Differential Effects of Instructor Feedback and Computerized Feedback in Online Learning

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**Short Paper**

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**Abstract**

Feedback is increasingly given in electronic channels, and the ability of information systems to generate feedback continues to increase in the meantime. In online learning, computerized feedback generated by information systems can reduce instructors’ workload as well as enhance learners’ self-regulation. However, information systems research lacks a systematic examination of the relative effects of computerized feedback and instructor feedback in online learning. The current study aims to fill this gap. Specifically, this study examines how different feedback choices, i.e., feedback source and feedback sign, influence online learners’ information processing and perceived social support, which in turn influence their learning outcomes. A laboratory experiment will be conducted to test the proposed hypotheses. Theoretically, this study is expected to add knowledge to feedback and human-computer interactions research. Practically, this study has potential to guide the design and management of online feedback systems.

**Keywords:** Instructor feedback, computerized feedback, online learning, information processing, social support, learning outcome

**Introduction**

There has been a great deal of interest in using information technology to improve education accessibility and education quality. Online learning platforms, such as Coursera and EdX, are designed to provide various online courses to learners across the world, and have attracted a lot of participants. In contrast to traditional courses that consist of a few hundred learners, online courses are typically taken by thousands of learners worldwide (Singh et al. 2013), which poses challenge for instructors to provide immediate and personalized feedback. In addition, learners in online learning platforms are more likely to disconnect from the learning material and learning partners. Practitioners have provided online education support tools in order to improve the experience of online learning. Among these tools, we focus on computer-mediated feedback tools with the feature to provide feedback remotely. Feedback refers to the information provided by others regarding one’s task performance (Kluger and DeNisi 1996). Feedback provided by instructors has been cited as an effective way to motivate online learning, and lacking it may cause course
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withdrawal (Singh et al. 2013). However, due to the large number of online learners, merely depending on instructor feedback is not only impractical, but also incongruent with the advocation of self-regulation in online learning (Delen et al. 2014). Computerized feedback generated by an information system (IS) is thus highlighted as an effective performance evaluator in online learning. As an important system design element, computerized feedback is expected to reduce instructors’ workload and enhance learners’ engagement by serving as a form of reinforcement (Walter et al. 2015).

Despite the increased popularity of computerized feedback, there has been no systematic investigation on how learners react to it and how it is related to learners’ perception of instructor feedback. Yet research lags behind this phenomenon. Human-computer interactions literature reveals that people treat computers as either social actors or neutral tools, and react to them accordingly. The former perspective proposes that people attribute human characteristics to computers (Lipnevich and Smith 2009), and interacting with computers elicits affective reactions (Shank 2013). The latter perspective postulates that computers are unbiased sources of information (Jordan 2012), and interacting with computers mainly involves cognitive and information processing rather than affective responses (Mishra 2006). Although prior work has alluded to the differences between human-provided and computer-generated feedback, these two types have not been examined relative to each other.

The opportunity for IS researchers to understand the effectiveness of computerized feedback has been constrained by limited existing knowledge about people’s psychological mechanisms underlying it. According to Podsakoff and Farh (1989), feedback involves both informational and affective elements. Computerized feedback may make unique demands on learners’ cognitive and affective resources that may change how learners process information and form affective reactions compared to instructor feedback. As learning is a cognitive process (Schunk 2012) as well as a social process (Yu et al. 2010), this study compares instructor feedback and computerized feedback by examining learners’ information processing and perceived social support in reaction to the feedback. These two variables represent powerful and complementary determinants of online learning outcomes.

Information processing is important in feedback research due to two main reasons. First, since feedback is more personal and customized to one’s previous performance, it is different from other types of human-computer interactions. Besides being an interaction process, feedback giving is also an information transmission process. Only when learners successfully process the feedback can the feedback exert a positive effect on their subsequent learning (Lipnevich and Smith 2009). Second, online learning often requires learners to be self-regulated and engaged (Delen et al. 2014). The information-processing mode has been highlighted as the basis of self-regulated learning (Rozendaal et al. 2003). This study also examines perceived social support as learners’ affective reactions to the feedback. On one hand, perceived social support is included because it reflects a learner’s primitive affective feelings in online social interactions. On the other hand, whether feedback can provide social support to learners determines its effectiveness (Walter et al. 2015).

Research on feedback design tends to examine the effectiveness of feedback (Hatziapostolou and Paraskakis 2010; Lim et al. 2005; Walter et al. 2015). However, the ultimate goal of feedback is to pursue desirable learning outcomes. This study examines both learning performance and satisfaction with online learning, which represent the cognitive and affective aspect of learning outcomes respectively (Yu et al. 2010). The research questions to be answered by this study are as follows: Are online learners more responsive to feedback generated by computers or are they more inclined to follow feedback provided by instructors? More specifically, in online learning, how do the two types of feedback, namely computerized feedback and instructor feedback, compare in influencing learners’ information processing and perceived social support, and their subsequent learning outcomes?

Theoretical Background

Feedback Research

Besides being examined in organizational research, feedback has been extensively studied in the field of education (Hattie and Timperley 2007). Both practitioners and scholars have recognized feedback as essential in prompting online learning (Grieve et al. 2016). Feedback strategy usually consists of two
components: the method used to convey feedback and the content of the feedback (Hatziapostolou and Paraskakis 2010).

The method used to convey feedback is very important in online learning because an appropriate method may draw learners' attention in the feedback process and encourage deliberate information processing (Mishra 2006; Walter et al. 2015). One focus of this study is about using IS to generate and convey feedback. We refer to this method of feedback as computerized feedback. Besides being feedback conveyance methods, computerized feedback and instructor feedback are also different feedback sources. In the feedback literature, there are two streams of research on feedback source. One stream focuses on examining the various characteristics of feedback source, such as source credibility, source expertise, source power, and so forth (Crommelinck and Anseel 2013; Hildebrand et al. 2013; Qian et al. 2016). The other stream emphasizes on examining feedback from different sources (Singh et al. 2013; Walter et al. 2015), such as instructors, peers, computers, and so on. This study builds on the second research stream and compares effects of computerized feedback and instructor feedback in online learning.

Feedback content has been extensively studied in organizational and psychological research (Watts 2007). In online learning, feedback content serves as a measure indicating whether the focal learner's performance is above or below the standard (Grieve et al. 2016). In this sense, feedback sign, which involves both positive and negative feedback, is one of the most salient dimensions of feedback content and needs investigation (Djamasbi and Loiacono 2008; Watts 2007). Positive feedback indicates that one's performance is above the desired goal, whereas negative feedback indicates that one's performance is below the desired goals (Mattern et al. 2013). Given that learners' reactions to feedback may change with feedback content, this study examines the moderating effect of feedback content on the relationships between feedback source and the different feedback reactions.

**Information Processing**

A learning process involves the acquisition of knowledge and skills, the formation of mental structures, and the processing of information. According to cognitive theories of learning, learners are processors of information and their mind is an information-processing system (Schunk 2012). In line with this rationale, the effects of feedback on learning outcomes are not automatic but instead depend on how learners process it. Thus, the key to understanding the effects of feedback relates to the active processing of feedback on the part of learners (Hattie and Timperley 2007).

Learners can process feedback in either a less effortful, fast and heuristic manner or in a more effortful, deliberate, and systematic way (Anseel et al. 2009; Smith and DeCoster 2000). For instance, learners may spend minimum effort to process feedback to fulfill the minimum requirements of learning; they may also actively engage in the feedback and treat feedback as something worthy of taking time to understand (Biggs 2011). The two modes of information processing usually yield different outcomes. Feedback intervention theory postulates that the effectiveness of feedback depends on whether the recipient allocates sufficient cognitive resources to process it (Kluger and DeNisi 1996). When feedback directs learners' attention to the learning task at hand, their cognitive processing on the task is strengthened, which sets stage for learning improvement (Tam and Ho 2006). Conversely, when feedback directs learners' attention away from the task, cognitive processing for the task is lacking, which results in decreased task performance (Vancouver and Tischner 2004). Therefore, feedback that stimulates effortful information processing has been regarded as an appropriate intervention to foster desirable learning outcomes (Smith and DeCoster 2000).

**Social Support**

Social learning theory underlines the social attributes of learning and views learning as a social process in which learners interact with instructors, peers and the environment (Yu et al. 2010). Thus, achieving desirable learning outcomes requires support from the social context. In this study, social support is defined as an individual's experience of being cared for, being responded to, and being helped by other people during the online learning process (Cobb 1976). Though research on social support has historically been conducted within the context of face-to-face interactions, there is increasing evidence that people can derive social support via using information technologies (Lin and Bhattacherjee 2009). Given the geographic dispersed nature of online learning, the dynamics of social support are quite different from...
that in face-to-face settings. In addition, while many studies support that people react socially to computers, it is admitted that computers do not possess human emotions (Edwards et al. 2016). However, computers may evoke emotional reactions. Thus, this study examines learners’ perceived social support as affective reactions to instructor feedback and computerized feedback.

**Hypotheses Development**

In this section, we develop the hypotheses. We predict that feedback source and feedback content will influence learners’ information processing and perceived social support, which in turn influence their learning performance and satisfaction with online learning. Figure 1 depicts the research model.

![Figure 1. Research Model](image)

**Feedback and Information Processing**

Social information processing theory assumes that impression management is essential in social interactions and relationship expectation is important during information processing (Walther 1992). Along with the rationale of social information processing theory, learners typically care about what others think of them and strive to be perceived positively by others (Riedl et al. 2011). Thus, we propose that features of the feedback source can affect how the feedback recipient processes it. In instructor feedback, there exists an interpersonal relationship between the source and the recipient. In response to instructor feedback, learners are more interpretive, strive to figure out the context of the feedback, and search for underlying meaning, which they will not do with computerized feedback (Garrison and Cleveland-Innes 2005). As a consequence, instructor feedback is digested and subjected to more information processing. Learners usually do not expect computers to be intelligent and are not willing to make sophisticated inferences about computers (Mishra 2006). Though they do respond to computerized feedback, they tend to process it at a somewhat superficial level and unwilling to commit the same level of information processing as in instructor feedback (Cotos 2011). Findings in neuroscience that detect human brains also support the differences in interacting with human and computer partners (Krach et al. 2008). It reveals that people follow different processing strategies in response to humans and computers, and they tend to attribute self-generated actions, intentions, and desires rather to humans than to computer partners.

**H-1:** Instructor feedback will elicit more information processing on the part of learners than computerized feedback.

Control theory suggests that people’s processing and utilization of feedback is influenced by their desire to minimize the discrepancy between the feedback they receive and their internal standards (Djamasbi and Loiacono 2008; Lim et al. 2005). Specifically, it is predicted in control theory that people’s effort will remain stable when positive feedback is received, and their effort will increase when negative feedback is received (Djamasbi and Loiacono 2008). When people are motivated to exert more effort to scrutinize a message, they will engage in a higher level of elaboration. On the contrary, they elaborate less when they are less motivated to exert effort (Tam and Ho 2006). Hence, it is reasonable to propose that learners elaborate more on negative feedback than positive feedback. An alternative explanation is rooted in media research, which postulates that responses to negative stimuli are automatic and require more attention to process than positive stimuli (Reeves and Nass 1996). To this end, we propose the following hypothesis.

**H-2:** Negative feedback will elicit more information processing on the part of learners than positive feedback.
Learning is a process that involves the formation of associations between stimuli and responses. Feedback sign can be explained by positive or negative reinforcement on stimuli-response link (Schunk 2012). In the light of control theory, people will maintain or even reduce their effort when positive feedback is received since positive feedback indicates that they perform successfully (Djamashi and Loiacono 2008). Therefore, the reinforcement effect of positive feedback on information processing is not significant.

In this study, we examine how negative feedback moderates the relationship between feedback source and information processing. First, the cognitive processes involved in feedback depend largely on both the goals toward which these processes are directed and the type of information that is available for attaining these goals (Wyer Jr and Srull 2014). People attach more value to social relationships when interacting with humans than computers (Garrison and Cleveland-Innes 2005). Negative feedback from instructors may threaten learners’ social images and affect their relationship development. In contrast, although learners do react socially to computers, negative feedback from computers is more likely to be perceived as impersonal and nonjudgmental (Jordan 2012). Hence, negative feedback entails more cognitive resources to be allocated to instructor feedback than computerized feedback, reinforcing the disparity between instructor feedback and computerized feedback in information processing. Second, people’s cognitive load and emotional stress increase when interacting with humans rather than computers (Lucas et al. 2014). They tend to believe that computers can bypass issues of attitude, affect, and stereotypes that are typical of human interactions (Lipnevich and Smith 2009). According to theories of human emotion, people are uncomfortable and emotionally laden when receiving negative evaluation from others (Watts 2007). Nevertheless, they are less fearful of negative evaluation from computers (Lucas et al. 2014), and negative emotions toward computers are less extreme than those toward humans (Shank 2013). As a consequence, negative feedback exacerbates emotional stress on learners in response to instructor feedback rather than computerized feedback. To eliminate emotional stress, learners will devote more cognitive resources to feedback message and engage more in information processing (Minas et al. 2014).

**H-3: Negative feedback strengthens the discrepancy between instructor feedback and computerized feedback in information processing amount.**

**Feedback and Perceived Social Support**

Although IS researchers have endowed humanness to computers and tried to use computers to replace humans in some social interactions (Edwards et al. 2016), computers do not contain the same level of social presence as humans (Walter et al. 2015). Due to the insufficient humanness in computerized feedback, learners tend to evoke less feelings of social connection than that in instructor feedback (Lucas et al. 2014). Prior studies have suggested that people inherently have the need for association (Lee 2004). They can fulfill their association needs by connecting with other people. Instructor feedback provides opportunities for learners to conduct further communication and build connections, which cannot be realized in computerized feedback. Hence, social interactions are largely reduced in computerized feedback where the interaction partner is a computer (Alder and Ambrose 2005).

**H-4: Instructor feedback will elicit more perceived social support on the part of learners than computerized feedback.**

Learning is a social process, in which learners value their social images (Anseel et al. 2009). Positive feedback enhances learners’ social images by recognizing their performance (Wang et al. 2014), while negative feedback harms learners’ social images by denying their performance (Audia and Locke 2004). Learners will perceive more social support from the feedback source where they are recognized than denied. Furthermore, feedback sign will evoke intense affective reactions. Specifically, positive feedback signals that the current learning context is supportive, and it is more associated with favorable affective states (O’Malley and Gregory 2011). While negative affective reactions such as disappointment and frustration are likely to appear in the wake of negative feedback (Audia and Locke 2004). This is in line with self-enhancement tendency, which postulates that people tend to respond favorably to positive feedback and unfavorably to negative feedback (O’Malley and Gregory 2011). Perceived social support as a favorable affective state is more likely to be fostered by positive feedback than negative feedback.

**H-5: Positive feedback will elicit more perceived social support on the part of learners than negative feedback.**
Positive feedback usually involves information to express feedback source’s approval of the learner’s behavior. Learners tend to consider positive feedback as an indication of what the feedback source thinks about their ability (Bracken et al. 2004). Positive feedback is likely to be regarded as a compliment. Learners can perceive higher social approval when the compliment is from humans rather than from computers. In addition, learners who receive positive feedback may develop good impressions of the feedback source. Once provided by instructors, positive feedback is conducive to fostering social relationship between instructors and learners (Bracken et al. 2004). In this sense, learners are aware that they can turn to instructors for support when they are in need. In addition, social support can be categorized into emotional support, informational support, instrumental support and socializing support (Lin and Bhattacharjee 2009). By facilitating each of the four aspects of social support, positive instructor feedback increases learners’ perceptions of social support. Hence, positive feedback from instructors strengthens learners’ sense of social support. Since feedback from computer reduces interaction and depersonalizes the learning environment, interpersonal sensitivity is diminished (Alder and Ambrose 2005). Hence, we expect positive feedback to exert less effect on learners’ perceived social support for computerized feedback. Therefore, we propose hypothesis 6.

Negative feedback is often regarded as a threat to recipients. Prior studies revealed that instructors who give negative feedback are often believed to be biased and inconsiderate (Leung et al. 2001). The perception of fairness is closely related to learners’ acceptance of feedback and their development of positive attitude towards the instructors (Leung et al. 2001). Moreover, negative feedback may undermine learners’ self-efficacy. Social cognitive theory postulates that self-efficacy influences one’s outcome expectations (Lin and Bhattacharjee 2009). Given our study’s focus on social support outcome of feedback receiving, the outcome expectation construct in social cognitive theory is labeled as social support perception in this study. In this sense, it is reasonable to expect that negative feedback from instructors weakens learners’ sense of social support. In contrast, computers are believed to be more impartial than humans (Lucas et al. 2014). Furthermore, interpersonal insensitivity is high for computerized feedback (Alder and Ambrose 2005). Hence, people usually do not care about what an impersonal computer thinks of them. As such, negative feedback has less effect on learners’ perceptions of social support for computerized feedback. Combining the above argument, we propose hypothesis 7.

H-6: Positive feedback strengthens the discrepancy between instructor feedback and computerized feedback in perceived social support.

H-7: Negative feedback reduces the discrepancy between instructor feedback and computerized feedback in perceived social support.

**Learning Outcomes**

The cognitive perspective of information processing entails a systematic investigation and understanding of the relationship between information processing and subsequent task performance. Unless individuals successfully process the feedback that they receive, the feedback won’t have a positive effect on learning (Lipnevich and Smith 2009). Thus, we assume that if learners rely on feedback to develop learning, the amount of information processing on feedback will affect learners’ learning performance.

Information processing on feedback is concerned with how people understand the meaning of feedback, integrate it into a cognitive schema, and draw implications that are far beyond the feedback itself (Dennis et al. 2008). Learners who are engaged in information processing undergo the cognitive processes that are necessary to analyze the feedback message and make sense of it, which is essential to improve learning performance. In addition, learners who spend more time and effort on information processing tend to treat the feedback and the learning content as something worthy to get to know and understand (Biggs 2011). Such cognitive schema motivates learners to gain more knowledge for subsequent learning.

H-8: The information processing amount is positively related to learners’ online learning performance.

Social support provides affective support to learners and leads them to believe that they are cared for (Lee 2004). As such, social support represents an emotional reassurance. For instance, it may convey the positive message to learners that others are willing to provide help when they encounter difficulties (Yu et al. 2010). By providing warmth and understanding, social support gained from feedback can satisfy learners’ affective needs as well as social needs, which fosters a favorable learning experience (Liang et al. 2011). Therefore, social support is conducive to fostering learners’ satisfaction with online learning.
Since the social support we study is gained from feedback, it conveys information to help learners to reduce learning uncertainty and enhance understanding of learning (Lin and Bhattacherjee 2009; Yu et al. 2010). In addition, learners who are socially supported by others in online learning can acquire social capital through the interpersonal relationship (Lin and Bhattacherjee 2009). Such social capital enhances learners’ acquisition of new knowledge, understanding of learning situations, and regulation of learning goals, which promotes learning progress (Yu et al. 2010). Therefore, we propose hypothesis 10.

H-9: Learners’ perceived social support is positively related to their satisfaction with online learning.

H-10: Learners’ perceived social support is positively related to their online learning performance.

Control Variables

In order to exclude the effects of confounding factors, we include several control variables: gender, need for cognition, GPA, and performance before feedback. Females and males differ in their information processing (Rozendaal et al. 2003). Therefore, we include gender as a control variable. The need for cognition is a personality variable reflecting the extent to which individuals are inclined towards effortful cognitive activities (Cacioppo et al. 1984). People high in need for cognition prefer to engage in high elaboration, while those low in need for cognition tend to engage less in elaborative processes (Barden and Petty 2008; Cacioppo et al. 1984). Since need for cognition may affect one’s information processing, we include it as a control variable. We also include GPA and subjects’ practice performance before feedback, since they are closely related to their final performance.

Construct Measurement

The measures of the constructs are adapted from prior studies. There has been an assumption that perceptions of the amount of thought generally reflect the actual amount of thought that has taken place (Barden and Petty 2008). Thus, this study uses perceived information processing to measure learners’ information processing amount. The measures for perceived information processing are adapted from Barden and Petty (2008) and Wan et al. (2010). The measures for perceived social support are adapted from Liang et al. (2011) and Lee (2004). We adapt items from Lin (2005) to measure learners’ satisfaction with online learning. The need for cognition is measured with items from Cacioppo et al. (1984). The measures and sources are listed in the Appendix.

Research Method

Experiment Design

A laboratory experiment will be conducted to test the proposed research model. We adopt a 2 (instructor feedback v.s. computerized feedback) * 2 (positive feedback v.s. negative feedback) between-subjects research design. The feedback provided will be related to subjects’ actual task performance. Subjects will be asked to submit the finished task via an online learning platform. Depending on their performance, the subjects will receive either positive or negative feedback via the platform. For feedback source, half of the subjects will receive feedback from an instructor while the others will receive feedback from a computer. In the instructor feedback, subjects will be told that the feedback is from an instructor (either an actual course instructor or an instructor introduced at the beginning of the experiment) and along the feedback they will be presented with the photo of the instructor. Subjects in groups of computerized feedback will be led to believe that the feedback is automatically generated by a computer. We will also add a photo of a computer in groups of computerized feedback.

Subjects

Undergraduate or graduate university students will be recruited as subjects because they are active learners and had enough experience to effectively process the feedback information. In order to ensure that all subjects have a baseline understanding of the experiment, an introductory session will be conducted prior to the experiment. Subjects will not be provided with any particular information regarding the purpose of the study. To provide a relevant and realistic context for the experiment, we will
use a popular online learning platform and subjects will be told that researchers are investigating their learning processes on the platform. Subjects will be informed that the online learning platform will provide feedback to help them go through the learning process. We use this platform for the experiment according to the following reasons: first, it is an online learning platform that involves a large number of learners and instructors, so the current research topic is important for the platform. Second, this online learning platform is interactive that entails feedback giving. Third, we are able to manipulate feedback and obtain the data from the platform with the help of a platform manager. In order to exclude the confounding effects of feedback content, we control for the content of feedback messages to make them consistent across treatment groups.

**Task**

The task used in this experiment should comply with two criteria. First, the task should be complex enough and subjects should not be familiar with the task so that they can benefit from the feedback. Second, the task should allow us to measure the process variables of interest (e.g., information processing and perceived social support). After a literature review, we chose a task that requires subjects to write a short essay (500 words or so) demonstrating their understanding of some questions that are part of their courses. This task entails subjects to benefit from feedback.

**Conclusions and Expected Contributions**

The main purpose of this study is to examine how instructor feedback and computerized feedback influence learners’ information processing and perceived social support, which in turn influence their learning outcomes. To develop a good understanding of feedback effects, the role of feedback sign is also examined. This study is expected to have theoretical contributions. First, this study applies theories of information processing in feedback research. IS researchers had used information processing theories to explain communication (Dennis et al. 2008) and decision making (Tam and Ho 2006). Information processing is a model to explain human thinking and learning, and it represents a cognitive perspective of learning. Since people’s cognitive ability is limited, information processing on specific tasks cannot increase without limit (De Jong 2010). Thus, a good design of online instruction motivates learners to spend more effort on processing the learning tasks, which ultimately leads to desirable learning outcomes. However, IS research lacks a systematic examination of how feedback design affects information processing and the subsequent effect on learning outcomes. Second, this study adds knowledge to the human-computer interactions literature. The psychological aspects of human-computer interactions are complex and hard to explain using a single cognitive or affective perspective (Mishra 2006). In the context of computer-mediated feedback, this study illustrates that both cognitive (i.e., information processing) and affective (i.e., perceived social support) perspectives should be considered to explain human-computer interactions. Third, this study also sheds light on the feedback research. While studies of the online learning process are common, there has been no systematic empirical investigation of the influence of information technology in feedback delivery. Due to the increasing flexible learning and working time by virtue of information technologies, computer-mediated feedback becomes more popular. This study lays a theoretical basis for a comparison of human and non-human feedback in promoting effective learning. The findings of this study can provide guidance for instructors who provide online feedback. Specifically, it may be better for instructors to give positive feedback rather than negative feedback in online learning, because negative feedback with no facial expressions and tones may frustrate the feedback recipients.

This study also has potential practical contributions. First, this study offers implication for the design of feedback for online learners. Extensive research, not only underpins the importance of feedback in enhancing learning, but also emphasizes the obligation of educational institutions to effectively integrate feedback in the learning experience. Owing to the large number of online learners and limited numbers of instructors, both human and non-human feedback can be designed into online feedback systems to establish multi-feedback. Second, despite the merits of computerized feedback in reducing instructors’ workload and encourage learning engagement (Walter et al. 2015), practitioners should be careful using computerized feedback to substitute instructor feedback. The effectiveness of feedback may depend on how learners react to it, e.g., how learners process the feedback message and how they perceive social support from the feedback interactions.
Acknowledgements

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Appendix. Measurement instruments

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Sources</th>
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</thead>
<tbody>
<tr>
<td>Information Processing (IP)</td>
<td>IP1: To what extent did you think a lot about the feedback information?</td>
<td>(Barden and Petty 2008; Wan et al. 2010)</td>
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<td></td>
<td>IP2: To what extent did you pay attention to the message when you read the feedback?</td>
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<td></td>
<td>IP3: To what extent did you carefully read the feedback?</td>
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<td></td>
<td>IP4: To what extent did you have a thorough processing of the feedback?</td>
<td></td>
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<tr>
<td>Social Support (SS)</td>
<td>SS1: When I encountered a problem, the instructor/computer on the online learning platform can help me solve the problem.</td>
<td>(Lee 2004; Liang et al. 2011)</td>
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<td></td>
<td>SS2: When faced with difficulties, the instructor/computer on the online learning platform would help me discover the causes and provide me with suggestions.</td>
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<td></td>
<td>SS3: When faced with difficulties, the instructor/computer on the online learning platform comforted and encouraged me.</td>
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<tr>
<td></td>
<td>SS4: When faced with difficulties, the instructor/computer on the online learning platform expressed interest and concern in my well-being.</td>
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<tr>
<td>Satisfaction with Online Learning (SOL)</td>
<td>SOL1: I developed knowledge and competencies in this online learning.</td>
<td>(Lin 2005)</td>
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<td></td>
<td>SOL2: The online learning activities were a good fit for the way I like to learn.</td>
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<tr>
<td></td>
<td>SOL3: The online learning activities met my expectations for what I had hoped to learn.</td>
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<td></td>
<td>SOL4: The knowledge and competencies gained through the online learning activities are personally meaningful and important to me.</td>
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<tr>
<td>Need for Cognition (NC)</td>
<td>NC1: I would prefer complex to simple problems.</td>
<td>(Cacioppo et al. 1984)</td>
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<td></td>
<td>NC2: I like to have the responsibility of handling a situation that requires a lot of thinking.</td>
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<td></td>
<td>NC3: Thinking is not my idea of fun. (R)</td>
<td></td>
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<td></td>
<td>NC4: I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. (R)</td>
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<td></td>
<td>NC5: I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something. (R)</td>
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<td>NC6: I find satisfaction in deliberating hard and for long hours.</td>
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<td></td>
<td>NC7: I only think as hard as I have to. (R)</td>
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<td></td>
<td>NC8: I prefer to think about small, daily projects to long-term ones. (R)</td>
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<td></td>
<td>NC9: I like tasks that require little thought once I've learned them. (R)</td>
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<td></td>
<td>NC10: The idea of relying on thought to make my way to the top appeals to me.</td>
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<td></td>
<td>NC11: I really enjoy a task that involves coming up with new solutions to problems.</td>
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<td></td>
<td>NC12: Learning new ways to think doesn’t excite me very much. (R)</td>
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<td></td>
<td>NC13: I prefer my life to be filled with puzzles that I must solve.</td>
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<td></td>
<td>NC14: The notion of thinking abstractly is appealing to me.</td>
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<td>NC15: I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.</td>
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<td>NC16: I feel relief rather than satisfaction after completing a task that required a lot of mental effort. (R)</td>
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<td>NC17: It’s enough for me that something gets the job done; I don’t care how or why it works. (R)</td>
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<td>NC18: I usually end up deliberating about issues even when they do not affect me personally.</td>
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References


