts, and exams that act as moderators of the relationship between exam performance scores and achievement goals.

Features of Learning Contexts

Goals, self-protective mechanism, feelings, and school performance, as a cluster of interrelated factors that result in achievement, are all subject to work demands and incentive methods used in the learning environment (Covington, 2000). Achievement goal theory can be used as an important lens to analyze the relationship among achievement goals, classroom structures and school environments (Meece et al., 2006). Classroom incentive structures influence achievement goals by working as precursors of students' personal goal orientations (Church et al., 2001; Roeser, Midgley, & Urdan, 1996; Urdan, 2004). One study indicates that goal structures highlighted in classrooms shaped the types of personal achievement goals that students adopted to influence their learning that corresponded with learners' perceptions of goal structure in the classroom (Covington, 2000). These relations were still identified even when the

researchers controlled the differences in students' characteristics (Anderman & Midgley, 1997). In a learning environment where there is little reward, poor grades indicate a lack of ability, which leads to perceptions of worthlessness. This failure may result in a feeling of threat which indicates one is incompetent. The lower the students' self-esteem, the more students experience shame, feelings of hopelessness, and anxiety. Additionally, other learner characteristics, such as level of abilities, pre-existing goal orientations, and gender are believed to be able to influence how students perceive the learning environments (Roeser et al., 1996).

According to Ames & Archer (1988), achievement goal theory can be used as an essential framework to study students' perceptions of the learning environments. Students who perceive mastery goals or performance goals to be highlighted in their learning contexts adopt different types of learning strategies, prefer learning tasks at different challenge levels, demonstrate different attitudes toward course work, and have different attribution for success and failure.

Mastery-approach structure in the classroom. Mastery learning emphasized in the learning context can moderate the effect of learner characteristics (i.e., ability perceived by learners) on achievement-related behaviors (Ames & Archer, 1988). For example, a mastery goal structure in learning context may provide a context which can change the impact of learner-perceived ability on achievement behaviors. What's more, the facilitating effects of learning environments with a focus on mastery goals are not weakened by the presence of cues of performance goals (Ames & Archer, 1988). Students' perception of the classroom highlighting mastery goals can negatively predict their behaviors in avoidance patterns in sixth-grade students (Turner et al., 2002), and avoidance strategies (Meece et al., 2006) and disruptive behaviors in ninth-grade students (Kaplan et al., 2002). But learning contexts with such a structure can

positively predict adoption of mastery-oriented goals (Meece et al., 2006), adoption of performance-avoidance goals, greater confidence in students' ability to complete the assignments in their class, less focus on performance-approach goals, and grades of the course work (Wolters, 2004). Students in this type of learning context are more likely to report that they put forth efforts to complete learning tasks, persist in disadvantageous situations, and do not put off starting their learning task. The extent to which a mastery structure characterizes a learning environment is a critical factor to predict students' long-term use of learning strategies that manage their attention and learning activities, approach to learning tasks, and adaptive motivational engagement. Students in this type of environment reported more preference for tasks which are challenging, showed more positive attitudes during learning process, and had a more positive attribution pattern that success follows one's efforts. However, a mastery goal orientation dominating the learning environments does not directly predict grades that are assigned by teachers (Ames & Archer, 1988; Kaplan et al., 2002; Meece et al., 2006; Wolters, 2004).

The functioning of students' perceptions of the mastery goal emphasized in the classroom works through students' adoption of a mastery achievement goal. When mastery goals are emphasized in learning contexts, and these goals are also adopted by students, goal orientation in the classroom may promote learners' adaptive motivation patterns. Students who perceive mastery goals are highlighted in their learning environment and also adopt mastery goals for themselves tend to reflect that they spend more efforts and use higher levels of metacognitive strategies (Ames & Archer, 1988; Meece et al., 2006). It appears that a mastery goal must be made salient in the learning environment so that students' adaptive motivation pattern can be facilitated (Ames & Archer, 1988; Meece et al., 2006).

Performance-approach structure in classroom. Students who perceive performance goals as salient in the learning context tend to focus more on their ability, negatively evaluate their ability, have a maladaptive attribution that attributes failure to lack of ability (Ames & Archer, 1988), work harder (Roderick & Engel, 2001), report more procrastination, and are disengaged from learning tasks more often when tasks are challenging, difficult or boring (Wolters, 2004). Studies that focus on elementary and middle school students found performance goal structures used in learning environments are also associated with more negative learning behaviors, such as academic cheating, teasing, and talking out of turn in the classroom (Kaplan, Gheen, & Midgley, 2002). These negative behaviors usually take learning opportunities away from students. For junior high school students, the perceptions of performance-approach goal structures are associated with the results of student self-reported self-efficacy (Wolters, 2004). Roderick & Engel (2001) found that learners in this type of context tend to adopt both performance-approach and performance-avoidance goals. There are no consistent conclusions about impact of performance approach-oriented goal structure on the students' motivation. Meece, Anderman and Anderman (2006) indicated that under performance-approach goal structures many young students experience diminished motivation during elementary school and secondary studies. While, for students who are older and have high level of abilities, a performance goal structure may be beneficial for promoting learner motivation, academic performance, and achievement.

Matching classroom goal structure with personal goal orientation. Several studies (Harackiewicz & Sansone, 1991; Harackiewicz et al., 2002) proposed that learners' achievement goals may be most beneficial when their achievement goals are consistent with or "match" with the goals that are highlighted in learning contexts. Harackiewicz et al. (2002) also asserted that learners' achievement goals become more effective when learners studied in learning

environments that afford a good match. Students who perceived a performance-approach classroom structure but who actually adopted a mastery goal tended to report that they spend less efforts in learning. Students who adopted performance-avoidance goals, but they perceived that the learning environment highlight a performance-approach structure tended to report that they use lower levels of metacognitive strategies. Students who are making efforts to surpass their peers' performance or the norms may be best motivated in a learning context in which learning excellence is defined by comparing an individual's achievement with their peers' performance. This method typically assigns grades in a normative way (Barron & Harackiewicz, 2001). When a proper match between the deficit of learners and instructional interventions in the learning contexts is manipulated, anxious students' performance can be improved (Naveh-Benjamin, 1991).

Matching classroom goal structure with features of learning events. Harackiewicz and Elliot (1998) confirmed the impact of performance-approach achievement goals and mastery achievement goals (experimentally manipulated) on learning as a function of the feature of learning events. McGregor and Elliot (2002) concluded that when students anticipate the exam time is still far away, their performance-approach goals can trigger appetitive appraisals. However, during the period of exam preparation, performance-approach goals activate both appetitive appraisals and aversive appraisals. In other words, in the early phase of the achievement sequence, pursuing performance goals primarily brings motivation pattern that is appetitive. The aversive feeling becomes more salient and operative when the time of the exam gets closer. Therefore, performance-approach achievement goals can bring some adaptive experiences in special learning events and achievement phases, but the effect of performance-avoidance achievement goals is negative on learning regulation throughout the overall

achievement sequence. Regarding mastery goals, Grant and Dweck (2003) reported that in situations when students are facing learning tasks which are highly challenging, they need to solve complex or difficult learning problems, or they feel the learning content is valuable to them, these mastery goals are more positively related to the results of performance measures.

Learner Characteristics Related Factors

Researchers (Elliot & Church, 1997; Harackiewicz et al., 1997) have validated that personality-related variables work as predictors of the achievement goals that college students adopt in their learning process. These variables can also moderate the effects of goals that are manipulated in learning environments. The experimental study conducted by Harackiewicz and Elliot (1993) indicated that both mastery goals and performance goals could enhance learners' intrinsic motivation. More specifically, the positive influence of mastery and performance goals is moderated by learner's personality differences, for example, an individual learner has a higher level of achievement motivation or has a lower level of achievement motivation.

Cognitive self-regulation is another factor which moderates the influence of achievement goals on learning. Self-regulation is defined as a process in which students actively get involved in learning tasks, analyze the requirements of specific assignments, make action plans, and manage the available learning resources so that they can meet these assignment requirements. During this process, they also monitor their learning progress by getting information about the completion status of assignments (Pintrich, 1999; Zimmerman, 1990; Zimmerman, Greenberg, & Weinstein, 1994). Self-regulation is the underlying working mechanism for achievement goals to differentially influence students' achievement goals and their motivation to learn. Depending on the learner's internal purposes, students' achievement goals affect their final achievement

outcomes differentially via variations of self-regulation related knowledge, skills and quality (Covington, 2000).

Three other key mediators of goals are the level of involvement in learning tasks, the perceived value of competence, and learner-perceived competence (Harackiewicz, Barron, & Elliot, 1998). Learners are more likely to be internally motivated in learning activities where they perceive that there is more value in what they are doing (competence valuation), become more motivated when they are involved in specific learning activities (task involvement), or when they feel more confident about their own abilities to deal with a learning task (perceived competence) (Harackiewicz, Barron, & Elliot, 1998) . Liem et al (2008) further explained by saying that

> Individuals with high competence perceptions are expected to be oriented toward success, positive outcomes, and would pursue an approach mode of goals, namely mastery approach, and performance-approach goals, whereas those with low competence perceptions, are expected to be oriented toward failure, negative outcomes, and would pursue a performance-avoidance goal" (Liem et al., 2008, p. 504).

Furthermore, task value/competence valuation is linked to the learner's pursuit of mastery goals and performance goals (Liem et al., 2008).

Elliot and Church (1997) stated that individual differences in learners' achievement orientations predict the types of achievement goals that student adopt in college level courses. For the learners with a low level of achievement orientations (LAMs), when they were assigned mastery goals, they were more interested in the learning activities, more likely to complete additional learning tasks during their free-choice time period, more likely to care about doing well and get involved in learning activities, reported more enjoyment, and wanted to learn more. On the other hand, for the learners with a high level of achievement orientations (HAMs), when they were assigned performance goals, they were more likely to do additional learning tasks when they were free to make choices, reported more enjoyment, got involved in more learning

activities, cared more about doing well, and were more interested in learning. For both HAMs students and LAMs students, when they were assigned both mastery goals and performance goals, both of them did additional learning tasks for similar average amounts of time, showed similar and average levels of interest in additional learning, enjoyment, learning involvement, and competence valuation (Harackiewicz & Elliot, 1993).

Overall, the working mechanism of the effect of achievement goal on learning outcomes is complicated. The relations between two groups of the factors described below are partially mediated by students' achievement goals. One group of factors includes the value that students perceive in specific learning tasks and their self-efficacy. The other group of factors includes the adoption of deep learning strategies and surface learning strategies, the level of behavioral engagement in learning tasks, and the quality of social relationship with peers. The associations between learners' achievement goals and their final achievement outcomes, in turn, are mediated by students' cognitive learning activity, behavioral pattern, and social interaction (Grant & Dweck, 2003; Liem et al., 2008; Roeser et al., 1996).

Multiple Goals for Optimal Motivation

As achievement goal theory evolved, a number of theorists supported multiple goal perspectives (Daniels et al., 2008; Harackiewicz, Barron, Pintrich, Elliot, & Trash, 2002; Pintrich, 2000a). According to this framework, a student may endorse more than one goal at the same time. Different learners adopt different combinations of achievement goals and can be classified into four types: i.e., High-mastery/High-performance (HH), Low-mastery/High-performance (LH), High-mastery/Low-performance (HL), and Low-mastery/Low-performance goals (LL). Different learners have different learning experiences -- either adaptive or maladaptive, different achievement related emotions -- either happiness or anxiety, and adopt

different regulation and learning strategies, that may lead to either positive or negative learning outcomes (Daniels et al., 2008; Harackiewicz & Linnenbrink, 2014; Pintrich, 2000a, 2000b).

This framework indicates adopting two types goals, performance and mastery achievement goals, is considered to be the most beneficial for learning (Harackiewicz, Barron, & Elliot, 1998). Barron & Harackiewicz (2001) explained that in a learning environment highlighting multiple types of achievement goals, students have opportunities to respond to the specific goals that are able to best motivate them. They further suggested that highlighting multiple types of achievement goals may be more beneficial to students than just highlighting a single goal which is less optimal to specific learners. However, assigning multiple goals in learning environments is not as beneficial as assigning a single goal which is optimal to specific students. The effects of manipulating achievement goals in learning environments are moderated by learners' individual differences in terms of achievement motivation. However, if there is no such information about learner achievement motivation, it is best to assign the combination of the two types of goals in the learning contexts.

Regarding the setting of multiple types of achievement goals in the learning context, different ways to integrate mastery goals and performance goals in learning contexts can lead to different patterns of the learning process (Pintrich, 2000a). Generally, in learning contexts with the High-mastery/High-performance goals assigned, students demonstrate the highest levels of motivation, self-regulation of their learning, cognitive strategy adoption, and final achievement outcomes. In the High-mastery/Low-performance setting, it displays the next best pattern of the four indicators, followed by the environments with Low-mastery/High-performance goals assigned, and the worst pattern usually emerges in the learning contexts with the feature of Low-mastery/Low-performance goals assigned (Bouffard, Boisvert, Vezeau, & Larouche, 1995).

It is still valid that students should be guided to pursue a mastery goal orientation and that learning environments should be set up to promote and highlight a general mastery orientation (Pintrich, 2000a). However, according to Pintrich, it is more beneficial for students to adopt multiple achievement goals at the same time.

> That is, if mastery goal students also adopt an approach performance orientation, there seems to be little cost in terms of motivation, affect, cognition, or achievement. Accordingly, as classroom situations often engender some competition and social comparison, invariably, given their general structure, and if students are focused on "approaching" the competition and comparison, there do not have to be detrimental effects if they also are oriented to mastery of their schoolwork (Pintrich, 2000a, p. 553).

This is consistent with the findings of Jagacinski and Nicholls (1987) that the cues of social comparison results did not necessarily hurt learners' self-evaluations when they were also involved in specific learning tasks simultaneously. All of these findings indicate that the presence of performance cues might not negatively affect students' achievement behaviors when mastery cues are also made salient in learning environment at the same time.

Take Aways for Instructional Design

As the major theoretical lens to analyze learning and achievement, achievement goal theories have already been used to guide instructional practices. Based on the literature reviewed, several principles for instructional design are summarized below.

At the stage of instructional analysis, achievement goal theory provides a special way to analyze learners' individual characteristics, and the features of instructional content. Based on the achievement goal theory multiple goal perspective (Pintrich, 2000a, 2000b), there can be different types of students, including performance goal dominated students, mastery goal dominated students, students with both of the goals, and students with avoidance goals. Different types of students demonstrate different patterns to regulate their learning process that may result

in different outcomes. Therefore, different instructional interventions can be designed for different types of students. Achievement goal theory could also be used to analyze and design instructional activities. For example, traditional lectures may emphasize more about performance goals (Harackiewicz et al., 1997), while seminars might focus more on whether students really understand the subject and promote mastery goals (Barron & Harackiewicz, 2001). Based on these features, instructional designers can tag the features of instructional activities, and then make sure goal setting, evaluation methods, feedback provided in learning contexts and learner characteristics are aligned with each other.

At the design stage, one major principle is to provide the most appropriate instructional interventions based on individual learners' achievement goal orientations. According to the multiple goal perspectives, emphasizing or assigning both mastery goals and performance goals can bring about the most adaptive learning process and outcomes (Barron & Harackiewicz, 2001). Based on the specific goal orientation of the individual learners, instructional designers can adjust the extent to which mastery goals and performance goals are highlighted in the learning environment, for example, designing a learning context highlighting high-level performance goals and high-level mastery goals, or highlighting high-level mastery goals and low-level performance goals, etc. Although there is no consistent conclusion about which pattern of the assigned achievement goals in the learning context works best for learners with a specific type of achievement goal, most researchers agree that goal structures in the learning context should match with learners' personal goal orientations (Harackiewicz & Sansone, 1991; Harackiewicz et al., 2002; Pintrich, 2000a).

General goal theory can also guide instructional feedback design. The general procedure framework for goals indicates the four major steps about how goals work (Austin & Vancouver,

1996). These steps can guide the researcher to decide the appropriate time when feedback should be provided to the students, such as at the stage of "Goal striving and monitoring." Regarding the content of feedback messages, according to achievement goal theory, especially the needs of students with specific goals, if mastery goals need to be emphasized in the learning environment, the feedback should provide information about whether a student is mastering a specific learning objective. If performance goals need to be emphasized, information about the normative ranking of the student should be provided as feedback. If both goals need to be emphasized, both types of feedback information should be provided. The proportion of each type of feedback information and frequency should be adjusted according to students' characteristics and the features of the learning content.

Feedback and Personalized Feedback

Feedback has been considered to be an important element in the areas of learning and instruction (Collis, Boer, & Slotman, 2001), since students can use feedback information to "confirm, add to, overwrite, tune and restructure information in memory, whether that information is domain knowledge, meta-cognitive knowledge, beliefs about self and tasks, or cognitive tactics and strategies…" (Winne & Butler, 1994, p. 5740). When designing personalized learning, personalized feedback should be an important component. In this section, related literature about feedback, a theoretical framework to analyze feedback, main dimensions of feedback design, and personalized feedback are reviewed.

A Theoretical Framework of Instructional Feedback

Narciss (2008) proposed a definition of instructional feedback: "Feedback is all post-response information that is provided to a learner to inform the learner on his or her actual state

of learning or performance" (p. 127). To understand instructional feedback and the factors that influence the effect of instructional feedback, a feedback framework (Figure 1) proposed by Hattie and Timperley (2007) to enhance learning can be used. According to this framework, the purpose to provide feedback is to help minimize the gap or discrepancy between the current level of students' performance and the desired level of performance which is the goal. To minimize this gap, there are two methods. The first one is that teachers should help students set goals at the appropriate challenge level. The second one is that student themselves make more efforts and

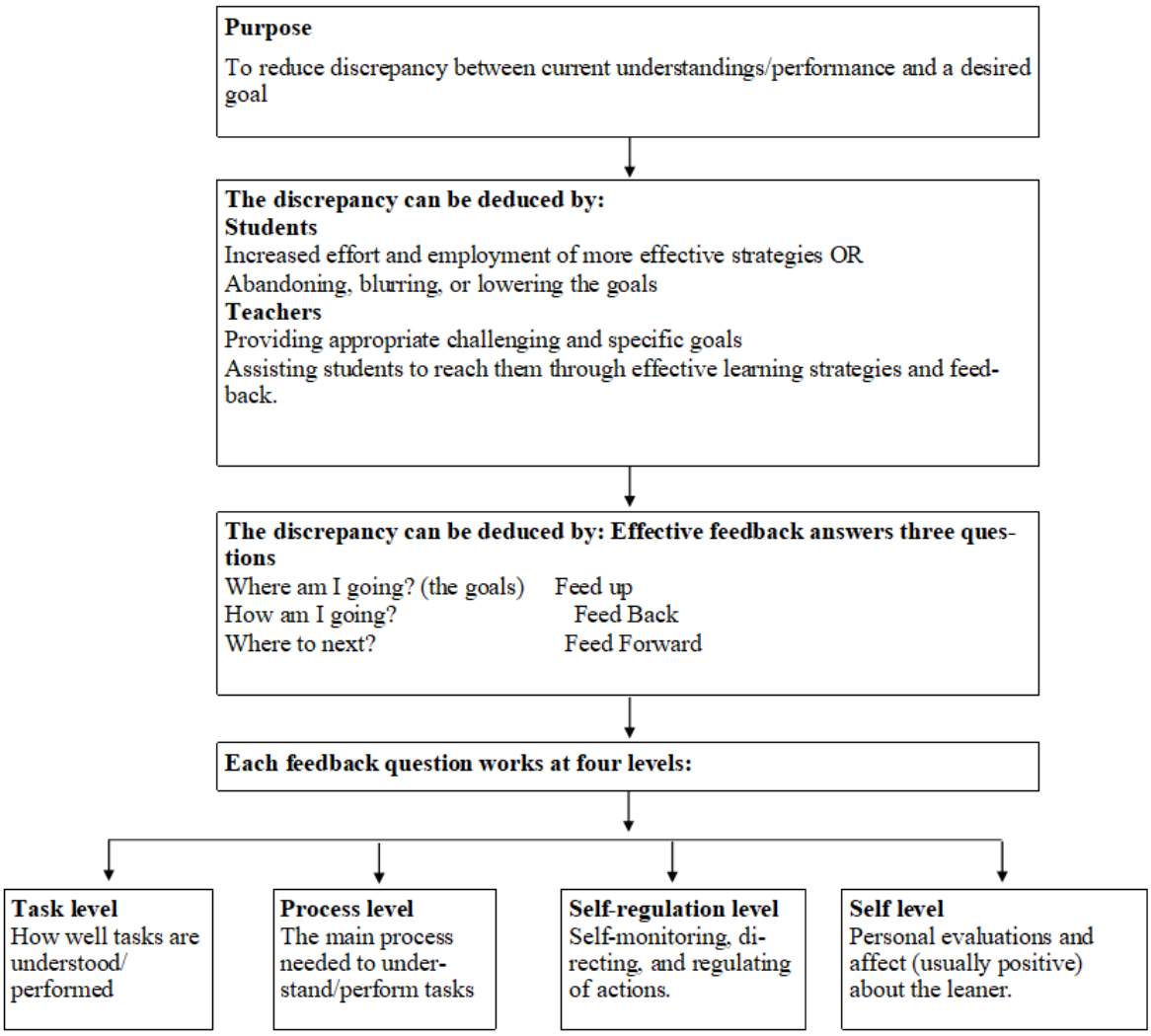

Figure 1. Hattie and Timperley (2007)'s framework of feedback

utilize more effective strategies to meet the goal. Students may also reduce this gap by just giving up or lowering the previous goals. To work effectively, feedback messages should inform students what the goals are, what progress is being made by them, and what they need to do to make better progress (Hattie & Timperley, 2007).

According to Hattie and Timperley (2007), feedback can work at four different levels with different effects, including task-level feedback, process-level feedback, self-regulation-level feedback, and self-level feedback. Feedback at task level aims at providing students information about whether their answer or work is correct or not correct. Feedback at process level provides information about how to complete an assignment or create a product. Feedback at self-regulation level delivers information about necessary skills for students to do self-evaluation or increase their confidence to improve task engagement. Feedback at self-level is directed to the students themselves, for example, "You are a good student."

Regarding the impact of feedback, Hattie and Timperley (2007) stated that the least effective feedback is that at the self-level because it delivers the least information about learners' responses. Task level feedback is effective only when students perceive feedback information is useful for them to improve process strategy or enhance their self-regulation. In other words, students should be motivated first then there can be opportunities for task feedback to work. However, Hattie and Timperley (2007) pointed out that task information is not often that useful, which may hurt the effectiveness of task-level feedback. They further pointed out that process-level feedback is more effective than task-level feedback, and feedback at process level and feedback at self-regulation level are effective to motivate students to use deep processing strategies and mastery tasks. In sum, feedback is most effective when it can guide students to move from learning task to processing and then finally to learning regulation. Therefore, it's

important to provide motivational feedback followed by task feedback or process feedback to enhance students' self-regulation (Hattie & Timperley, 2007).

Besides, the effects of instructional feedback are further influenced by learning objectives, specific requirements of the course work, learners' subjective representation of learning tasks, skills of conducting self-assessment, knowledge and strategies about processing information, motivation and techniques in dealing with challenges and correct mistakes, the ways and quality of representing task requirements externally, goals of instruction, the quality and accuracy of diagnostic process, quality of external information processing, and the quality of designed feedback messages (Narciss, 2008). Thus, feedback can be more effective if personalized feedback can be provided based on the features of the instruction and the motivational characteristics of the learners.

Dimensions of Instructional Feedback Design

To design feedback, several dimensions need to be specified, such as functional aspects, semantic aspects, and technical aspects (Narciss, 2008). Functional aspects refer to the purpose or goals of the feedback. From this perspective, feedback can be classified into cognitive feedback, metacognitive feedback, and motivational feedback (Narciss, 2008). Cognitive feedback presents information about the knowledge of learning performance, learning results/response, and the correct response. Metacognitive feedback can inform metacognitive strategies (Aleven et al., 2006; Gouli, Candidate, Gogoulou, Papanikolaou, & Grigoriadou, 2005), provide criteria for students to monitor and evaluate goals, motivate learners to generate monitoring-related information, works as a basis to assess the appropriateness of solutions, or strategies used to detect errors and correction strategies. Motivational feedback is intended to maintain the level of efforts, persistence, and intensity of processing learning tasks. Motivational

feedback has multiple sub-functions, such as incentives, task facilitation, self-efficacy, and reattribution. Focusing on these different functions, there are different kinds of motivational feedback including reattribution feedback, mastery-oriented feedback which presents a visual representation of a learner's progress, and competence feedback (Schunk & Rice, 1993; Senko & Harackiewicz, 2005). Motivational feedback aims to generate a positive impact on learners' motivation usually through stressing the relation between efforts, ability, and success; providing task information rather than performance information; making learning progress visible; or eliciting goal discrepancy (Narciss, 2008).

Semantic aspects refer to the informational content of feedback, which has two basic components (Kulhavy & Stock, 1989). The first component focuses on evaluation or verification of responses, which addresses the learning outcome and performance level that the learner achieved. This feedback component is the same as task feedback discussed previously. The second component is an informational part which contains additional information such as the task, errors, or further solutions. Using different ways to combine these two components can result in different types of feedback contents. These feedback messages can deliver information to inform students of errors or mistakes they make, clarify the rules for learning tasks, explain constraints and requirements of assignments, introduce conceptual knowledge, suggest procedure-related methods for specific learning tasks, or to recommend metacognitive strategies (Kulhavy & Stock, 1989).

Technical aspects of feedback refer to the format and mode of feedback message presentation (Narciss, 2006). This aspect focuses on timing issues of feedback delivery, which includes when students will receive feedback, how many times students are allowed to try, and adaptivity which means whether feedback can be adaptive or personalized for different learners.

Researchers have come to mixed patterns of conclusions regarding the timing of feedback. Kulhavy and Anderson (1972) explained immediate feedback might proactively affect the incorrect response, which might prevent students away from acquiring the correct response. Kulik and Kulik (1988) pointed out that when learning environment provide learners immediate feedback, students only have one chance to try, whereas with delayed feedback they have more than one chance to try for each item. For the influence on memorization, two trials in a separate way are better than just one trial, and feedback delivered in a delayed way might be better than feedback delivered immediately.

In subsequent studies, more complicated conclusions about feedback effects have emerged, which suggest that feedback with different features has different effects in different learning situations. Mathan and Koedinger (2005) suggested feedback that provides information about the correct responses should be offered in a delayed way. However, when feedback offers knowledge of the answers and knowledge that explains mistakes or errors is delivered to students in a multiple-try method, this feedback should be provided immediately. Clariana and Koul (2004) revealed that for verbatim learning outcomes multiple try feedback is less effective. However, for higher-order learning outcomes, multiple try feedback was more effective (Clariana & Koul, 2006). Research (Chandler & Sweller, 1992; VanLehn et al., 2005) suggests that when the feedback content is complex and elaborated, it is more beneficial to deliver feedback presentation in a sequential way than to deliver a simultaneous presentation.

Based on the literature review in this section, it appears to be ideal to provide feedback starting at task level, moving through process level, and finally arriving at regulation level. In order to make feedback start to work and be effective, it is necessary to design motivational

feedback to enhance students' regulation and design personalized feedback to match the features of instruction and the important motivational characteristics of individual learners.

Personalized Feedback

As described above, the technical aspects of feedback, such as making feedback personalized, are important to consider when designing feedback. Personalized feedback can be designed by considering the learner characteristics used to customize feedback, the methods to measure these learner characteristics, characteristics of the learning tasks, and the approaches to enabling the feedback personalization process (Narciss, 2008).

For learner characteristics, previous feedback studies have made feedback personalized based on state of learners' prior knowledge or current knowledge (Albert & Lukas, 1999; Hancock, Thurman, & Hubbard, 1995), learners' perceptions of correctness of their responses (Mory, 1994), learners' metacognitive status (Hancock et al., 1992, 1995; Mory, 1994), as well as learners' metacognitive skills (Aleven et al., 2006)), self-efficacy (Narciss, 2004), learning styles (Vasilyeva et al., 2008), gender (Arroyo et al., 2001), and goal orientations (Senko & Harackiewicz, 2005).

Mixed results have been found about the effects of personalized feedback. Learners with different characteristics such as different achievement levels process feedback in different ways (Hancock et al., 1995). Arroyo et al. found that personalized feedback works well for learners with lower cognitive abilities, but it does not have significant effects for learners with a high level of cognitive abilities, since different learners need instructional help in different ways (Arroyo et al., 2001). Mory (1994) did not find a significant effect of personalized feedback (in terms of personalized amount of feedback) based on a combination of response correctness and learner-perceived certainty of their responses. However, Vasilyeva et al. (2008) found positive

effects of learning style-based personalized feedback on learning performance in the context of a test. What's more, the positive effects of personalized feedback based on learners' meta-cognitive abilities were also found to increase students' help-seeking behaviors and reduce metacognitive error rates (Aleven et al., 2006).

Learner characteristics can be measured or estimated by using several methods. A manually authored finite-state machines method (Koedinger, Aleven, Heffernan, Mclaren, & Hockenberry, 2004) traces learner' current knowledge characteristics dynamically by utilizing a mathematical computation model in which learners are asked to solve given math problems. Knowledge tracing is the method that estimates students' knowledge based on the results of student exercises by using a Bayesian procedure (Anderson, Corbett, Koedinger, & Pelletier, 1995). An evaluative approach is a learner modeling method which uses the result of formative and summative evaluation in real classrooms to measure students' knowledge (Mitrovic, Martin, & Mayo, 2002). The decision-theoretic approach uses a network to represent the teacher's belief about students' knowledge. Each node within this network is created based on the probability distribution of the value of the extent to which what a student "knows" about a specific knowledge. In this method, the initial probability is based on the results of pre-tests or statistical evaluation data of a student population (Murray, VanLehn, & Mostow, 2004). A more recent method is to document observable data on students' activities in courses such as discussion, communication, sharing files, editing documents, etc., then use data mining technology to infer non-observable learner characteristics, mainly knowledge (Kutay & Ho, 2005; Melis & Andrès, 2005; Romero, Ventura, & DeBra, 2004).

The characteristics of learning tasks that can be used to personalize feedback is a less studied topic (Sanz, 2004). In an algebra tutoring system developed by Heffernan (2001), the

feedback strategies were determined by the structure of exercises. To implement a feedback personalization process, three models were summarized by Narciss (2008), including system-controlled model, learner-controlled model, and the model combining learner-control and system-control. This is consistent with the general models of personalized learning. Narciss (2008) summarized these methods but did not provide concrete research examples.

Based on the literature review, most feedback studies have focused on non-personalized feedback and feedback at the cognitive or metacognitive level. Little attention has been given to personalized feedback and motivational feedback. However, personalized feedback is viewed as a powerful method to help students to resolve learning difficulties and optimize learning experiences (Narciss, 2008). In the studies that focused personalized feedback, some of the learner characteristics on which personalized feedback was built, such as learning styles, were subsequently criticized as invalid learning constructs (An & Carr, 2017). This makes it necessary to find valid learning constructs for personalized feedback design. Senko and Harackiewicz (2005) studied motivational factors such as achievement goals. Their study found different achievement goal adoption predicted different learning outcomes, and competence feedback could help regulate achievement goal adoption. However, the feedback they provided was not actually personalized.

Considering the mixed results of the past studies, how to design effective personalized feedback is still an open question. What learner characteristics should be used to enable the personalization process of feedback? Inspired by the research work of Senko and Harackiewicz (2005), this study focused on learners' achievement goals as a learner characteristic to personalize feedback. A set of rules for personalized feedback design based on achievement goals was developed and is presented in the next section.

Derived Rules of Personalized Motivational Feedback Design

To design personalized feedback for students with different achievement goal, it's necessary to analyze the characteristics or features of students with different achievement goal types. According to the achievement goals theory multiple goals perspective framework (Pintrich, 2000a), a student may endorse more than one goal at the same time. There are four types of achievement goal patterns, including High-mastery/High-performance (HH), Low-mastery/High-performance (LH), High-mastery/Low-performance (HL), and Low-mastery/Low-performance goals (LL). The characteristics of each type of students are described in this section.

The Characteristics of HH Students

HH students usually have significantly higher expectations for achievement than other types of students (Daniels et al., 2008). They have the most interest and the highest level of perceived value in the learning content, and the lowest level of self-handicapping learning behaviors. It's more likely for them to take risks for additional learning and use more strategies at cognitive and self-regulation levels to regulate learning. They usually experience more positive affect (such as joy), but this positive affect is not stable as time passes by. They perceive less boredom but relatively higher levels of anxiety (Pintrich, 2000a). These types of students feel they are significantly more successful than other types of students in terms of learning performance. It suggests that when students adopt high levels of both mastery and performance goals, it is more possible for them to achieve the highest level of overall performance, which is also supported by Wentzel (1993).

The Characteristics of HL Students

HL students share a lot of characteristics with HH students. Their expectations for achievement are higher than students in the LL group. HL students also have a high level of interests and perceived value in the learning content, but such perceptions are not stable over time. They have positive affect (such as enjoyment), and this affect is stable. They perceive less boredom, have a relatively low level of anxiety, report fewer handicapping behaviors, and use more cognitive and self-regulation strategies. However, they report effort-withholding behaviors and have more risk-taking behaviors, but this risk-taking is not stable over time (Pintrich, 2000a). They perceive themselves as significantly more successful than students in the LH group (Daniels et al., 2008).

The Characteristics of LH Students

Adopting dominant performance goals but a low level of mastery goals, LH students are more vulnerable than HH and HL students in their psychological and emotional well-being (Daniels et al., 2008). Elliot & Church (1997) reported that achievement outcome could be promoted when students adopt high levels of performance goals but lower levels of mastery goals simultaneously. LH students do not have a positive expectation for learning success or have a positive perception of success like those students with HL and HH goals. Compared to HL students, LH students perceive significantly lower levels of success. Past research which can explain this indicates that compared to mastery students, performance goals oriented students may need a much higher level of achievement or success so that they can perceive that achievement or success (McGregor & Elliot, 2002; Valle, Antonio González-Pienda, & Rodríguez, 2003). They perceive their success at a low level close to the level of LL students' perception of success. It suggests that LH students may not be able to appropriately appreciate

what they have achieved. LH students may not have the perspective which is necessary for them to view their achievement as a success. Adopting mastery goals may help this type of students interpret their achievement properly and generate a perception of success.

The emotional characteristics of LH students are more negative. They are at least as vulnerable as the LL students. They display a maladaptive emotional feature with less enjoyment, more boredom, and more anxiety than HL and LL students. LH Students and HH students have a similarly high level of anxiety. It suggests that even when accompanied by mastery achievement goals, high-performance achievement goals appear to upgrade students' sensitivity to anxiety. Given the negative characteristics of LH students, instructional interventions should be designed and implemented to increase LH students' mastery goals relative to their performance goals (Daniels et al., 2008).

The Characteristics of LL Students

LL students are viewed as maladaptive students (Pintrich, 2000a). They are similarly vulnerable to LH students. They have low levels of expectation for achievement, perceive a low level of success, have a less positive affect, more boredom, and less anxiety. They usually achieve lower grades than all other types of students and experience cognitive and emotional distress. They have fewer interests, perceive a lower value of learning content, perceive lower levels of self-efficacy, tend to withdraw efforts, experience more procrastinating, and avoid difficulties, challenges, and risks (Pintrich, 2000a). Instructional interventions to enhance mastery goals should be provided to them (Daniels et al., 2008).

The Proposed Rules of Personalized Feedback Based on Achievement Goals

Based on the learner characteristics and recommended feedback interventions described in the previous studies (Daniels et al., 2008; Defalco et al., 2016; Pintrich, 2000a; Sarsar, 2017; Senko & Harackiewicz, 2005; Senko & Miles, 2008; Shin et al., 2017), a set of principles for personalized feedback design was extracted. Students in different learning situations may have different perceptions and experiences. For example, students have a different perception in a challenging learning situation than that in a non-challenging situation (Ames & Archer, 1988). Therefore, this set of rules differentiated the feedback design for the situations when students made correct responses (advantageous) and when students made incorrect responses (disadvantageous). For the four groups of students (HH, HL, LH, and LL) in the two types of situations, the detailed rules of designing personalized feedback are described in Table 1 in Chapter 1 and the following section. The specific examples of feedback that were utilized in these rules for study implementation are described in Chapter 3 and Appendix D.

For HH students, when they are facing an advantageous situation, defined to be no frustrating experiences, normative feedback and self-referenced feedback are provided to them. Normative feedback is defined as feedback that describes where the student locates compared to others in a study unit, such as a class (Mccolskey & Leary, 1985). Self-referential feedback is the feedback about the learner's improvement based on his or her previous performance (Shin & Dickson, 2010). When HH students are facing a disadvantageous situation, when they may experience some frustrating experiences like making wrong responses or failing to perform well, anxiety might emerge. Under this situation, promotion-focused feedback (Molden, Lucas, Finkel, Kumashiro, & Rusbult, 2009) is provided together with normative feedback and self-referenced feedback to HH students. Promotion-focused feedback delivers information emphasizing the

target learner's existing achievement (Molden et al., 2009). The purpose of providing this feedback is to mitigate students' anxiety since promotion-focused feedback is validated to be able to mitigate the negative side-effects of normative feedback (Shin et al., 2017). This is further supported by the previous research (Keller, 2006) that indicated promotion-focused students tend to attain new achievements or gains.

For HL students, self-referenced feedback is provided when they are facing an advantageous situation via visual graphs to show their achievement as times passed by. When HL students are facing a disadvantageous situation, they may make mistakes or experience failures. This may be because HL students might under-prepare for a course topic that they consider boring, which further jeopardizes their class performance (Senko & Miles, 2008). So, HL students might withhold efforts and do not have a stable learning behavior to take risks in learning additional content (Pintrich, 2000a). In this situation, it is risky just to allow personal interest to guide the learner's efforts (Senko & Miles, 2008). Therefore, task value-embedded feedback is provided together with self-reference feedback to enhance students' motivation for the current learning tasks. Task value embedded-feedback refers to feedback that highlights the value of learning task by describing the benefits associated with the learning task (Defalco et al., 2016).

For LH students, normative feedback is necessary to them. Considering their low level of mastery goals, task-value embedded feedback is provided to help them to increase their expectation toward study and increase the target value of the level of their mastery goals. Because they tend to underestimate their achievement (Daniels et al., 2008), promotion-focused feedback is provided to them to highlight their success, help them appreciate their achievement, and also mitigate the detrimental effects of the normative feedback used. When LH students are

facing a disadvantageous situation, normative feedback, task value embedded feedback, and self-efficacy motivational feedback (Defalco et al., 2016) are provided to mitigate the potential negative feelings they have in the disadvantageous situation and encourage them to make efforts to study. Self-efficacy motivational feedback is one type of motivational feedback message that provides information to enhance students' self-efficacy and motivation (Defalco et al., 2016).

For LL students, task value-embedded feedback is provided to them to address the issues that result from their low levels of mastery goals. Since they tend to perceive low levels of success, promotion-focused feedback, and self-referenced feedback are provided to them in an advantageous situation to confirm their success and efforts. The purpose is to enhance their perception of success and self-efficacy. When they are facing a disadvantageous situation, they make mistakes, withdraw efforts, and experience failures. Self-efficacy motivational feedback is provided to them together with task-value embedded feedback to highlight task value and encourage them to study.

This set of rules was used to guide personalized motivational feedback design in this study. The effects of the specific personalized feedback examples were examined by using a mixed-methods explanatory study design. The details of the study design are described in Chapter 3.

CHAPTER 3: METHODOLOGY

Research Design

The purpose of this study was to examine the effects of the personalized motivational feedback that were designed following proposed rules. A mixed-methods sequential explanatory design (Ivankova et al., 2006) was used in this study, which had two sequential phases (Table 2). The first phase was a quasi-experimental study using a non-equivalent control group design (Privitera, 2016) in which the effectiveness of the personalized motivational feedback was examined by comparing the quantitative data of assignment scores and motivation scores in the treatment group (T) and the control group (C). Study phase two was a set of post-interviews in which the participants were interviewed and their detailed perceptions of the feedback that they received were investigated, and this qualitative data and the comparison of the responses from the two groups was used to help explain the results in the first stage. Such a research design was used to answer the two research questions of this study.

RQ 1: To what extent does personalized motivational feedback based on learners' achievement goals affect learning performance and motivation in online learning? There are two research hypotheses derived from this question: (1) After delivering the feedback intervention, scores on assignments in the test group will be higher than those in the control group;
(2) The post-survey measurement scores for motivation in the test group will be higher than those in the control group.

RQ 2: What are online learners' perceptions of the feedback they received?

Table 2 A Mixed-methods Sequential Explanatory Design

Group	Phase 0	Phase 1 (Quasi-experimental study)		Phase 2
	(week 1)	Treatment delivery (week 2-6)	Measurement	
T	Pre-survey	Regular instructor feedback Personalized feedback	Post-survey (week 6) Assignment scores (week 7)	Post-interview
C	Pre-survey	Regular instructor feedback		

Note. T: test group. C: control group. Pre-survey: measured achievement goal types and learner motivation. Post-survey: measured learner motivation.

Sampling, Context, and Participants

Target Population and Inclusion Criteria

The target population was all regular online students who take online courses at the higher education graduate level. The desired sample was a group of students who were taking one specific online course in the selected university. The ideal participants should meet the criteria as below:

1. They should be the graduate students who were enrolled in an online course in a target university.
2. They should have the necessary technology tool literacy to support them to study online by using a learning management system, such as Blackboard, Engage, etc.
3. At the group level, there should be appropriate variation in the distribution of students' achievement goals so that the researcher could classify students and have the opportunity to apply the proposed personalization rules for feedback.

Sampling Procedure and Power Analysis

The sampling for the quasi-experimental study. A convenience sampling method was used for this study phase (Table 3). With the help of the faculty social network in the target university and their recommendations, a 2018 summer online course in this university with the graduate students who enrolled in it was chosen as the study context. It met the criteria of participant characteristics in this study since these students were taking an online graduate course at the higher education level in university. There was proper variation in the distribution of two achievement goals, especially the performance goals, based on the pre-survey data. It also matched the key characteristics of the target population and thus was representative.

Table 3 Sampling Methods

1. Quasi-experimental study phase	2. Post-interview phase
Convenience sampling	Critical case sampling

The selected online course was one of the core courses offered by an online master's degree program in education. The theme of this course was integrating technology in learning environments. There were five sections within this course. Four online instructors led these five sections, with one section led by two instructors simultaneously. The four instructors held Ph.D. degrees in the field. All of them had experiences and expertise in teaching and research in online contexts. The students in the online master program had relevant prerequisite knowledge of the online learning context. Students were sensitive to online instructional feedback. This was supportive of the functioning of the proposed feedback in this study. The learning content, format, assignments, and time framework were the same for all the students in all sections.

The instruction covered six weeks, beginning in June of the 2018 summer semester. The instructional activities and learning activities took place in the online environment using the Blackboard LMS. The major learning activities included weekly reading assignments, online discussions, and two major online projects. The instructor provided instructional support via Blackboard, emails, and office hours on Skype to assist students with assignments and address students' needs.

The initial power analysis was conducted by using the application G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). The major parameters needed for calculation were customarily set (Eng, 2003), with a confidence level at 0.05, the effect size of 0.5, and a power value of 0.8. For a one-sided, two-sample t-test, a sample size of 27 students was needed for each of the two groups (see Figure 2). As a result, two sections with a total of 28 students from this class were randomly chosen as the test group (T). Another three sections with a total of 40 students were chosen as the control group (C).

The sampling for the post-interview study. A critical case sampling method (Table 3) was used to make sure the sample included participants with all the four different types of achievement goals, including HH, HL, LH, and LL. This method was chosen because this study aimed at validating the effects of personalized feedback for students with these four different types of achievement goals. To recruit participants, Blackboard announcements via emails were sent by the course instructors to the students at the end of the semester. As a result, 13 participants (six from the test group and seven from the control group) responded to the email and consented to the interviews. Students with all four types of achievement goals were

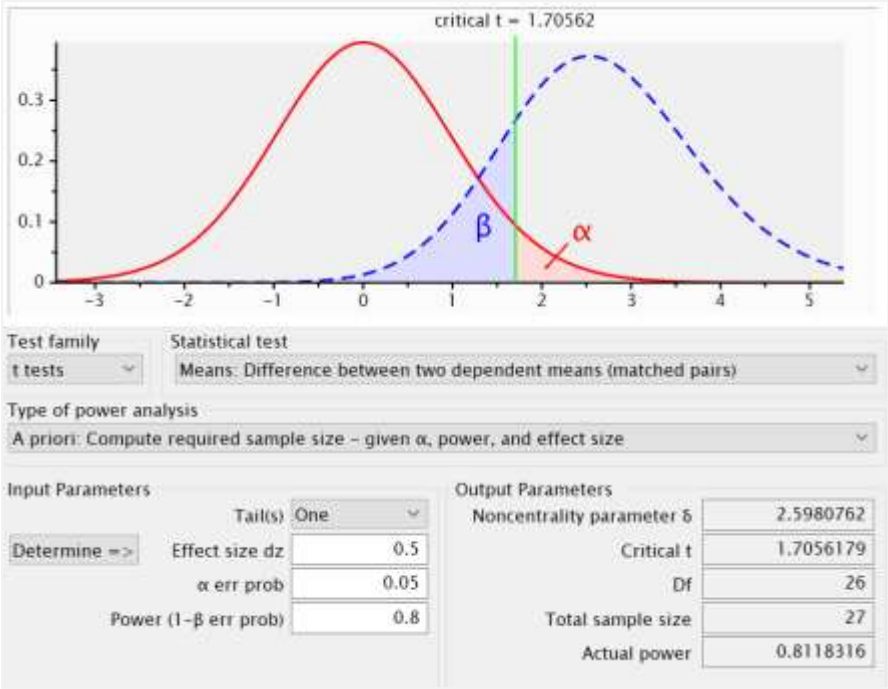

Figure 2. The result of initial power analysis

represented. As an incentive, a gift card ($20) was provided to each participant who completed the interview.

Research Procedure

Phase One

To protect the participants' privacy, an Institutional Review Board (IRB) protocol was submitted to the chosen university and approval obtained before all study activities began, and the researcher followed the procedures described in this protocol throughout the study proccess. Before the class began, in Week 1, a pre-survey via Qualtrics was conducted to identify each student's achievement goal type and measure the initial level of motivation in the learning process in the two groups. Based on students' achievement goal type, the principles proposed (Table 1) and examples of each type of feedback (Appendix D) guided the researcher to decide

what specific personalized feedback would be provided to students in the treatment group under the specific course assignment situation.

As the class proceeded, students completed and submitted each of the major assignments. In total, there were nine assignments. Students received feedback on each assignment through the feature of "Feedback to learners" in the Blackboard Gradebook. Students in the test group received both the regular instructor's feedback and personalized feedback, while students in the control group received only the regular instructor's feedback.

During the first five weeks of the course for Assignments 1, 2, 3, 4, 5, 6 and 7, in the test group two layers of feedback were posted together to students. To give such feedback, first the researcher did an initial assessment of each submission following the grading rubric for that assignment. Then, based on students' achievement goal type and the results of the initial assessment, personalized motivational feedback was designed following the proposed rules, and this feedback was posted to the Blackboard Gradebook. Then, the course instuctor logged into the Blackboard system, reviewed the assignment submissions, audited the initial assessment scores and the grading comments posted by the researcher, and added his or her regular feedback. Finally, these two layers of feedback, regular instructor feedback (RF) and personalized feedback (PF), were made visible to students to view in their gradebook. When presented to the student in the Blackboard Gradebook, the instructor's feedback appeared first and was followed by the personalized motivational feedback posted by the researcher. The principles used by the researcher to create personalized motivatonal feedback are listed in Table 1. The examples of each type of motivational feedback are described in Appendix D.

The personalized feedback interventions were delivered in the test group only at the end of Week 1 (Assignment 1, 2), Week 2 (Assignment 3, 4), Week 3 (Assignment 5), Week 4

(Assignment 6), Week 5 (Assignment 7), but there was no personalized feedback intervention delivered at the end of Week 6 (Assignment 8 and 9). Considering that the effects of the feedback only work after students receive the feedback, the scores of Assignment 1 and 2 were not affected by the proposed personalized feedback and thus can serve as a covariate for assessing the effects of the treatment and to check for group equivalence.

The students in the control group only received the regular instructor feedback (RF) throughout the semester. There was no personalized motivational feedback delivered to them.

Near the end of the summer semester, in Week 6, all students were administered a post-survey via Qualtrics to measure students' post-course motivation. The pre-post surveys were included as a regular part of the course. Like the other instructional activities and content, the surveys were mandatory for all students to complete.

After the semester ended, the scores of all the assignments (Assignment 1-9) in the two groups were collected from the course instructors to measure students' learning performance (LP). However, for the scores of Assignment 2 and 9, there was no variation observed in some class sections during initial data checking thus they were viewed as invalid data. Therefore, in the end, the summed scores of Assignments 3,4,5,6,7 and 8 were included as a dependent variable for the measure of learning performance, and the scores of Assignment 1 were included as a covariate.

Phase Two

After the semester ended, the course instructors sent out an email to help recruit participants for interviews. Thirteen students (six from the test group and seven from the control group) who completed this course responded that they were willing to participate in the interview. To reduce time during the interview, those students who agreed to participate the

interview filled out a demographic questionnaire (Appendix G) online prior to the actual interview, and these data were included as part of the interview data. Then, a 20-40-minute post-interview was conducted with each participant via phone or Skype to understand his/her perceptions about the perceived impact of the feedback on his/her learning motivation and outcomes. Upon students' agreement, each interview was audio recorded, and the audio files and transcription documents were saved on a passcode-protected computer. The transcription documents were de-identified through assigning each interviewee a pseudonym. The purpose of this post-interview was to gather students' perceptions that might not be captured by the surveys and might help inform the quantitative results. Pintrich (2000a) noted that students with different achievement goals probably have different experiences or perceptions during the learning process even if they have the same learning outcomes.

The interview results were expected to yield themes about students' perceptions of the effects of the feedback on their learning motivation and performance and how they used this feedback information in their learning process, which could support or further explain the findings from study phase one. The impact of this personalized feedback on improving online learning could be further analyzed by comparing the participants' responses in each theme between the two groups.

Data Sources and Measurements

The major data sources were the measurement results of the input variable (achievement goals), output variables (learning performance and motivation), and the investigation of learners' perceptions of the feedback they received in the class. The measurement instruments used are listed in Table 4. The detailed psychometric data of each instrument are described in this section.

Table 4 Major Data Sources and the Measurement Instruments

Measurement Item	Instrument	Author	Details
Achievement goals	Pre-survey Part 1	Midgley et al. (1998)	Appendix A
Motivation	Pre-survey Part 2, Post-survey	Keller (2006)	Appendix B
Learning performance	Grading Rubric	The course instructor	Appendix E
Perceptions of the feedback	Interview protocol	The researcher	Appendix C

The Instrument to Measure Achievement Goals

Learners' achievement goal type was measured by using an online pre-survey adapted from the scale created by Midgley et al. (1998). According to the method used by Pintrich (2000a) to measure achievement goals, one subscale pertaining to mastery goals and one subscale pertaining to performance approach goals were selected and included in this survey. The parts pertaining to avoidance patterns of performance goals were excluded. Finally, there were two sub-scales with 12 items on a 7-point Likert-type scale. One scale (items 1-6) was focused on mastery goals, which has a Cronbach's alpha greater than 0.70. The other one was focused on performance goals (items 7-12), which has a Cronbach's alpha greater than 0.6. The internal consistency of each scale is 0.84 (Midgley et al., 1998). See Appendix A. Approximately 5-10 minutes were needed for the participants to complete this part of the pre-survey.

To examine the interaction of the two parts and classify students, Pintrich (2000a) dichotomized the two categories by using a method called "median splits." Based on the data collected in his study, students scoring below 4.8 on mastery items were identified as "low

mastery" and students scoring under 4.6 were identified as "low performance." As shown in Figure 3, the median point (4.8, 4.6) was used to divide the subjects into four groups (HH, HL, LH, LL) corresponding to four different achievement goal types.

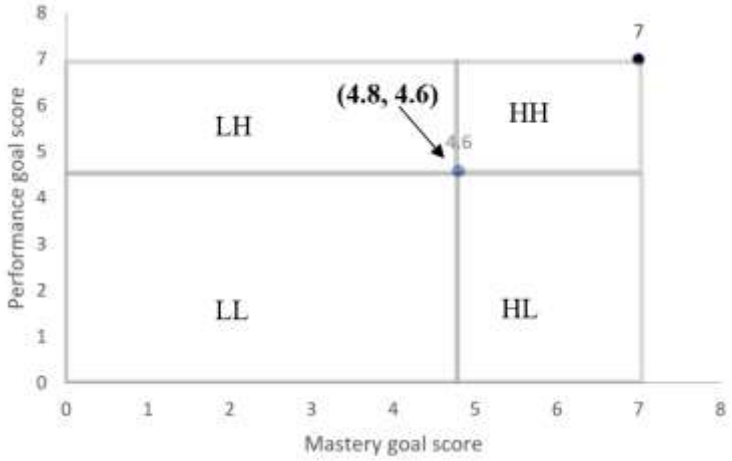

Figure 3. Pintrich's method to categorize achievement goal types

The researcher applied a similar method to classify the students in this study. The participants in this study were adult learners, different from Pintrich's K-12 students. The actual distribution of the students with different achievement goals in this class was also different, so the researcher adjusted the method. According to the median values calculated in this study, students with a mastery goal value equal or lower than 5.7 were identified as students with low mastery goals, and those with a mastery goal value higher than 5.7 were identified as students with high mastery goals. Similarly, students with a performance goal value equal or lower than 3.5 were identified as students with low-performance goals, and those with a performance goal value higher than 3.5 were identified as students with high-performance goals. The purpose of this adjustment was to make the result of classification match better with the actual distribution of students' achievement goals in this study. At the same time, four types of students based on

achievement goals emerged, which allowed the researcher to test the personalization rules for all four types of students.

The Instrument to Measure Learning Performance

At the end of the course, the raw scores of all course assignments collected from the course instructors were used as data source to measure dependent variable 1 (learning performance). The assignments and the grading rubrics were created by the course instructors and had been used for multiple years. The assignments covered all the major learning content in this course. The assignments and rubrics had been reviewed multiple times by the course instructors, who were the subject experts, as well as by student users, and graders, and they were updated based on various types of feedback. Therefore, this measure of learning performance was assumed to have acceptable validity and reliability.

As it is described in the section of study procedure, based on how the feedback intervention was delivered during the study process, its expected impact, and the variance observed, in the end the summed scores of Assignments 3,4,5,6,7 and 8 were included as a dependent variable for the measure of learning performance, and the scores of Assignment 1 were included as a covariate.

The Instrument to Measure Learning Motivation

At the beginning and the end of the course, dependent variable 2 (motivation) was measured by using an online Qualtrics pre and post-survey with items from an existing instrument (Keller, 2006). The instrument (See Appendix B) consists of 34 items on a five-point Likert-type scale. Approximately 10-15 minutes were needed for each student to complete it.

This instrument can be further grouped into four sub-themes, Attention, Relevance, Confidence, and Satisfaction. Two rounds of psychometric testing were conducted by Keller in undergraduate classes, and the items were updated and improved based on the testing results. The Cronbach's alpha of the total scale is 0.95 (subtheme Attention 0.84, Relevance 0.84, Confidence 0.81, and Satisfaction 0.88), which indicates a high internal consistency. The measured scores correlated with students' course grades significantly (r=0.47), which supports the validity of this instrument as a situation-specific measure of motivation.

The purpose of measuring learning motivation twice was that the researcher wanted to examine the potential effect of the proposed feedback on motivation by comparing the pre and post data. Naturally, without any special intervention, motivation generally tends to decrease as time passes by (Pintrich, 2000a). The researcher hypothesized that by receiving the proposed personalized feedback with embedded information in the test group, students' motivation would increase or at least stay constant as time passed by.

The Instrument to Investigate Learner's Perceptions of the Received Feedback

After the course ended, learners' perceptions of the received feedback were investigated by using a semi-structured post-interview via cell phone or Skype. This interview protocol was developed by the researcher. It required 20-40 minutes for each participant to complete each interview. To enhance validity and reliability, four faculty members with expertise in online learning were invited to complete expert reviews. Five doctoral students majoring in education who had online learning experiences and qualitative research experiences were also invited to pilot the interview protocol. Revisions were made based on their feedback. See the updated interview questions in Appendix C.

Before creating this protocol, the researcher took steps to clarify potential researcher bias (Creswell, 2013). The researcher had previous teaching experiences related to providing students feedback in the online contexts, such as giving online feedback by using BlackBoard and Passport LMSs. The past experiences of using various types of feedback may have influenced the researcher to advocate for specific personalized feedback even before the study began. Therefore, the researcher took steps to make her biases explicit before the data collection to avoid pre-assumptions which may have affected the inquiry. Reflexivity through the researcher's self-reflection was also made to preclude potential researcher bias.

Before the interview began, the demographic data of the 13 participants was collected via an online questionnaire (Appendix G). Then, communication via emails was used to build trust and rapport between the participants and the researcher so that more authentic responses could be collected during the interview (Creswell, 2013). During the interview and the data processing process, the researcher closely followed the interview protocol. Critical and negative cases (including the students who expressed negative perceptions about the received feedback) were also included to enhance reliability (Creswell, 2013).

Methods of Data Analysis

Data Analysis of the Quasi-Experimental Study Phase

Motivation and achievement goals were measured on an ordinal scale. The raw total assignment scores were measured on a ratio scale. First, basic descriptive statistics were calculated for these three variables. Then, for the motivation scores, two sample t-tests were used to compare general motivation and subtheme motivation between the two groups, since the data distribution was approximately normal. Then, ANCOVA F tests were used to examine the difference while controlling the general motivation scores and subtheme motivation scores

measured in the pre-survey as covariates. For the assignment scores, Wilcoxon two-sample tests were used to analyze the difference between the two groups, since the data distribution was not normal. Then, ANCOVA F test was also used to examine the difference while controlling the scores of assignment 1 as a covariate. More details are described in Table 5 and Table 6. The measurement results were organized in tables, to show the distributions and comparison results.

Table 5 Descriptive Analysis Methods

Variables	Frequency	Mean	Median	SD	Distribution
Achievement goal type	×	×	×	×	×
DV 1 (learning performance)		×		×	×
DV 2 (motivation)		×		×	×

Note. SD: standard deviation

Table 6 Inferential Analysis Methods

Variables	Range	Analytic technique
DV 1 (learning performance)	0-55	Wilcoxon two-sample test
		ANCOVA F test
DV 2 (motivation)	34-70	Two sample t-test
		ANCOVA F test

Data Analysis of the Post Interview Phase

First, all the interviews were audiotaped and then transcribed in a verbatim way by the researcher. Once the transcription was completed, researcher review and member checking

(Creswell, 2013) were conducted to make sure the transcription was accurate. All the transcription documents were saved on a password-protected computer.

Then, QSR International's NVivo 12 Pro (QSR, 2019) software was used to do qualitative coding. Based on the purpose of this study, a set of prior codes (see Appendix F) was created before actual coding started and served as the initial coding schema to guide the incoming coding work. Before actual coding work started, the researcher coded one small part of the transcription document at the different time spots, then made adjustments, and made sure the coding was consistent throughout and the coding schema worked well.

After coding and analyzing of responses and the relationships of different codes, a set of themes about the research questions were expected to emerge through the analysis. For example, the themes included students' perception of the impact of the feedback on their learning performance and motivation, and the ways that students used feedback messages in their learning process.

Further analysis was conducted based on these emergent themes. Comparison analysis was conducted by using NVivo's Crosstab Query Feature to investigate the difference between the two groups. For example, what is the difference between the perceptions of the effects of the feedback on learning performance in the two groups? What is the difference between the perceptions of the effects of the feedback on learning motivation in the two groups? What is the difference between the ways that students in the two groups used the feedback messages they received? It was expected students' perceptions could further explain the results of the first study phase.

Validity, and Trustworthiness of the Data

As previously stated, this study used a convenience sampling method. There was no true randomization in sampling, which cannot preclude sample-specific factors which may affect internal validity, such as students' cultural background. To address this concern, a control group and the pre-post measurement setting in this study were used to mitigate the effects that might be caused by student-related factors, such as the pre-existing level of students' motivation and their learning performance.

Second, the reactive effects of the treatment arrangements may make it difficult to generalize the conclusion to other-experimental settings. This group of students had the relevant background experiences or skills related to online learning. Instructional design was the core knowledge and skill of the students in this area. Both instructors and students were probably more sensitive to the online setting and the received feedback. The situation might be different for participants with a different professional background. The method used in this study to mitigate that concern was to set a clear set of inclusion criteria and then follow those criteria strictly so that the sample is representative. The control group used in this study was also helpful to mitigate reactive effect.

Last, the factor of researcher bias may jeopardize trustworthiness of post-interview. This feedback intervention was designed and delivered by the researcher. The data were also analyzed by the researcher. The researcher hypothesized that the personalized feedback had a positive effect on online learning. Based on this, there may have been researcher bias during the study process, such as guiding interviewees unconsciously during the interview. To avoid this, researcher reflexivity was conducted throughout the interview and data analysis process. Two rounds of interview transcription audits were conducted by the researcher to make sure the

transcriptions reflect the exact meaning expressed by the interviewees. One interview was re-conducted to address the poor quality of the original audio file and make sure the interviewee's responses were accurately documented. To further enhance the trustworthiness, member checking was also conducted. Through member checking, the interviewees identified and revised the incorrect parts emerged in the original transcriptions. All these methods enhanced the trustworthiness of the interview.

CHAPTER 4: RESULTS

The Results of Study Phase One

The Result of Input Variable Measurement

Students' achievement goals, as measured via the pre-survey, were used as an input to design personalized motivational feedback. Sixty-eight responses were received from the two groups of students. The mean value of the first six items of this instrument was calculated as an indicator of a student's mastery goal level. The mean value of the last six items was calculated as an indicator of the performance goal level. At the class level, the minimum, maximum, mean value, median, and standard deviation of the two achievement goals for all students' responses were calculated and are shown in Table 7. The results show that most of the students had a high mastery goal value, ranging from 4.8 to 7. On the other hand, the distribution of the performance goal value had a larger variance, ranging from 1 to 7. This obvious difference made it possible to for the researcher to differentiate students and apply personalized feedback in this study.

Table 7 The Descriptive Statistics of Achievement Goals

Goals	Minimum	Median	Mean	Maximum	SD
Mastery goal	4.83	6.08	6.15	7.00	0.57
Performance goal	1.00	3.67	3.63	7.00	1.22

As described in the methods section in Chapter 3, students were categorized into four groups. The numbers of the students in each group are shown in Table 8. It shows HH and HL were the two largest groups, and relatively fewer students fell into the LH and LL groups.

Table 8 Counts of Students with Different Achievement Goals

Study group	HH	HL	LH	LL	Total counts
Test	13	9	2	4	28
Control	13	16	7	4	40
Total counts	26	25	9	8	68

The Results of Dependent Variables Measurement

Motivation Measurement Results

Learners' motivation was measured at the beginning (Week 1) and the end of the course term (Week 6) using Qualtrics surveys. The initial data checking indicated that the distribution of motivation scores was approximately normal. One-sided, two-sample t-tests were used to measure the difference between the control group and the test group. For the pre-test motivation, at the mean level, the control group's motivation (mean =138.10) was somewhat higher than that of the test group (mean=132.00), but the difference measured was not significant statistically (t=1.40, *p*=.17). See Table 9.

Table 9 t-Test Results Comparing Test and Control Group on Pre-test Motivation Scores

Group	n	Mean	SD	t Value	DF	*p*
C	39	138.10	20.94	1.40	65	0.17
T	28	132.00	14.33			

For the post-test motivation, the test group had a higher motivation value (mean=144.90) than that of the control group (mean=140.50). However, this difference was not statistically significant (t=-0.96, *p*=.34). See Table 10. In both of the two groups, the post-test motivation mean score was higher than the pre-test motivation mean score. In the test group, the increase of motivation score (mean gain=12.90) was higher than that of the control group (mean gain=2.40) which might suggest an impact of the feedback treatment.

Table 10 t-Test Results Comparing Test and Control Group on Post-test Motivation Scores

Group	n	Mean	SD	t Value	DF	*p*
C	34	140.50	22.39	-0.96	57	0.34
T	28	144.90	14.79			

To further explore the effects, the researcher also conducted an ANCOVA F test to measure the group difference on post-test motivation scores when controlling the effects of pre-test motivation scores as a covariate, since the pre-test motivation scores were not affected by the feedback intervention. The ANCOVA F test result (see Table 11) shows for the variable Group,

Table 11 ANCOVA F-Test Results on the Motivation Scores

Dependent Variable: Post-test motivation

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	8064.14	4032.07	16.19	<.0001(**)
Group	1	1162.94	1162.94	4.67	0.03(*)
Pre-test motivation	1	7742.46	7742.46	31.09	<.0001(**)
Error	59	14694.52	249.06		
Corrected Total	61	22758.67			

R-Square=0.35

Note. * indicates there is a difference at the .05 significance level. ** indicates there is a difference at the .01 significance level.

F=4.67, p=.03. It indicates that there was a statistically significant difference in the post-test motivation between the two groups when the effects of the pre-test motivation were controlled. This suggests there was an effect of the feedback treatment on students' motivation.

The researcher further tested the group differences at the motivation's sub-theme level. Two-sample t-tests were conducted for each subtheme using the post-survey data. The result shows the mean value for motivation sub-themes attention, relevance, and confidence in the test group was higher than that in the control group, but there was no statistically significant difference. However, the mean value for the motivation subtheme satisfaction for the test group (Mean=39.14, SD=4.33) was higher than that in the control group (Mean=36.38, SD =7.70), and this difference approached the borderline of significance ($p\approx.07$). See Table 12.

Table 12 t-Test Results Comparing Test and Control Group on Motivation Subtheme Scores

	Attention		Relevance		Confidence		Satisfaction	
	Mean (SD)	*t(p)*	Mean (SD)	*t(p)*	Mean (SD)	*t(p)*	Mean (SD)	*t(p)*
T	29.54 (5.43)	0.45(0.65)	39.96(4.45)	0.72(0.47)	36.42(2.85)	0.92(0.36)	39.14(4.33)	1.81(0.07)
C	28.89 (5.91)		39.06(5.38)		35.55(4.67)		36.38(7.70)	

Then an ANCOVA F test was conducted to further measure the difference while partialling out the motivation subtheme satisfaction scores measured in the pre-survey. The results indicated that there was a significant difference between the two groups, F =5.85, p=.02. See Table 13. Students who received personalized feedback demonstrated higher levels of satisfaction than students who only received the regular instructor's feedback. It indicates that the personalized motivational feedback enhanced students' perceived satisfaction as indicated by higher satisfaction mean scores and smaller standard deviation value. This suggests the personalized motivational feedback that was designed to align with students' individual achievement goals according to the proposed personalization rules was beneficial in terms of students' motivation, especially the subtheme satisfaction.

The Results of the Comparison of Assignments Scores

Once the semester ended, the scores of Assignments 1-9 were collected from 68 students, 28 from the test group and 40 from the control group. Basic descriptive statistics were calculated for the scores of each assignment to check the data distribution. The results (Table 14) showed that the data were severely skewed with most scores clustered toward the high end of the distribution.

Table 13 ANCOVA F-Test Results on the Post-test Subtheme Satisfaction Scores

Dependent Variable: Post-test satisfaction

Source	df	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	620.42	310.21	9.22	0.0003(**)
Group	1	196.83	196.83	5.85	0.02(*)
Pre-test satisfaction	1	518.56	518.56	15.41	0.0002(**)
Error	59	1985.06	33.65		
Corrected Total	61	2605.48			

R-Square=0.24

Note. * indicates there is a difference at the .05 significance level. ** indicates there is a difference at the .01 significance level.

Table 14 The Mean and Standard Deviation Values of Each Assignment Score

Assignment	Full	Test Group		Control Group	
ID	score	Mean	SD	Mean	SD
A1	5	4.91	0.39	4.61	1.19
A2	5	5.00	0.00	4.63	1.15
A3	5	4.64	1.31	4.81	0.50
A4	10	9.96	0.19	9.75	0.59
A5	25	24.11	1.13	23.35	2.57
A6	5	4.91	0.27	4.76	0.85
A7	5	4.64	1.03	4.68	0.98
A8	5	4.27	1.37	4.65	0.79
A9	35	33.82	1.09	34.1	1.17

There was no variation observed in Assignment 2 and Assignment 9 in some class sections, which suggests the scores of most assignments might have a ceiling effect. As described in Chapter 3, the summed scores of Assignment 3-8 were included as the dependent

variable, and the scores of Assignment 1 were included as a covariate. This data inclusion was determined based on how the feedback intervention was delivered, its expected impact, and the variance observed.

The basic statistics results showed that for the summed scores of Assignment 3-8, the test group (mean=52.53, SD=3.29) had a slightly higher mean score than the control group (mean=52.00, SD=3.56). However, Wilcoxon Two-Sample (Rank Sums) test did not find a significant difference between the two groups (p>.05). Considering the possible confounding effects of the covariate, students' assignment scores prior to receiving any feedback intervention, an ANCOVA F test was conducted to measure the group difference with the scores of Assignment 1 used as the covariate. The ANCOVA F test results (Table 15) showed although the scores of Assignment 1 were significantly associated with cumulative scores the researcher measured, there was not a significant difference of cumulative assignment scores between the test group and the control group (F=.02, p=.88) when the effects of this covariate were partialled out. This result suggests that the personalized feedback intervention did not influence students' achievement scores in the course.

The Results of Study Phase Two

Participants' Background Information

To further understand students' perceptions of the received feedback and explain the results in the quantitative study phase, 13 students from the class responded to a demographic

Table 15 ANCOVA F-Test Results Comparing Test and Control Group on the Assignment Scores

Dependent Variable: sum3_8

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	117.10	58.55	5.63	0.006(**)
Group	1	0.24	0.24	0.02	0.88
Assignment 1	1	112.42	112.42	10.82	0.0016(**)
Error	65	675.66	10.39		
Corrected Total	67	792.76			

R-Square: 0.15

Note. * indicates there is a difference at the .05 significance level. ** indicates there is a difference at the .01 significance level.

questionnaire (Appendix G), and then they were interviewed after the summer semester ended. The background information of the participants is summarized in Table 16. Six of them were from the test group, and the other seven participants were from the control group. Regarding their achievement goal types, six students fell into the HH group, five students fell into the HL group, one student fell into the LH group, and one student fell into the LL group. Four of them were male, and all the others were female.

According to the participants' background information, most of them had prior experiences with online learning and learning feedback, ranging from having completed no formal online course at all to almost having completed all the courses needed to receive the online master's degree. As adult learners, all these participants highly valued online learning feedback from their instructors. Their responses indicated that the instructor's feedback was very important to them, helped them address specific learning challenges, kept them engaged in the

Table 16 Background Information on the Interview Participants

ID	Pseudonym	Group	Goal	Gender	Previous Online Learning Experiences
1	Mike	Test	HL	Male	Completed six online courses
2	Aasta	Test	HH	Female	Completed eight online courses
3	Kala	Test	HH	Female	Completed twelve online courses
4	Maggie	Test	HL	Female	Completed seven online courses
5	Kate	Test	LL	Female	Completed twelve online courses
6	Fairfax	Test	HH	Male	Experienced EdX MOOC courses but completed zero formal online courses
7	Karolinda	Control	HH	Female	Completed twelve online courses
8	Rabi	Control	HL	Female	Completed five online courses
9	Adena	Control	HH	Female	Completed eight online courses
10	Reena	Control	LH	Female	Completed five online courses
11	Blake	Control	HL	Male	Completed four online courses
12	Sabrina	Control	HL	Female	Completed twelve online courses
13	Yvan	Control	HH	Male	Completed one online course

learning process and maintained the connection with the learning program. Before taking this online course, almost all of the participants experienced some positive feedback and non-positive feedback which they thought could be further improved. They identified the features of prior positive feedback examples, such as being delivered in a timely manner, constructive, specific, and delivered in a way that can be checked conveniently, etc. The prior negative feedback examples they reported had features like being written in a punitive style, too vague, too general, not frequent enough, etc. It indicates most of these participants were experienced,

and they were able to evaluate and criticize the feedback they received in a meaningful way. The interviews were first transcribed verbatim and then analyzed by using NVivo 12 Pro, addressing the second research question, "What are online learner's perceptions of the proposed feedback?" Five major themes emerged: (1) students' overall perceptions about the effect of the specific instructional feedback received in this course; (2) the impact of feedback they perceived on their learning motivation; (3) the impact of the feedback they perceived on their learning performance; (4) the ways they used the received feedback message in the learning process; and (5) their suggestions to improve feedback. These themes are reported in the following sections.

Theme 1: Students' Overall Perceptions of the Received Feedback

For the interview question "What is your overall perception of the feedback you received from the course instructors/TAs in this course [the target course ID]?" three types of perceptions emerged from the responses in both groups, including positive perceptions, negative perceptions, and mixed patterns of perceptions. The factors that led to positive perceptions include that the received feedback showed students the correctness or quality of their assignment submissions, the feedback indicated whether students were on the right track, the feedback encouraged students to continue learning, etc. The features of this positive feedback were timeliness and specificity. The causes that led to negative perceptions included that the received feedback was not very specific, or the feedback did not provide enough critiques to make the feedback very constructive.

Using the feature Crosstab Query of NVivo 12 Pro, students' overall perceptions of the received feedback between the two groups were compared to investigate the differences. First, the researcher found all the students in the test group expressed more explicitly and strongly that they had an overall positive perception of the feedback received in this course. For example,

Mike said, “I thought it (the feedback) was great, and it was one of my favorite classes… In this class, I thought it (feedback) was consistently good.” Similarly, Kala had the same perception, “I feel very strongly about the feedback being excellent, like, better than other courses taken.”

While for the control group students, there were different voices for their perceptions of the feedback. Some of them felt the feedback was very positive. This positive perception can be found in Rabi’s response, “The feedback I received was encouraging, and it helped me continue working. And I always waited for the feedback to make sure I got the right track.” Yvan also mentioned the feedback was timely and very helpful.

However, there were also some responses from the control group that indicated students did not have an overall positive perception, and they wanted the feedback to be improved. For example, Karolinda didn’t feel the amount of the received feedback was enough, “In this course, the online feedback (I received) was much less than all my previous work, previous course...” When asked whether she found helpful feedback examples in this class, Karolinda answered, “not really.”

> Yeah, like I said, I'm really looking for the professor to go through (my work) and comment. (What I got is) Oh, this is great. This is (a) great idea, but not so much. You know, that’s not going to work, stuff like that. I needed somebody really go through (my work) and bounce idea(s) off of. (Karolinda, control group student)

Although Karolinda got full points for one assignment she still wanted to get feedback that can provide further clarification of this result.

> And even on my final project [project name], you know, it was, I turned it in, and all I know is, I got, I received all of the points on. So, I got, a, 100 percent (of the scores) and A, which is awesome. But, again, no feedback (about) what’s the matter. (Karolinda, control group student）

Some other students in the control group had overall mixed patterns of perceptions, which did not emerge in the test group students. Blake and Adena felt there were positive and non-positive pieces in their received feedback.

> It (the feedback) was a pretty good (one), as I think, it, it, just, it just lacked the more constructive feedback. But it was timely. I didn't have to wait around a lot of time to find my, my graded material, which is also important to me, because I like, it's good to know where I need to improve on early." (Blake, control group student)

Adena also had a mixed pattern of perception.

> The comment (feedback), said, like, positive. You know, like, this is well done, or, nice work, but sometimes it did not specify what was nice work about it. But there were some degrees of specificity like with the some of those assignments as opposed like the discussion board posting. There will be a little more specific feedback. But again, like nothing really was an opportunity for improvement or growth for me. Only sometimes. (Adena, control group student)

Since students in the test group received a second layer of personalized motivational feedback, it is necessary to look closer to see how this added layer of feedback contributed to their overall positive perceptions. The test group students identified some key features of the personalized feedback components, such as being delivered in visual way (self-referential feedback, normative feedback, promotion-focused feedback), providing visual representations to highlight students' accomplishments (promotion-focused feedback), providing visual data to show the trend of personal growth (self-referential feedback), providing references for comparison with personal and peers' performance (self-referential feedback and normative feedback), and providing backup message to encourage students to study (self-efficacy motivational feedback). Students felt these features contributed to their overall positive perceptions of the received feedback.

> I think it, it painted a picture for me in a very concrete way, that I could see how I was doing if I was improving. Or, maybe one week, we get down a little bit, and also compare to other people in the class, and I love that I could chart my growth through that rhythm. (Kala, test group student)

> So, the wording form above the chart, that is, congrats, congratulations, you have a positive learning trend, showing (in the) graph below. You know, that, it's like, you know, learning trend and analysis. Something like that, right, so, that aspect is also useful to me. (Fairfax, test group student)

The test group students, Fairfax and Kate, liked the visual badges, one form as promotion-focused feedback embedded in the second layer of feedback, which highlighted what students had achieved in this course.

> I remember, there are badges, the badges. Yeah. The badges gave you five points, (or) 7 points out. That thing, that visualizes your, your accomplishments. So yeah, that is also good. So overall, my experience is, that is, the thing, kind of, motivate more, get my attention, to so it's better than just words. (Fairfax, test group student)

Kala liked the "backup" feedback and got encouraged to do further learning.

> You color code your responses, and you gave me very clear and concrete feedback, so that I could improve my post, this discussion post, and I thought that answered correctly, and you give me backup feedback, (such as) thank you, don't worry, you could improve, and make me think more clear. And so, I went back and up to change something, to make it better based off of your feedback. So, I really appreciate it. (Kala, test group student)

From the test group students' perspective, it seems both layers of feedback, regular instructor feedback and personalized motivational feedback, worked together to contribute to their positive perceptions of the received feedback.

> So, I felt like, that was really helpful to have both of those together within that feedback, both the chart and the written feedback as well. (Aasta, test group student)

> As I said, I felt like this course was well rounded in terms of the way that it gave feedback. There were often different methods provided for giving feedback. And it is very timely and constructive. So overall, I am very pleased with the feedback that I received in this course. (Kala, test group student)

Theme 2: The Perceived Impact of the Feedback on Learning Motivation

For the interview question "What is the impact of the feedback on your learning motivation?" two types of perceived impact emerged, positive impact and no impact. For the positive impact, students felt that the feedback they received kept them engaged in the learning process, encouraged them to take more steps for additional learning, caught their attention,

helped them perceive more confidence in learning, and made them feel more active. Students who felt there was no impact of the received feedback on their motivation emphasized that they were more self-driven in the learning process, and their motivation was not impacted by the external feedback they received from the instructors.

Further analysis found that the reported positive impact on motivation emerged in both groups. However, the perception "no impact" was only noted by the control group students. In the test group, one student, Mike, said, "(I) found both (two layers of feedback) that is managing my motivation, and keep me engaged in the class, and I also found that helped me kind of explore a little more deeply, and really engage with the materials." In the control group, Rabi had a similar feeling, "… I think, that feedback is good in that it helps you, you know, if you're on the right track or not on the right track." The perception of "no impact" only emerged in the control group. Blake is a good caseWhen asked why the received feedback had a positive impact on their motivation, the students in both groups gave further explanations. Students from both groups indicated that they were motivated by the feedback that addressed the specific issues in their assignments. Sabrina from the control group explained that, "Getting that feedback is really just like validation that, we're, our thought process is going along right, or, that we're meeting the requirements, that we don't necessarily get that face to face interaction with the professor, like, you would if you're on campus." This same perception also emerged in the test group, such as in Maggie's case, "getting feedback and written feedback directly onto the document itself is very valuable because you can read it. Number one, you know the instructor actually looked at your work and read through it, because they're giving you specific examples of how you can improve your work..."

In the test group, students reported that the two types of feedback impacted their motivation positively in a unique way that did not take place in the control group. The feedback affected learners' motivation by having them adjust their goals and activated their internal self-regulation process. Kala's experience is a good example.

> I think, it, it (the personalized feedback) painted a picture for me in a very concrete way. That, I could see, how I was doing, if I was improving, or maybe one week we get down a little bit, and also compare to other people in the class. And I love that I could chart my growth through that rhythm… I would always make sure to look at that feedback closely to see where I was, and how I was doing. And if, it's almost like, it was like a goal setter for me, like I could manage my goals for improving in the course through those charts. I could look at it and say, OK, you know, I got down a little bit, and I wanted to get back up. And, it's just such a clear way of looking at it. (Kala, control group student)

Theme 3: The Perceived Impact of the Feedback on Learning Performance

For the interview question, "What is the impact of the feedback on your learning performance (in terms of assignment scores)?", two types of responses from students emerged in both groups. The first one is that the feedback had a positive impact on learning performance. The second one is the feedback had no impact on their learning performance.

When comparing the perceived impact of feedback on learning performance in the two groups, the researcher found that all six participants in the test group indicated that the impact they perceived was positive. The regular instructor feedback that addressed the specific assignment issues contributed to the perceived positive impact.

> Yes, I would say that the feedback definitely impacted my, my grade, because of, it kind of, again, it, kind of, helped me along the way to know what I needed to be doing differently, or what I needed to improve on to do better next time… especially, in regards to (the) feedback I received about the two (project) assignments and proposals, that worked for the method for both of those that helped me a lot. That feedback to be able to kind of re-evaluate and make some adjustments within that assignment so that I could do well in meeting the goals of the assignment. (Aasta, test group student)

The second layer of personalized motivational feedback also contributed to this positive impact. The experience of Kala, an HH student, was a great example of how this feedback motivated a student with HH goals.

> Yes, definitely, because, I would be, if it (the second layer of feedback) kind of about like a control process I could look out and see how I did the previous, how I found throughout the course, I was trying to get back at the top. So, it was a huge motivating influence for me. (Kala, test group student)

This type of feedback worked in the same way for Fairfax, who was also an HH student.

> … like, yeah, on week 3, I did fall a little bit of behind. I was behind my schedule that I didn't do really well on that assignment. It shows on the graph (one type of personalized feedback). So, once I see the graph, and I know everything, you know. Ok, I need to catch up catch up a little bit, so It helps me to keep my speed. You know, I said, you know, you know, it's the same with other students in the class. I see the median. You know, what I understood they are doing now, and so, I probably, I will be a little bit behind. So, I need to catch up on them. So, on, it's, overall, it is helping me to keep track or keep the course on myself. (Fairfax, test group student)

In the control group, students perceived different types of impact of the feedback on their performance, such as "positive impact," and "no impact." For Sabrina, the feedback worked positively.

> Yes, absolutely. Feedback on my first assignment helped me improve on my second assignment. I could say that for certain. So, like I said before, the feedback helped me refocus on what was most important in the assignment. And that helped me do much better on (the) second assignment. (Sabrina, control group student)

Blake also felt such feedback had a positive impact, "I think it probably had a positive impact, because, it allows, because, it was timely, and it was, it allowed me (to) know that I am following the right direction, it kept the momentum going." However, Karolinda did not feel such feedback had any impact on her assignment scores. When the researcher asked whether she found any part of the feedback was helpful, she answered, "not really".

> … and then I turned it in as far as the feedback went. Basically, all I received was… I didn't even get a rubric attached to it (the feedback). I got told, OK, you

> going to miss a couple of points, because you forgot this little, minor thing, over here. OK. Anything else? (Karolinda, control group student)

Theme 4: The Ways Students Used the Feedback Messages

To further understand how feedback worked for students and the causes of the perceived impact, the researcher asked this question, "How did you use the feedback information in your following-up learning activities once you received them?" The responses showed students used the feedback messages in multiple ways. For example, feedback encouraged students to dig deeper in the learning content, initiate additional learning, fix the issues in their assignments, apply lessons that they learned to the following assignments, track their learning process, make adjustments by comparing their performance to their own previous performance and to their peers' performance, and manage their goals and the time spent on their learning.

When comparing the responses across groups, the researcher found there were common ways that students in both the groups used feedback messages, but the students in the test group also identified some unique ways that they used the feedback messages. First, the students in both groups used feedback messages to address specific assignment issues, such as making revisions. For example, Sabrina, from the control group, said, "Yeah, so, like I said, I might receive feedback to on my first project I had, and, I did miss some points, and the feedback was specific about the things that I had not, not, done for the formatting in my project. And so that helped me make sure that those, those things, were in place for the second project and there was no issue." Second, students in both groups felt that the feedback encouraged them to spend time on additional learning. For example, Mike, from the test group, used the feedback message to make a reflection on the learning materials.

> I think the way it (feedback) helps me is, that, it was encouraging me to dig for another layer in what I'm doing. You know, so much of what we do in a program like this, is sort of, you know, I'll do the reading, watching the video, whatever

> the materials, and then, I will go online and answer the questions. So that feedback helps me, then after I've done it, go back and think harder about it, (and) try to ask tougher questions to myself about the work that we're doing about the materials that we're reading. That to me is a huge benefit. (Mike)

Similarly, in the control group, Reena said, "He (the instructor) wanted to make sure that the technology that was included in the learning module was going to fit with the SAMR model. And, so, I did some more research on that."

Besides the two ways of using the feedback listed above, there were also unique ways that only emerged in the test group students. Kala, who claimed that she was an "A" oriented student, used the charts embedded in the second layer of feedback to compare her current performance with her previous performance and her peers' performance, and then determined her learning status. When the Kala achieved unsatisfying learning performance, the visual feedback message made the results stand out and thus motivated her to take more actions and communicate with the course instructor in the following learning tasks to improve her performance.

> Well, I just compare(d) how I had done previously, and I also like (to) see how the class did. Because it let me know kind of where I was of that maybe even the median, when I was higher than I did, or, just a motivating thing. But that works from setting goals for myself on where I, what I wanted. I always wanted an A in the course. It very clear way of me saying, OK. Am I, I'm on track to get that...? One week I dip down, and I thought I needed to tell her (instructor) the questions next week and I did (that), and it (scores) went up, so that it worked really well for me. (Kala, test group student)

Fairfax emphasized that he mainly used feedback to compare his performance with his own past performance.

> ... for one of my assignments, in week 3, [the project proposal name], that assignment, I received a chart, and it show(s) me like, like, a record of my individual assignments. So, yeah, it gives you the points for my discussion, and keep track of my performance. So, I know, yeah, what time I get, you know, I'm on track, and what time, I, you know, fall a little bit, that is keep(ing) me in mind that I need to go back to on track, or spend more time to do work. That is very useful. (Fairfax, test group student)

The personalized feedback also helped test group students to visualize what they had achieved and kept them learning. Like it is in Kate's case, "… then I also liked the visual indicators of feedback legacy. (It's) sort of like a digital badge type emblem, or if it was a bar graph. I liked the visual one better, and, I'm a really, really, visual-spatial kind of person. So for me, it was something I should keep going."

Theme 5: Further Suggestions for Ideal Feedback

To elicit students' further thoughts on improving the feedback, the researcher asked a question, "What is the ideal online feedback in your eyes or how to further improve feedback in an online class?" The participants actively shared their suggestions. There were common feedback suggestions across groups. For example, the feedback should be specific and timely, related to specific learning topics, confirm the strength of students' work, point out the weak areas that need improvement, give guidance or steps about how to address the specific assignment issues, provide feedback with rubrics to show specific issues or explain grading results, ask guiding questions to drive further learning, facilitate further growth through challenging students or providing additional learning resources. For the format of the feedback, students in both groups prefer feedback to be delivered in an audio-visual way, such as screencast video or online chat.

With further analysis, the researcher found some types of feedback suggestions only emerged in the test group. The charts and graphs, as personalized feedback components used in this study, were suggested by the test groups students to be used in future online classes. For example, Maggie told us, "I don't think I would give it a better feedback. I think that I would give similar feedback." Kala strongly suggested using this specially designed feedback in other online classes.

> I feel really good about it, the, what you did on, you made the chart in the grading section. OK. And I had never had that before, and I love it… Well, I wish that every class had that kind of charting, but this is the only class that I should have had. (Kala, test group student)

Students in the test group also felt ideal feedback should help get students to buy in and make them feel like they want to improve their performance. They further suggested that ideal feedback should be genuine, help build social connections between the students with the academic program, and help students keep a positive feeling.

The students in the control group also provided some unique suggestions that did not emerge in the test group. For example, they suggested feedback to be delivered in a customized way. As in Yvan's response, he suggested that feedback should be tailored based on the problems or questions that emerged in instruction.

> If I did see that some instruction or some question is not clear, I would address that specifically in feedback… The problem of the instruction is, (the) instruction might not be clear as it is. This is (where) I am able to do the work. …but what is required, so I would tailor feedback around this specific problem. (Yvan, control group student)

Yvan also suggested ideal feedback should be personalized based on individual students' learning performance.

> Let's say, you're given an assignment, and you get a grade, get an assignment and your grade is a 70 percent out of 100. If that means you fairly understand what is going on, and so, a short feedback, in 3 lines, feedback, and it's by e-mail or wherever would suffice. It would be enough for the 70 percent or 70 percent very, that should explain it says, it says, you could understand what's going on, you are not totally lost. If you get like 40 percent, in that case, I (am) willing to offer you a quick live chat to discuss the challenges you're having. I think that might be even more helpful than a short (written feedback).... (Yvan, control group student)

Control groups students also suggested that feedback should be delivered in appropriate chunks or segments for a big project assignment.

Based on these student-suggested features of ideal feedback, the second layer of personalized motivational feedback as implemented in this study works together with regular

instructor feedback to help meet online students' needs. The added layer of feedback increased the amount of the feedback received by the students. It was reported by students to facilitate students' growth, motivate students to continue learning, indicate whether learning is on the right track, and acknowledge students' efforts and strengths. It was delivered in a visual way and a personalized way. It seems these features of the second layer of feedback contributed to this model of ideal feedback and led to students' positive perceptions of the overall feedback.

Summary of Results

In the phase of the quasi-experimental study, the ANCOVA F test results indicate that the test group students demonstrated significantly higher motivation scores and subtheme satisfaction scores in the post-test measurement than the control group students when the effects of the pre-test measurement results were controlled. These results suggest the personalized motivational feedback that was designed to align with students' individual achievement goals according to the proposed personalization rules was beneficial in terms of students' motivation, especially the perceived satisfaction. However, both the Wilcoxon Two-Sample test results and ANCOVA F test results show that there was not a significant difference in cumulative assignment scores between the two groups. This result suggests that personalized feedback intervention did not influence students' achievement scores in the course.

The post-interviews showed that students in the test group expressed more consistently and strongly that they had an overall positive perception of the feedback received in the course. However, students in the control group had mixed patterns of perceptions of the received feedback, including positive perceptions and non-positive perceptions. Key features of the personalized motivational feedback contributed to the positive perceptions, such as being

delivered in a visual way, highlighting students' accomplishments, showing the trend of personal learning growth, providing references for comparison with personal and peers' performance, and providing backup messages to encourage students. The participants from the test group further explained the underlying mechanism of this personalized motivational feedback was that it affected students' learning positively by helping them set and regulate learning goals, activated self-regulation mechanisms, and adjusted their learning behaviors.

How should we interpret the results overall? What is the conclusion? Further discussions about the relationship between the quantitative and qualitative results, the overall conclusions, the limitations and implication of this study, and further research directions are reported in Chapter 5.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

Discussion

In this study, the researcher's purpose was to examine the effectiveness of personalized motivational feedback, designed according to the proposed rules based on learners' achievement goals, in the online learning context by using an explanatory mixed methods study design. The researcher hypothesized that the students in the test group who received personalized motivational feedback along with their instructor's regular feedback would have better learning outcomes as indicated by higher scores of learning performance and motivation, and more positive perceptions of the received feedback than students in the control group who only received regular instructor feedback. For each of the major indicators (learner motivation, learning performance scores), the impact of the personalized motivational feedback is discussed based on the results generated from the quasi-experimental study phase and the post-interview phase in the following sections.

The Impact of the Personalized Feedback on Learner Motivation

The results in the quasi-experimental study support the impact of personalized motivational feedback to enhance motivation. The statistical analysis found that students in the test group did have significantly higher mean scores on the post-assessment of motivation and subtheme satisfaction than students in the control group when partialling out the effects of the covariate**.** The qualitative results further supported the findings from the quasi-experimental study. In the post interviews, the test group students consistently perceived the feedback had a positive impact on their motivation. The responses provided by the test group students further explained this result. As indicated by the test group students' reflections, the personalized

feedback enhanced learners' motivation by helping them regulate their goals, activate their internal self-regulation processes, and take steps to learn more.

Based on the results in the two study phases, the personalized motivational feedback in this study did have a consistently positive impact on enhancing learners' motivation. Since this personalized motivational feedback was designed based on learners' individual achievement goals, the effects of this personalized feedback support that the learning construct of achievement goals is able to drive learning at least from the motivational dimension (Masrtinez, 1999, 2001). The designed feedback messages helped learners regulate their goals, which is consistent with the conclusion reported in the study of Senko and Harackiewicz (2005). According to responses received in the post interviews, the regulation of learning goals further activated internal self-regulation processes and then motivated students to take actions in their learning process, which is consistent with the claims of Pintrich (1999) that cognitive self-regulation meditates the influence of achievement goals on learning. As a response to the feedback theoretical framework proposed by Hattie and Timperley's (2007), this layer of personalized motivational feedback supplemented regular instructor's feedback, which usually works at the cognitive level to address specific learning tasks. Two layers of feedback worked together to guide students to go beyond specific cognitive learning tasks, get motivated and enhance learning via self-regulation. Therefore, from the perspectives of achievement goal theory, feedback theory, and teaching practices, it is meaningful to design motivational feedback based on achievement goals to regulate learners' goals, and then learners' goals activate their self-regulation mechanism and finally affect learning motivation.

The Impact of the Personalized Feedback on Learning Performance

The results of the quantitative phase of the quasi-experimental study indicate that students in the test group did have higher cumulative assignment mean scores than students in the control group. However, the main effects of the personalized feedback treatment on performance scores were not statistically significant. So, we cannot conclude that the treatment benefitted students' performance scores in the course. This result is not consistent with the qualitative results found in the post interviews. All the test group students perceived that the feedback they received positively affected their performance scores. They felt that the feedback affected their performance scores positively by addressing specific assignment issues and enhancing learner motivation via the internal learning control process. In contrast, the control group students had a mixed pattern of perceptions, some of them perceiving a positive impact and some perceiving no impact.

In this mixed methods study, based on the major research questions, the features of the two-phase study design, and the number of the participants, more weight was put on the quasi-experimental study phase. Therefore, the overall conclusion of the impact of the personalized feedback on performance scores is that the personalized motivational feedback does not have an effect to improve performance scores.

How can we explain these findings? One possible interpretation is that personalized feedback, in fact, does not influence student achievement scores. However, previous research has suggested that feedback can help students regulate their achievement goals adoption (Senko & Harackiewicz, 2005), and different types of achievement goals can drive different mechanisms of learning with distinct affective, behavioral, and cognitive consequences (Dweck & Leggett, 1988; Senko & Harackiewicz, 2005). In this study, the test group scored higher than the control

group on post-test measures of both learning performance and motivation. From the post-interviews, the participants in the test group also felt that personalized feedback impacted learning performance positively. These results suggest that the feedback intervention may have some effects, but the effects were not large enough to reach the level of statistical significance in most cases. It is possible that other factors limited our ability to detect the effects of the treatment.

According to the course instructor, a competency-based instructional strategy was utilized in this online class. For this type of class, a variety of instructional supports were utilized to make sure learners achieved learning mastery for each task. These instructional supports included, for example, answering students' questions, helping students pre-evaluate assignments, providing feedback, and using multiple opportunities for grading. Such instructional support allowed the students in the course to earn high performance scores, thereby creating a ceiling effect for the final grades. This ceiling effect can be observed in the distribution pattern of the actual assignment scores in this study, which was severely negatively skewed. Most assignments' mean scores were very close to the full scores with a small range. This lack of variance in performance scores made it difficult to detect a statistically significant difference.

This part of the results is consistent with some previous studies that found achievement goals sometimes fail to directly influence actual performance on exams (Elliot & Church, 1997; Harackiewicz et al., 1997). From a theoretical perspective, although achievement goal is a powerful predictive factor for learning, the quality of learning outcomes also depends closely on an interaction between students' achievement goals, the motivating properties of these goals, and dominating structures manipulated in learning environment. As Covington (2000) pointed out,

the impact of learning goals, personal feelings, and final school performance are all subject to predominant work requirements and incentive methods adopted in the learning environment.

Covington (2000) further explained that "Achievement goals differentially influence school achievement via variations in the quality of cognitive self-regulation processes" (p. 174). However, the process for designing personalized feedback in this study did not take into account the moderator factor of self-regulation. In the future, to realize the effects of personalized feedback, it may be necessary to include moderator factors which affect the relationship between achievement goals and learning performance when designing personalized feedback, such as considering students' self-regulation skills when classifying students.

Lastly, it is also possible that the feedback example design itself has limitations, because the quality of the feedback message influences its effect (Narciss, 2008). For example, it may be that the task value embedded feedback failed to highlight the values that individual students really care about and thus did not help students' learning results. So, it may be that any of these factors either inhibited students' performance or the ability of this study to detect a result of that performance and so led to the non-significant results for learning performance.

Implications

In this study, personalized motivational feedback was designed and implemented following the rules that were intended to create feedback consistent with or "matching" students' personal achievement goals, which was suggested by the previous researchers since this alignment was thought to be able to make the achievement goals work most effectively (Harackiewicz & Sansone, 1991; Harackiewicz et al., 2002). The results of this study confirmed that personalized motivational feedback does have an effect to enhance learner motivation and learner-perceived satisfaction and may have some benefits for improving learning performance

in online learning contexts. Therefore, online instructors, instructional designers, and faculty members, should not only analyze commonly used learner features but also consider students' achievement goals when conducting learner analysis and creating learner profiles. To make it more convenient, academic program administers are suggested to create and maintain such a database to record learner characteristics including achievement goals when students are enrolled in the program so that online instructors, instructional designers and faculty members can use it directly without measuring it repeatedly.

Personalization may be beneficial to increase learner perceived satisfaction, learning results, and retention of online learning. To implement this personalization method, faculty members, online instructors and instructional designers must understand and utilize the kinds of instructional treatments employed in this study. For example, they will need to know not just one type of feedback but a variety of different types of feedback, such as self-referenced feedback, normative feedback, promotion-focused feedback, etc. In this study, a list of different types of feedback was suggested. With a comprehensive understanding of the effect of each individual type of feedback, online instructors, instructional designers and faculty members can provide more appropriate personalized feedback for students with different achievement goals.

Since it is challenging for instructors and faculty members to provide personalized feedback manually especially in large-enrollment classes, a learning management system with advanced features is needed. Ideally what is needed is an embedded tool, such as the feedback application OnTask (Pardo et al., 2018), which allows instructors and faculty members to choose one or a set of learning indicators that they feel critical in the learning process, set specific conditions for the chosen indicators, and then predefine rules that are able to enhance learning from their perspectives to generate personalized feedback messages for students. Achievement

goal orientation and the proposed personalization rules in this study could be integrated into such a tool to increase working efficiency and help improve the learning management system. The researcher suggests developers of next-generation LMSs include achievement goals in the learner model and include such rules in a personalization mechanism.

Limitations and Future Research Directions

One primary limitation of this study is that a ceiling effect on learning performance emerged leading to insufficient variation for the researcher to detect a statistically significant difference in learning performance. This effect may come from the setting of the class which used a particular instructional strategy, competency-based instruction, which helped students achieve learning mastery and earn high scores. The method used in this class to support students' learning may not be applicable in classes dominated by other types of instructional strategies. Therefore, the researcher suggests future researchers in this area consider employing personalized feedback in different types of classes and using specific instructional approaches, such as problem-based learning, competency-based learning, etc., since there may be different learner characteristics and other factors which may affect how the personalization works. To capture the desired positive results of the personalized feedback intervention, the researcher also suggests future research consider moderator factors of achievement goals, such as learner' self-regulation, when classifying students and designing personalization rules.

A second limitation is associated with the adjusted median split method used in this study to classify students. A concern with the original median split method was that it might cause the loss of information about individual variability (Iacobucci, Posavac, Kardes, Schneider, & Popovich, 2014). For example, a student's performance goal value above the median was classified as high-performance, no matter if it was just a little bit higher or significantly higher

than the median value. Being further adjusted based on actual data distribution of achievement goals in this study, this method also labeled some students as (relatively) low mastery goal students even if their mastery goal values were in fact high. Supports were provided to this type of students to enhance their motivation through feedback. In fact, these feedback messages may not have been necessary for these students and may not have motivated them to learn.

Last, the researcher did not apply true randomization when assigning students to treatments. Without randomization, the researcher cannot exclude the potential effects of other external factors, such as learners' demographic background, instructional subjects, dominating instructional strategies, and course instructors. For example, as reflected in the post interview, in this course, different instructors provided different amount of feedback, and this difference may have led to the measured group difference on learner motivation and assignment scores. More advanced experiment design or analysis methods should be used to determine the extent to which instructors influenced the target group difference. Lacking randomization in the sampling process also means the sample may not be totally representative of the target population (Privitera, 2016) thus may make it difficult to generalize the results to other instructional contexts. The subject of the course was technology integration in learning environments, and the students had relatively good background knowledge of online learning and feedback. All these features may make it difficult to generalize the results of this study.

Based on the complex results of this study, in the immediate future, the study needs to be replicated in classes with different subjects and different instructional settings dominated by different instructional strategies, such as problem-based learning, competency-based learning, or design-based learning. More learner feature factors will need to be considered along with achievement goals, such as self-regulation, to design personalized feedback. Due to the available

time and resources, the intervention was delivered by the researcher which cannot exclude the potential effects generated by the researcher. If resources allow in the future, an automated method, such as a technical tool embedded in the learning management system, should be used to help online instructors deliver the personalized feedback intervention.

Conclusion

This study brought a little-used learner characteristic, achievement goal, into consideration for designing online personalized feedback and refining online learners' profiles. It attempted to optimize online learning experiences from a motivational perspective by providing appropriate motivational feedback information that different students need to make learning adjustments so that their learning experiences can be optimized. On the one hand, this approach increased online learner motivation and perceived satisfaction and, therefore, has the potential to mitigate the issues of high dropout rates and low motivation in traditional online learning. On the other hand, the lack of a significant learning performance score result in this study suggests that more needs to be done to further realize the effects of this approach on final learning outcomes.

There is a complex working mechanism underlying how achievement goals affect the learning process and outcomes, and various factors need to be considered for personalized instructional intervention design. Based on the effects of the proposed personalization rules for feedback design, the researcher recommends that instructional designers, online instructors, and LMS developers consider this learning construct and the proposed personalization rules to enhance the power of the instructional feedback. In this way, personalized online learning experiences can be further optimized.

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APPENDIX A. INSTRUMENT TO MEASURE ACHIEVEMENT GOALS

ID	Item description	1 2 3 4 5 6 7 (Strongly disagree) (Strongly agree)
1	I like school work that I'll learn from, even if I make a lot of mistakes.	
2	An important reason why I do my school work is because I like to learn new things.	
3	I like school work best when it really makes me think.	
4	An important reason why I do my work in school is because I want to get better at it.	
5	I do my school work because I'm interested in it.	
6	An important reason I do my school work is because I enjoy it.	
7	I would feel really good if I were the only one who could answer the teachers' questions in class.	
8	It's important to me that the other students in my classes think that I am good at my work.	

9	I want to do better than other students in my classes.	
10	I would feel successful in school if I did better than most of the other students.	
11	I'd like to show my teachers that I'm smarter than the other students in my classes.	
12	Doing better than other students in school is important to me.	

APPENDIX B. THE SURVEY TO MEASURE MOTIVATION

Course Interest Survey
John M. Keller

Instructions

- There are 34 statements in this questionnaire. Please think about each statement in relation to the instructional materials you have just studied, and indicate how true it is. Give the answer that truly applies to you, and not what you would like to be true, or what you think others want to hear.
- Think about each statement by itself and indicate how true it is. Do not be influenced by your answers to other statements.
- Record your responses on the answer sheet that is provided, and follow any additional instructions that may be provided in regard to the answer sheet that is being used with this survey.

  Thank you.

1 (or A) = Not true
2 (or B) = Slightly true
3 (or C) = Moderately true
4 (or D) = Mostly true
5 (or E) = Very true

1. The instructor knows how to make us feel enthusiastic about the subject matter of this course.
2. The things I am learning in this course will be useful to me.
3. I feel confident that I will do well in this course.
4. This class has very little in it that captures my attention.
5. The instructor makes the subject matter of this course seem important.
6. You have to be lucky to get good grades in this course.
7. I have to work too hard to succeed in this course.
8. I do NOT see how the content of this course relates to anything I already know.
9. Whether or not I succeed in this course is up to me.
10. The instructor creates suspense when building up to a point.
11. The subject matter of this course is just too difficult for me.
12. I feel that this course gives me a lot of satisfaction.
13. In this class, I try to set and achieve high standards of excellence.
14. I feel that the grades or other recognition I receive are fair compared to other students.
15. The students in this class seem curious about the subject matter.

16. I enjoy working for this course.
17. It is difficult to predict what grade the instructor will give my assignments.
18. I am pleased with the instructor's evaluations of my work compared to how well I think I have done.
19. I feel satisfied with what I am getting from this course.
20. The content of this course relates to my expectations and goals.
21. The instructor does unusual or surprising things that are interesting.
22. The students actively participate in this class.
23. To accomplish my goals, it is important that I do well in this course.
24. The instructor uses an interesting variety of teaching techniques.
25. I do NOT think I will benefit much from this course.
26. I often daydream while in this class.
27. As I am taking this class, I believe that I can succeed if I try hard enough.
28. The personal benefits of this course are clear to me.
29. My curiosity is often stimulated by the questions asked or the problems given on the subject matter in this class.
30. I find the challenge level in this course to be about right: neither too easy not too hard.
31. I feel rather disappointed with this course.
32. I feel that I get enough recognition of my work in this course by means of grades, comments, or other feedback.
33. The amount of work I have to do is appropriate for this type of course.
34. I get enough feedback to know how well I am doing.

APPENDIX C. UPDATED QUESTIONS IN INTERVIEW PROTOCOL

Personalized online feedback study project

Interview protocol

Thank you for participating in the interview and completing the pre-survey in advance. I appreciate you taking the time out of your busy schedule! As a reminder the purpose of this study is to study the students' perception of the feedback they received from Instructors/TAs in their online classes and then we will use these responses to improve the feedback design.
Just to let you know participation is voluntary and you are free to withdraw at any time. The data collected for this research project will be kept confidential; once we have provided a transcript of your interview to you for verification of responses, your name will be removed from the data and you will not be identified as an individual in any way. Before we get started, do you have any questions? Do I have your permission to tape this session (once permission is granted then turn on recorder and verify so they are on "tape" granting permission)?

Part.1. Background information questions *(You have responded to this question in the pre-survey. We may briefly go through this part in the interview.)*

1. Have you taken any online graduate level courses previously? If so, what were they (category), when did you take them, and what institutions provided them?
2. Please describe your overall perceptions/feelings of the feedback received from these course instructors (TA).

   Prompt: Here are some examples of possible feedback, such as instructor feedback to the assignments, feedbacks in instructor email or feedback comments embedded in your online assignment documents, feedback information in course announcement, etc.

3. Could you talk about the positive/good/useful feedback examples and their features (in time, frequency, helpfulness…) and negative/useless feedback example and their features.

Part 2. Perceptions about the feedback in this course, EDCI [target course ID]

1. How do you feel about the feedback you received from the instructors/TAs in this course?

   (As you may still remember, in most of your assignments, you get instructor/TA's regular feedback text and some chart/graphs feedback.) Prompt: What is the impact of the course EDCI [target course ID] feedback on your learning motivation, the way

you manage your learning process, your feelings during learning process, and the overall learning results?)

2. Was it (the course feedback) overall helpful for your learning online?

   If yes,

   1) Can you talk about which aspects/parts of the feedback helped you?
   2) Can you provide some examples?

      If possible, would you show provide me the screenshots of these examples later?

   3) How did it help you?

      How did you use this feedback information in your following learning once you received them in your learning?

   4) Why do you think it was helpful for you?

   If some feedback may need to be improved,

   1) Can you provide some feedback examples that need to improve? If possible, would you provide me the screenshots of these examples later?
   2) If you are one of the TAs or instructors, what kind of feedback would you give to your students? Please give some the example(s)?

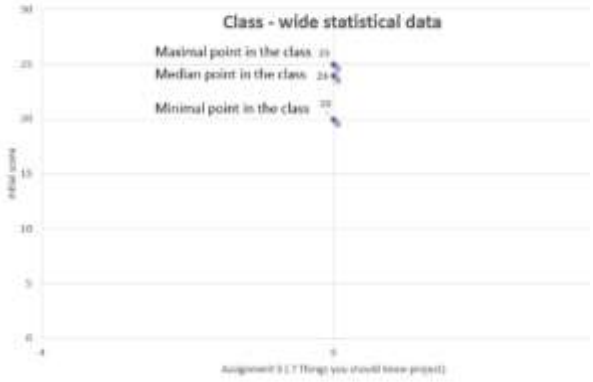
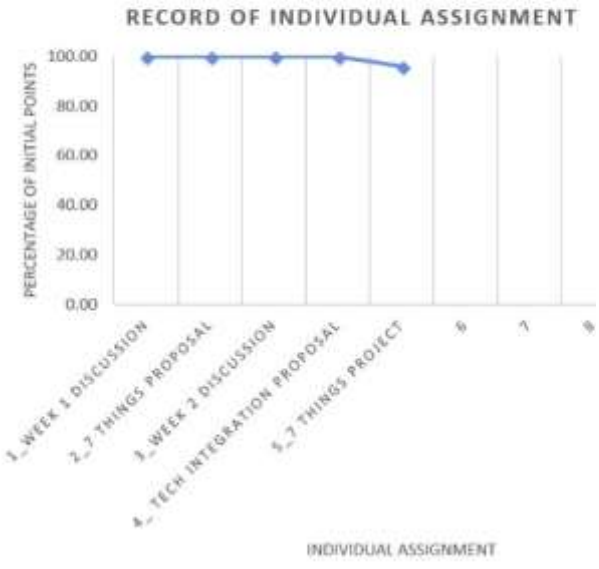
Part 3. Further suggestions to improve online feedback

1. What is the ideal feedback (good/useful feedback) in your opinions, what are the features (in time, frequency, usefulness, etc.) of ideal feedback?
2. How do you think the feedback you received in this course could be improved? What suggestions do you have?
3. What additional feedback information do you expect to get from the course instructor/TA?

Closing out
Is there anything else you would like to share that may be related to effective feedback in the online learning that I have not asked?

Great! That's all for the interview.
Thank you again for your time in participating in this interview.
Please feel free to reach out to us by email or phone if you have any questions or concerns.
We will contact you for verification as we conduct the analyses.
Thank you!

APPENDIX D. THE EXAMPLES OF THE PROPOSED FEEDBACK

Type	Definition	Example
normative feedback	a type of feedback to deliver information to indicate where the student stands relative to others in some group.	• Here is the statistical data within the class. 
self-referential feedback	a type of feedback to deliver information about learner's improvement based on students' previous performance.	• Here is the graph which records your personal growth base on assignment assessment. Nice far! We'd like to support your learning success throughout the semester. Note. The graph is b the percentage format of the initial points you 

self-efficacy motivational feedback	a type of feedback to deliver information to enhance learner's self-efficacy.	*In this important project(task), with the preparation you made, your best outcomes will be achieved if you continue to make an effort and seek additional tutoring support if needed.*
promotion-focused feedback	a type of feedback to deliver information to emphasize target learner's existing achievement.	• Here is what you have achieved so far! Nice work. Let's finish the semester strong! Just let us know if you need any help. 
task value-embedded feedback	a type of feedback that highlights the value of learning task through describing the benefits associated with the learning task.	Getting more involved in the online discussion will help you reflect your own thoughts and get inspired by your classmates that may help generate cool project solutions. We hope you enjoy it and get more involved!

APPENDIX E. COURSE SYLLABUS

Instructor's online hours

Greetings and welcome to the class! I will hold virtual office hours by appointment via Skype to discuss any questions you might have related to readings and assignments. Always feel free to email me to set up a meeting with me if you have any questions or ideas you'd like to bounce off of me. Email is typically the fastest way to get a hold of me if it is a quick item or urgent issue.

Course website

Blackboard Learn is our course management system. You can access the course website at university name http://mycourses.[university name].edu. It is strongly suggested that you explore and become familiar not only with the site navigation, but with content and resources available for this course.

Course description

This course is intended for teachers, trainers, administrators, and others who use or intend to use technology in instructional settings. This course is designed to build on skills acquired in other courses (e.g. EDCI 56600, EDCI 56800). This course focuses on techniques for and issues related to integrating technology in learning environments. Topics covered stem from literature in the field and include (1) theoretical foundations of technology integration, (2) teaching and learning issues with technology integration, (3) designing technology applications for use in educational settings, and (4) emerging issues in research and practice with technology integration.

Class activities are designed to model educational applications of technology, while class projects allow individuals to develop skills and knowledge in areas of your personal need or interest. The goal of the course is to help you develop an understanding of important issues associated with the integration and management of technology in education and to effectively plan, implement, and evaluate technology-based instruction.

Course instructional goals

Through readings, discussions, and course projects you will:

1. Apply learning technology to enhance your own professional growth and productivity.
2. Use learning technology to communicate, collaborate, conduct research, and solve problems.
3. Apply the information from this course into authentic settings.
4. Successfully integrate technology into different aspects of learning.

Course readings and resources (subject to revision)

Readings will be provided within your Blackboard course.

Assignments

Assignments	Points
1. Statement of Program Commitment	Ungraded but Required
2. Individual Posts and Discussion Participation (5 X 5pts)	25
3. Seven (7) Things to Know Assignment Project Proposal	5
4. Seven (7) Things to Know Assignment Final Project	25
5. Technology Integrated Project Proposal	10
6. Technology Integrated Final Project	35
Total	**100**

1. Statement of Program Commitment (Ungraded but Required)

Prior to beginning your coursework, please be sure to complete the Statement of Program Commitment. The Statement of Program Commitment covers the Online M.S. in Education in Learning Design and Technology Program Policies and Student Expectations. In order to accomplish the goals and maintain the academic rigor, students must follow a structured curriculum of sequenced courses. To be successful, students must recognize, accept, and strive to accomplish each of the following performance expectations covered in the statement.

2. Course/Discussion Participation (5 discussions at 5 points each for a total of 25 pts.)

This course relies heavily on each student's ongoing participation in the discussions; in this way we hope to facilitate scaffolding among the instructors and students, as well as among the students. Your discussion will be graded based upon the discussion evaluation guidelines, which looks to quality, timeliness, responsiveness, and moving the discussion forward. Discussions will run from Monday through Saturday 5pm. EST, after which discussion postings will not be included in the grading. You are expected to participate throughout the week in the discussions, not clump them all together on one day (please see discussion evaluation guidelines).

3. "7 Things to Know…" Project (Proposal and Final Project)

You will be creating a concise resource overview to assist you and others in the integration of technology using EDUCAUSE's "7 Things You Should Know About" format. The focus of the technology-integration can be K-12, higher-education, or industry based and should focus on either a particular educational technology tool or technology integration concept.

To see specific examples, visit the *7 Things You Should Know About…* EDUCAUSE Library: http://www.educause.edu/research-and-publications/7-things-you-should-know-about

Please be sure to find a topic 1) that enables you to create something that you can actually use in your professional or personal life, and 2) that really **intrigues** you. Feel free to be creative and innovative with this assignment – I would really like to see your creative juices flowing in this course!

1) **Project Proposal (5 Points):** Please include the following points in your project proposal.
    a) The setting for the technology integration: K-12, higher education, business and industry, or healthcare or military, etc.
    b) The technology tool or technology integration technique or technology integration concept.

2) **Final Project (25 Points):** Using the 7 Things You Should Know About… structure, develop an informational document on an technology-integration topic or tool. As the EDUCAUSE description explains, this should be an informative "quick read" and be two pages in length. Additionally, be sure to include an introductory scenario, and answer the following seven questions:
    1. What is it & What sort of learning function does it address (planning for learning, assessing learning, etc.)?
    2. Who is your target audience?
    3. How does it work?
    4. Who's doing it? & Why is it significant?
    5. What are the downsides?
    6. Where is it going?
    7. What are the implications for your target audience? (Note: So in total, you will have eight sections. 1 for the scenario and 7 for answering each of the questions!)

***See the Assignment section in Blackboard for detailed guidelines and rubrics.**

4. Technology Integrated Project (Proposal and Final Project)

Using the SAMR Model (Substitution, Augmentation, Modification, Redefinition) from the reading in Week 2 (Hamilton, Rosenberg, & Akcaoglu) you will be taking all the information and knowledge you have gathered from [target course ID]and other [program name] program courses and apply it to a current

instructional unit to integrate learner-centered or transformative learning applications (instruction, assessment, planning for learning, etc.). ***See the Assignment section in Blackboard for detailed guidelines and rubrics.**

1. **ORIGINAL INSTRUCTIONAL UNIT:** First, find a training that enables you to create something that you can actually use in your professional or personal life or that really intrigues you. Feel free to be creative and innovative with this assignment – I would really like to see your creative juices flowing in this course! This training could include be a full-day workshop for a specific issue in your company, a pre-existing unit of study for the classroom, or anything else relevant to your current position. Again, try to find a topic and project that you will be able to use in your professional or personal life!

2. **SAMR WORKSHEET:** After finding an instructional unit of your liking, you will complete the SAMR Worksheet (attached in Blackboard) – focusing on areas of improvement within the current instructional unit. You will look at areas where you can add technology to transform the learning process. Think of implementing technology either the instruction of the topic or processes beyond instruction – really focus on improving the training by successfully integrating technology from any angle.

3. **UPDATED INSTRUCTIONAL UNIT:** After you have completed the SAMR Worksheet, you will revamp your original instructional unit to include the technology choices you selected in the worksheet.

4. **REFLECTION:** In less than one page, reflect on how the technology concepts you applied in your SAMR Worksheet and instructional unit helped transform the educational process. Cite at least (3) specific examples from your assignment and course readings. Remember you are not adding technology for the sake of adding technology. Dive deep into the process and address how you added elements that truly transformed the educational process.

The objectives of this Project is to demonstrate that you can:

- Apply the information from this course into a realistic setting
- Successfully integrate technology in different forms

1) **Project Proposal (10 Points):** After reviewing the project details, please use the discussion board to post your initial ideas addressing the following sections:
    - Overview of the instructional unit you have selected for this topic.
    - Why you selected this topic (is it interesting, current training offered by company, current lesson you are teaching or training that needs updated, etc.).
    - Are there any missing components from the original unit that will be required for the updated instructional unit (target population, curriculum links, objectives, etc.)?
    - Do you plan on modifying any of the elements provided in the original lesson plan
    - Initial ideas on improving the unit by integrating transformative technology
    - Your overall vision for this instructional unit

2) **Final Project (35 Points):** This final product should include all parts of the assignment combined into one Word Document (Original Instructional Unit, SAMR Worksheet, Updated Instructional Unit, and Reflection) and upload to the Assignment Section in Blackboard.

***See the Assignment section in Blackboard for detailed guidelines and rubrics.**

Grading Scale

A	94 - 100% of points
A-	90 - 93% of points
B+	87- 89% of points
B	84 - 86% of points
B-	80 - 83% of points
C+	77 - 79% of points
C	74 - 76% of points
C-	70 - 73% of points
D+	67 - 69% of points
D	64 - 66% of points
D-	60 - 63% of points

Course Evaluations

During the last two weeks of the course, you will be provided with an opportunity to evaluate this course and your instructor(s). [university name] now uses an online course evaluation system. You will receive an official e-mail from evaluation administrators with a link to the online evaluation site. You will have up to two weeks to complete this evaluation. Your participation is an integral part of this course, and your feedback is vital to improving education at [university name] University. I strongly urge you to participate in the evaluation system. Similarly, the [program name] program will be asking you to provide feedback for your course and learning experience via a second survey based on the Community of Inquiry (CoI). This is also a summative evaluation tool and will provide us feedback into how we can improve our courses.

Course Policies

- ***Assignment due dates***: Course activities and projects are mostly due on the Sunday (11:59 p.m., EST) of a given week, EXCEPT for the last week, when it is due on Friday, since that is the last day of class (due dates are listed below). Points will be deducted for late assignments as follows: assignments that are late by 1 day will be penalized 20% of available points; 2 days or later 0 points will be assigned.

- A grade of Incomplete (I) grades will be given only in extenuating circumstances. To receive an "I" grade, a **written request must be submitted prior to the Friday of week 4** and approved by the instructor. The request must describe the circumstances, along with a proposed timeline for completing the course work. You will be required to fill out and sign an "Incomplete Contract" form that will be turned in with the course grades. Any requests made after the course is completed will not be considered for an Incomplete grade.

- Etiquette: Although it is not expected to be a problem in a graduate level class, students are asked to behave in the discussions and other class interactions in a professional and civil manner. If you are in doubt, do not post it! Instructors reserve the right to remove any postings deemed inappropriate, unprofessional, or otherwise distracting from the course.

[university name] Policy Statements

EMERGENCY STATEMENT

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Any changes in *this* course will be announced on our course Website.

ADAPTIVE PROGRAMS STATEMENT

Students with disabilities must be registered with Adaptive Programs in the Office of the Dean of Students before classroom accommodations can be provided. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with me as soon as possible to discuss your needs.

ACADEMIC DISHONESTY STATEMENT

[university name] prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, *University Regulations*] Plagiarism, whether intended or unintended, is an extremely serious offense in academia. Be absolutely sure you are properly citing all references. Instances of plagiarism will result in failure of the assignment in question. More than one instance will result in failure of the course. ***All incidents of plagiarism, whether intentional or not, will be documented with the Dean of Students office.***

COPYRIGHTED MATERIALS

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, [university name] University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

INTELLECTUAL PROPERTY

Online educational environments, like all learning environments, should provide opportunities for students to reflect, explore new ideas, post opinions openly, and have the freedom to change those opinions over time. Students enrolled in and instructors working in online courses are the sole proprietors of their work, opinions, and ideas. It is expected that other students will not copy, reproduce or post to any other outlet (e.g., YouTube, Facebook, or other open media sources) any work in which they are not the sole author or have not obtained the permission of the author(s). Based on the success of LTD graduates, students in this course will likely be or become K-12 or university instructional technologists, instructional designers, instructors or administrators, or corporate trainers. The open, public nature of these careers is certainly unavoidable; however, our online classroom is not an open "public forum". Therefore, all opinions, ideas, and work conducted in a password-protected online educational environment like Blackboard are owned by the author, intended for educational purposes, and are not intended for public dissemination or consumption without the permission of the author(s). This includes all areas of the online academic environment, including, but not limited to email, papers, reports, presentations, videos, chats, blogs and discussion board posts.

**The same specific due dates are also provided on Blackboard*

** Readings, schedule, and assignments subject to change.*

Week	Title	Assignments (due by 11:59 pm, EST on due date)
01	**What Does it Mean to Integrate Technology in a Meaningful and Transformative Way?**	**Readings** Watson, Watson, & Reigeluth (2013) Bush & Mott (2009) Tamim, Bernard, et. al. (2011 **Due on July 2, 2017** • Statement of Program Commitment • Course Introductions Discussion • Week 1 Discussion: Discussion Forum • 7 Things to Know Assignment Project Proposal Discussion
02	**Technology for Instruction**	**Readings** Herrington, Reeves, & Oliver (2014) Kopcha (2010) Hamilton, Rosenberg, & Akcaoglu (2016) **Due on July 9, 2017** Week 2 Discussion: Discussion Forum Technology Integrated Project Proposal Assignment
03	**Technology for Assessing Learning**	**Readings** Shute & Kim (2014) **Due on July 16, 2017** 7 Things to Know Assignment
04	**Technology for Planning for Learning**	**Readings** Prensky (2014) **Due on July 23, 2017** Week 4 Discussion: Discussion Forum
05	**Technology for Tracking Learning**	**Readings** Papamitsiou & Economides (2014) **Due on July 30, 2017**

		Week 5 Discussion: Discussion Forum
06	**Systemic Integration of Technology and the Future of Learning Technology**	**Readings** Straub (2009) **Due on August 4, 2017 (Friday, since this is the last day of class)** Final Product for the Technology Integrated Project

APPENDIX F. SAMPLE PRIOR CODES

Level 1	Level 2	Code name	Comments
LP	LP_PO	The feedback improves learning performance.	
	LP_Neg	The feedback affects learning performance negatively.	
	LP_NO	The feedback does not affect learning performance.	
LM	LM_PO	The feedback enhances motivation	
	LM_Neg	The feedback does not affect motivation	
	LM_NO	The feedback affects learning motivation negatively.	
LE	LE_PO	Positive emotion in learning	
	LE_PO_Ha	Happiness related emotion	
	LE_PO_Pr	Proud related emotion	
	LE_Neg	Negative emotion in learning	
	LE_Neg_Anx	Anxiety related emotion	
	LE_Neg_Bor	Boredom related emotion	
	LE_Neg_no	No special motion emerged	

APPENDIX G. PRE-INTERVIEW QUESTIONNAIRE

Dear all, thank you for your interest to take the interview!
Let's use this survey to set down the interview method and time.
I would like to know the regular background information about your previous online learning experiences before taking EDCI [target course ID].

Thank you in advance for the input.
Huanhuan

What is your preferred method for our interview? Please provide your name and your preferred contact information, such as phone number or Skype ID.

- ○ Your full name (4) _____
- ○ Cell Phone (type in your phone number) (1)
  _____
- ○ Skype (type in your skype ID) (2)
  _____
- ○ WebEx (type in yes to choose this one, use "https://purdue-student.webex.com/meet/wang2306" to attend the meeting) (3)
  _____

IMPORTANT: Please use this link to indicate your preferred interview time. Please copy and paste this URL to your browser.

https://docs.google.com/spreadsheets/d/1u082l9m1weh9V2bfjmFylBo7IErKxeJcKqUW2luAkBs/edit#gid=0

Below are some background information questions of the online course you took previously. EDCI [target course ID] is not included since we will talk about the EDCI [target course ID] in the official interview.

Have you taken any online graduate level courses previously before EDCI [target course ID]? If so, what were they, when did you take them, and what institutions provided them?

- ○ The title of the courses (1) _____
- ○ Time when you took it/them (2) _____
- ○ The institutions that offered the course(s) (3) _____
- ○ Other comments (4) _____

Please describe your overall perceptions/feelings of the feedback received from these online course instructors (TAs). *Prompt: Here are some examples of possible feedback, such as instructor feedback to the assignments, feedbacks in instructor email or feedback comments*

embedded in your online assignment documents, feedback information in course announcement, etc.

_____

_____

_____

_____

_____

Could you talk about the positive/good/useful feedback examples and their features (in time, frequency, helpfulness…) you received in the previous online courses?

_____

_____

_____

_____

_____

Could you talk about the negative/bad/useless feedback examples and their features you received in the previous online courses?

_____

_____

_____

_____

_____

To appreciate your response, a $20 gift card will be sent to you. Please choose your preferred method.

- ○ Amazon e gift card (if you choose this one, type in your amazon ID to accept it) (1) _____
- ○ A physical gift card (If you choose this one, type in your mail address to accept it) (2) _____

That's all!
Thank you very much for the input which is helpful for me to interview you later.