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Abstract

This chapter reviews theories and research on academic emotions and motivation that can be integrated into the processes of instructional design and development. First, we discuss the impact of emotions in learning and performance contexts. Second, we review theories describing how emotions occur. Third, we discuss how to optimize emotional experiences in learning and performance contexts and review several models and approaches that can be used in instructional design. Fourth, we review instruments and technologies measuring emotions and emotion regulation. We conclude the chapter by suggesting future research directions including reframing motivation research that considers emotions in the realm of educational communications and technology.

Keywords

Academic emotions • Motivation to learn • Cognitive appraisal • Causal expectancies • Causal attribution • Emotion regulation

Introduction

Motivation and emotions play a critical role in learning and performance (Astleitner, 2000; Carver & Scheier, 1990; Goetz, Pekrun, Hall, & Haag, 2006; Op't Eynde, Corte, & Verschaffel, 2006; Pekrun, 1992; Pekrun, Goetz, Titz, & Perry, 2002). When students do not exhibit high motivation, they either do not initiate or discontinue learning tasks. Furthermore, when students have high anxiety, their performance is not ideal. However, instructional designers and researchers often pay little heed to motivation and emotions due to their indirect effects on learning and performance

(Schiefele & Csikszentmihalyi, 1995). Additionally, little research examines interventions designed to improve learners' emotional experiences in learning and performance (Astleitner, 2001; Gläser-Zikuda, Fuß, Laukenmann, Metz, & Randler, 2005; Kim & Hodges, 2012). While some studies have examined interventions to reduce learners' motivational problems (e.g., Hodges & Kim, 2010; Kim & Keller, 2008, 2010, 2011), there is little research in which both emotions and motivation are considered in efforts to improve learning and performance. In this chapter, we explore the intersection of motivation and emotions in the learning process, and how to support students in this critical area.

The Inseparable: Emotions and Motivation

Emotions result from “the dynamic interplay of cognitive, physiological, and motivational processes in a specific context” (Op't Eynde et al., 2006, p. 193). In order to understand educational experiences, emotions and motivation need to be considered alongside cognition (Ainley, 2006; Hannula, 2006; Meyer & Turner, 2006; Op't Eynde et al., 2006; Op't Eynde

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& Turner, 2006; Pekrun, 2006; Turner & Patrick, 2008). The interplay among emotions, motivation, and cognition can be understood from the perspective of goals (Ainley, 2006; Dweck, 1992; Linnenbrink, 2006; Linnenbrink & Pintrich, 2002; Op't Eynde & Turner, 2006; Pekrun, 2006; Schutz, Hong, Cross, & Osbon, 2006). For example, a mastery goal orientation can promote positive emotions and sustain motivation whereas a performance-avoidance goal orientation can promote negative emotions and poor motivation (Dweck, 1992; Pekrun, Elliot, & Maier, 2006). Emotions and motivation are enacted while striving to pursue or avoid goals (Carver & Scheier, 1990; Op't Eynde & Turner, 2006).

In addition to their organization around goals, there are bidirectional (reciprocal) influences between emotions and motivation (Kim & Hodges, 2012; Kim, Park, & Cozart, 2013; Pekrun, 2006). Emotions and motivation interact with each other and make each other activated (or deactivated), which directs behaviors (Hannula, 2006; McLeod, 1988; Op't Eynde et al., 2006; Op't Eynde & Turner, 2006; Pekrun, 2006). Some researchers regard motivation as part of emotion processes (e.g., Op't Eynde et al., 2006), whereas others regard emotions as part of motivation processes (e.g., Ford, 1992; Hannula, 2006). Buck (1985) explained the relation between emotions and motivation using the analogy of energy and matter in physics: "Just as energy is a potential that manifests itself in matter, motivation is a potential that manifests itself in emotion. Thus motivation and emotion are seen to be two sides of the same coin, two aspects of the same process" (p. 396). Although emotions and motivation are not inseparable conceptually and empirically, it is difficult to separate them in the contexts of learning and performance (Ainley, 2006; Op't Eynde et al., 2006). An integrative view of emotions and motivation is needed to understand and facilitate learning and performance (Kim & Hodges, 2012; Pekrun, 2006).

The purpose of this chapter is to discuss theories and research on emotions and motivation that can be integrated into instructional design and development. A detailed review of motivation research is not included in this chapter because previous editions of the *Handbook of Research for Educational Communications and Technology* addressed motivation research in multiple chapters (e.g., Park & Lee, 1996; Seel, 2007). Much of this chapter focuses on academic emotions while acknowledging that emotions and motivation are difficult to separate. First, we discuss the impact of emotions in learning and performance contexts. Second, we review several theories describing how emotions occur. Third, we discuss how to optimize emotions in learning and performance contexts and present design strategies that employ emotion regulation. Fourth, we review instruments and technologies that measure emotions and emotion regulation. We conclude the chapter by suggesting directions for future research.

How Emotions Influence Learning and Performance

Emotions impact the quality of learning and performance (Gläser-Zikuda et al., 2005; Goetz et al., 2006; Pekrun, Elliot, & Maier, 2009; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010). The impact of emotions on learning and performance should be studied in the context where the emotions are occurring. This in turn would improve explanations of how emotions impact learning and performance. The following list overviews what mediates the impact of emotions on learning and performance:

- Emotions influence cognitive processes and strategies
- Emotions influence decision making
- Emotions influence motivation
- The aforementioned influences are reciprocal

Impact of Emotions on Cognitive Processes and Strategies

Emotions influence cognitive processes (Forgas, 2000; Gläser-Zikuda et al., 2005; Linnenbrink, 2006; Pekrun, 2006; Pekrun et al., 2002; Schwarz, 1990, 2000). Information processing can be initiated, accelerated, altered, or interrupted by emotions (Astleitner, 2000; Pekrun, 1992; Pekrun et al., 2002). Emotions can alter how information is stored and retrieved (Levine & Pizarro, 2004; Linnenbrink, 2006; Schwarz, 2000). Memory can be organized differently depending on emotions experienced when the information was stored and/or the information is being retrieved.

Mood-congruent retrieval implies that a person's current emotional state influences the way his/her memories are recalled (Blaney, 1986; Bower, 1981; Levine & Pizarro, 2004; Parrott & Spackman, 2000). For example, in one study, people recalled their experiences about blood donation differently depending on their current feelings about blood donation (Breckler, 1994). In another study, people retrieved memories about their early marriage life differently depending on how happy or unhappy they feel about their marriage at present (Holmberg & Holmes, 1994). This is consistent with the notion that "emotions enhance the availability of emotion-congruent information" (Levine & Pizarro, 2004, p. 537). In other words, people tend to retrieve information that is congruent with their current emotions (Schwarz, 2000). For example, a student may recall enjoyable memories about mathematics while having fun playing Sudoku rather than while taking a mathematics exam in a classroom.

The type of emotion (e.g., positive vs. negative; activating vs. deactivating) can influence the use of cognitive strategies (Pekrun, 2006; Pekrun et al., 2002). People experiencing positive emotions tend to use more general knowledge in

heuristic ways whereas people experiencing negative emotions tend to use systematic analyses with more focus on details (Hertel, Neuhof, Theuer, & Kerr, 2000; Levine & Pizarro, 2004; Schwarz, 2000). Research has shown that activating positive emotions (e.g., happiness) facilitates flexibility and creativity (Isen, 2000; Levine & Pizarro, 2004). Activating negative emotions (e.g., anxiety) can lead to the use of narrowly focused, rigid strategies and deactivating negative emotions (e.g., boredom) can lead to superficial information processing due to unfocused attention (Pekrun, 2006). For example, students with high test anxiety could dwell on one exam question with which they are struggling because their use of narrowly focused strategies keeps them from allocating time for all exam questions. The impact of emotions on cognitive processes and strategies influences learning strategies, problem-solving behavior, and performance (Kim et al., 2013; Op't Eynde et al., 2006; Pekrun, 2006).

Impact of Emotions on Decision Making

Emotions influence decision making (Schwarz, 2000). When making decisions, people intend to minimize the likelihood of negative emotions and maximize the likelihood of positive emotions; therefore, anticipated emotions can influence decision-making processes (Schwarz, 2000). As a negative consequence of such influence, Schwarz (2000) provided the following example:

Parents may hesitate to vaccinate their child when the vaccine has potentially fatal side effects, even under conditions where the likelihood of a fatal side effect is only a fraction of the death rate from the disease, presumably because anticipated regret looms larger for the act of vaccination. (p. 436)

When parents choose not to vaccinate their children, they make such a decision because they are motivated to avoid the possibility of the anticipated emotion (regret) and also because regret for action (vaccination) is usually more intense than that for inaction (Schwarz, 2000).

Anticipated emotions may also impact decision-making processes in learning and performance contexts (Stephens & Pekrun, 2011). For instance, if Jake decided not to study for the final exam because he thinks he would fail anyway, he may have made such a decision to minimize the likelihood of the negative emotions such as hopelessness and shame that would come from ineffective action.

Past experiences of emotions (i.e., emotional memories) influence decision making as well (Levine & Pizarro, 2004; Schwarz, 2000). In the aforementioned example, Jake may have felt hopeless in the past when he did not perform well on an exam for which he studied. This past, negative emotion (a) made Jake underestimate the probability that studying for the exam would result in success in the exam, and (b) influenced his decision not to study. In Jake's decision-making

process, expectancy assessment was involved, which is heavily dependent on memories of prior experiences (Carver & Scheier, 1990). One would then wonder if Jake would never make a decision to study for an exam due to his past experience of negative emotions. "Emotional memories are not indelible" (Levine & Pizarro, 2004, p. 535). Instructional designers can promote positive changes in learners' expectancy assessment processes. For example, goals in tasks should be specified. Without knowing what is expected, it is not likely that learners' expectancy assessment will be constructive. Nonetheless, "goal specificity in itself does not necessarily lead to high performance because specific goals vary in difficulty" (Locke & Latham, 2000, p. 706). Task difficulty needs to be modified per learners' ability; the provision of incremental success experiences can increase learners' assessment of the probability of success in completing tasks.

Impact of Emotions on Motivation

Different emotions correspond to different actions. For example, fear can induce withdrawal or avoidance and anger can induce a physical attack (Frijda, Kuipers, & Schure, 1989; Plutchik, 1980). Action tendencies result from discrete emotions that create specific action impulses. For example, the physical attack (an action) induced by anger (an emotion) is meant to hurt someone (a motivational intention) (Roseman, Wiest, & Swartz, 1994). How emotions influence one's motivation to act in a certain way can be explained in terms of memory and goals. Some researchers view emotion as a kind of information in working memory that could contribute to motivation regulation (Carver & Scheier, 1990; Levine & Pizarro, 2004). In the previous example, Jake's memory of past, negative emotions deactivated his motivation to study, as did anticipatory, negative emotions. As "emotions can cause interruption and reprioritization of one's goals" (Carver & Scheier, 1990, p. 31), the influence of emotions on motivation may also be mediated by goals. As illustrated earlier, students' expectancy assessment can be involved in this process of emotions influencing motivation. Emotions also influence goal pursuit (Seifert, 1995). Emotions along with expectancy assessment are used in monitoring, which leads to either goal-pursuit or goal-disengagement (Carver & Scheier, 1990). The monitoring process can be either conscious or nonconscious (Carver & Scheier, 1990). Through the monitoring process involving emotions, emotions facilitate or impede self-regulatory behaviors toward goals.

Optimizing academic emotions can in turn optimize motivation and ultimately learning and performance. For example, compared with students in the control group, students who received an emotion regulation intervention showed more positive motivation and positive emotions than those in the control group (Kim & Hodges, 2012). To promote optimal

learning and performance, instructional designers need to consider not only the content to be learned but also student needs related to academic emotions and motivation during the design of instruction (Pintrich & Schunk, 2002). Also, instructional designers need to consider ways of highlighting intrinsic task value. Autonomy-supportive learning environments can promote learners' curiosity and desire to take on a challenge (Ryan & Deci, 2000). An emphasis on mastery goal orientations helps learners perceive task value beyond instrumental usefulness (Ames, 1992; Covington, 2000).

Reciprocal Effects

Up to now, how emotions influence learning and performance has been explained through the discussions of the impact of emotions on cognitive processes and strategies, decision making, goal-pursuit, and motivation. Cognition, emotions, and motivation are reciprocal (Pekrun, 2006). For example, emotions influence memory but memory also influences emotional reactions (Carver & Scheier, 1990). Emotions can influence goal orientations, but also different emotions are possible when a student displays a particular goal orientation (Dweck, 1992; Linnenbrink & Pintrich, 2002; Schwarz, 2000). In short, emotions influence ongoing behaviors (Carver & Scheier, 1990) and vice versa because emotional processes interact with motivational and cognitive processes (Astleitner, 2000). Second, situational aspects influence this interactive process (Pekrun, 2006). For example, the quality of communications and understanding between students and teachers is influenced by emotions (e.g., empathy) and impacts the interactive process (Goetz et al., 2006; Meyer & Turner, 2002). In the next section, the manifestation of academic emotions is discussed in light of instructional design.

How Emotions Occur

Emotions arise when a person *appraises* a given situation. The *meaning and causal structures* of the situation and *controllability* are cognitively evaluated and expectancy is formed accordingly (Gross, 2008; Pekrun, 2006; Scherer, 1999; Schutz & Davis, 2000; Weiner, 1985). This appraisal process, which can be either conscious or nonconscious and either deliberate or automatic, brings about an emotional response (Gross, 2008; Johnson-Laird & Mancini, 2006; Op't Eynde et al., 2006; Pekrun, 2006; Schutz & Davis, 2000, 2010).

A person's expectancy and perceived values of a certain action (or inaction) and its outcomes determine the person's responses to the situation where the person takes (or does not take) the action (Carver & Scheier, 1990; Pekrun, 2006). Motivational and emotional responses occur based on these

expectancy and value appraisals. In this section, what forms the expectancy and values is discussed to explain how emotions occur.

The *meaning structure* of a given situation initiates expectancy and value assessment; that is, the subjective controllability and value of the situation (i.e., achievement activities and/or outcomes) are analyzed (Carver & Scheier, 1990; Pekrun, 2006; Schutz & Davis, 2000). For example, Bill just entered a 2-year college and is required to take a remedial math course. Without taking the remedial math course, he is not allowed to take any other course. If he drops the remedial math course, he must drop other courses that are being taken together as well. Bill values the remedial math course in that it can determine whether he can continue to pursue his goal—completing the 2-year college, eventually transferring to a 4-year college, getting a college degree in social work, and becoming a social worker. On one hand, the value of an anticipated outcome—the completion of the remedial math course that leads Bill one semester closer to his dream job—strengthens his motivation to study hard. On the other hand, anxiety could grow due to the extremely important and relevant meaning of the remedial math course to Bill's goal. As discussed in Pekrun's (2006) control-value theory of achievement emotions, this meaning structure analysis involves the appraisal of extrinsic value and intrinsic value. In terms of extrinsic value, Bill values the instrumental usefulness of the remedial course for his goal attainment. In terms of intrinsic value, Bill may value the course itself (if Bill just likes to learn math). However, the meaning structure of the situation alone does not bring about emotional responses; rather, it should be accompanied with the analysis of what controls the situation, one's actions, and their outcomes.

The *causal structure* of a given situation forms the expectancy in part; that is, learners' perceived control (i.e., subjective control over achievement outcomes; perceptions of what the outcome of their action depends on) is critical in their expectancy assessment (Pekrun, 2006; Weiner, 1985). The causal structure of the situation is analyzed and leads to one's perception of the locus of control (internal vs. external) and the stability of control (stable vs. unstable) (Weiner, 1985). In Bill's case, if he perceives that his ability will help him succeed in the remedial math course, his perceived control is internal and stable. If he perceives that he needs luck to be successful in the course, his perceived control is external and unstable. As described in expectancy-value theories, this perceived control influences a person's motivation (e.g., Eccles, 1983). Bill would not be motivated to study for the course when he perceives that his effort would not matter but luck does. At the same time, Bill's emotional experience can also be different according to his perception of the causal structure. For example, Bill would be proud of himself if he thinks that he passed the midterm exam because his effort paid off rather than he was lucky. In contrast, if Bill failed the

exam and he thinks that his failure was not from lack of effort but from lack of support by others, he would experience the emotion of anger. As discussed by Pekrun (2006), the process of this causal structure analysis involves causal expectancies and causal attributions: the former is prospective appraisal of the relation of causes to anticipated effects (examples about Bill's course success above), and the latter is retrospective appraisal of the relation of observed effects to causes (examples about Bill's exam results above).

People can perceive the causal structure of the same situation differently for various reasons. Past emotions, memory of prior experiences, task difficulty, goal specificity, and vicarious experience are examples of sources of individuals' different analyses of the causal structure and corresponding different emotional responses (Carver & Scheier, 1990; Locke & Latham, 2000; Pekrun, 2006; Weiner, 1985). Bill may feel hopeless because unpleasant memories of 8th-grade algebra returned (past emotions). He may still be ashamed of his low scores on the college placement test that resulted in a required remedial math course (past emotions). He may be frustrated because taking an online course is new to him (task difficulty; lack of goal specificity). He may be nervous because a friend who had taken the course told him that the exam questions were unpredictable (vicarious experience).

Even when people perceive that they are equipped with internal and stable dispositions that are important to attain success, their expectancies are not necessarily positive. For example, Bill may perceive that his ability is the enabler for success in the remedial math course, but if he thinks that he is not able to exert the required effort due to habitual procrastination, his expectancy of course completion could be low and he might experience negative emotions. Bill's controllability over his own effort would also be critical in the appraisal process. Thus, how people evaluate the *controllability of actions*—i.e., subjective control over achievement activities in Pekrun (2006)—also forms expectancies and drives emotional responses (Weiner, 1985). The concept of controllability is worth mentioning especially because some causes can be viewed as either stable or unstable (Weiner, 1985), and as either controllable or uncontrollable. Ability is perceived as stable and uncontrollable if math ability is regarded as a fixed entity, but it can be perceived as unstable and controllable if Bill thinks that math ability can be acquired over time because math is learnable.

In summary, the appraisal process that forms perceived control, expectancies, and subjective values plays a central role in an emotion process (Levine & Pizarro, 2004; Op't Eynde et al., 2006; Pekrun, 2006; Weiner, 1985). The perceived meaning and causal structure of the situation can be considered by instructional designers to optimize emotional experiences and motivation in learning and performance contexts. It is also important to address learners' needs not only individually but also in groups. As mentioned earlier, vicarious experience from peers can lead to learners' different

perceptions of meaning and causal structures of the situation, as shown in research on goal contagion (e.g., Aarts, Dijksterhuis, & Dik, 2008).

How Emotional Experience Can Be Optimized

Understanding learners' emotions implies understanding not only their values and beliefs but also their learning and problem-solving behaviors (Astleitner, 2000; Op't Eynde et al., 2006). However, simply understanding learners' emotions is not sufficient; rather, positive activating emotions should be cultivated since they can lead to positive outcomes such as open-mindedness, effective cognitive strategy use, motivation, self-regulatory behaviors toward goals, academic achievement, psychological growth, and positive career aspirations (Astleitner, 2000; Fredrickson, 1998; Goetz et al., 2006; Pekrun, 2006). Theory-driven interventions can be designed to cultivate learners' positive activating emotions (Astleitner, 2000; Goetz et al., 2006; Kim & Hodges, 2012; Pekrun, 2006). In fact, several theoretically guided models and approaches can be used in instructional design to improve learners' emotional experiences as discussed below.

Models and Approaches for Optimizing Emotional Experience

The FEASP (fear, envy, anger, sympathy, and pleasure) approach was proposed to help design "emotionally sound instruction" (Astleitner, 2000, p. 173):

- *Fear* arising from subjectively judging a situation as threatening or dangerous
- *Envy* resulting from the desire to get something that is possessed by others
- *Anger* coming from being hindered to reach a goal and being forced to an additional action
- *Sympathy* referring to an experience of feelings and orientations of other people who are in the need of help
- *Pleasure* based on mastering a situation with a deep devotion (Astleitner, 2000, p. 175)

A set of instructional strategies can systematically decrease fear, envy, and anger and increase sympathy and pleasure (Astleitner, 2000). For example, strategies for reducing learners' fear include helping learners accept their mistakes as opportunities to learn. Astleitner (2000) argued that the strategies should be implemented by instructional designers and teachers to promote the desired emotional experience of learners. He also emphasizes that strategies should be designed and implemented based on learners' problems and the outcomes should be evaluated. As part of an empirical validation of the FEASP approach, Astleitner (2001) asked both teachers and students how important they thought emotions were in learning

and instruction and if and how often the strategies in the FEASP approach were used in classroom. Based on the survey results, Astleitner (2001) concluded that the FEASP approach was “relevant, usable, consistent, and affecting emotions in daily instruction” (p. 209). However, his approach has not been tested in the process of design, development, implementation, and evaluation of interventions aiming to improve learners’ emotional experience. Also, his validation process seems to be limited. A finding that students state that emotions are important in school may be limited by students’ (often) inaccurate understanding of academic emotions. In addition, the functions of emotions for motivation and learning were not elaborated; for example, he defined envy as a maladaptive emotion, which does not address benign envy, as opposed to malicious envy, that can serve as a motivation to study more (for further discussion of benign vs. malicious envy, see Van de Ven, Zeelenberg, & Pieters, 2009, 2011).

Keller’s attention, relevance, confidence, and satisfaction (ARCS) motivational design model (1987, 2010) considers learners’ emotional experiences, although Keller did not explicitly mention design for emotions. The model provides instructional strategies to increase the four components in learners. For example, one motivational strategy for attention is creating curiosity in learners by asking them questions that are not congruent with their current knowledge (e.g., paradoxical questions) (see Keller, 2010). Keller (2010) discussed learners’ emotional states such as anxiety, boredom, pleasantness, and so on, and he provided specific strategies to deal with these emotional states in instructional design. There has not been much research implementing the ARCS model to promote learners’ emotional experience, although there have been numerous studies that applied the model to the design of interventions to promote motivation (e.g., Martindale, Pearson, Curda, & Pilcher, 2005). Keller’s more recent model, called an integrative theory of motivation, volition, and performance (MVP), includes design to facilitate learners’ volition (Keller, 2008). The MVP model has been used in a few empirical studies (Kim & Keller, 2008, 2010, 2011). The model recommends using emotion control as a volitional strategy but lacks specific strategies to promote emotion control.

Park and Kim (2012) introduced an approach to enhance students’ enjoyment and reduce boredom in online learning contexts by promoting interest in course readings. Specifically, the virtual tutee system (VTS) was proposed as a computer-based peer-tutoring environment where learners teach virtual tutees. The VTS was designed based on the concept of *learning by teaching* to increase interest and enjoyment and decrease boredom. Role theory and self-determination theory were used as theoretical foundations. However, empirical validations of the VTS design framework have not yet been published; one study illustrating the positive outcome of applying the VTS framework to a college course is under review.

Emotional scaffolding has been studied in face-to-face classrooms (e.g., Meyer & Turner, 2007; Rosiek & Beghetto, 2009) as well as in online environments (e.g., Aist, Kort, Reilly, Picard, & Mostow, 2002). Emotional scaffolding refers to activities that are tailored to specific aspects of the content of teaching as well as to emotional experience of students in the classroom (Rosiek, 2003). Emotional scaffolding requires teachers’ knowledge of interactions among “curricular content, cultural discourses, community histories, students’ personal histories, and general attitudes about schooling that precipitated students’ emotional response to their lessons” (Rosiek, 2003, p. 406). Also, emotion regulation has been used to promote positive emotions and desired motivational states. Gross (2008) proposed four antecedent-focused strategies (used before the activation of certain emotions) and one response-focused strategy (used during the activation of certain emotions):

- Situation selection—choosing to be in environments that are likely to diminish negative emotions
- Situation modification—changing a certain environment to reduce negative emotions
- Attentional deployment—shifting attention to something else
- Cognitive change—reappraisal; cognitively reevaluating the situation
- Response modulation—suppressing certain emotions activated (pp. 500–505)

Kim and Hodges (2012) designed and implemented an emotion regulation intervention that focused on the renewal of cognitive appraisal processes using three of these strategies (attentional deployment, cognitive change, and response modulation). They intended to help with learners’ conscious and deliberate awareness and reappraisal of the situation.

Schutz and Davis (2010) proposed four emotion regulation processes in test-taking contexts as follows:

- Cognitive-appraising processes related to the goal-directed person–environment transaction involving goal importance, goal congruence, agency, and problem efficacy
- Task-focusing processes
- Emotion-focusing processes involving wishful thinking and self-blame
- Regaining task-focusing processes involving tension reduction and reappraisal (Schutz & Davis, 2010, p. 2)

Schutz and Davis (2010) did not produce an instructional intervention; they examined naturally occurring processes. However, their proposed dimensions for emotion regulation processes, especially the *regaining task-focusing processes*, can be applied to the design of interventions promoting emotion regulation. The effects of emotion regulation may persist beyond the intervention because acquired regulatory reappraisal skills can be transferable to other contexts. This approach of emotion regulation may be worth pursuing since one of the important goals as to educational contexts should be to raise self-regulatory learners who can help themselves outside of class.

A Comprehensive Framework: The Control-Value Theory of Achievement Emotions

Pekrun's (2006) control-value theory of achievement emotions provides a comprehensive framework illustrating four paths that can be used to promote emotion regulation: (a) emotions, (b) appraisals, (c) competences for learning and achievement, and (d) design of tasks and learning environments.

First, the emotion path is *emotion-oriented regulation* that directly deals with emotions. For example, when students feel anxious before an exam, they can try to focus on "tasks to do" before the exam without thinking of "the exam." *Response modulation* and *attentional deployment* can be categorized as emotion-oriented regulation (Gross, 2008). Second, the appraisal path is *appraisal-oriented regulation* that deals with the subjective control and subjective value of a given context. For subjective control, causal expectancies and/or causal attributions need to improve; for subjective value, the perceived intrinsic and/or extrinsic value need to improve. That is, the meaning and causal structure of the situation and controllability, as described in the *How Emotions Occur* section, need to be reappraised. Schutz and Davis' (2010) *regaining task-focusing processes* can be explained by this appraisal-oriented regulation. Gross' (2008) emotion regulation strategy, *cognitive change*, can be categorized as appraisal-oriented regulation. Third, the learning and achievement path is *competence-oriented regulation* that deals with the improvement of learning and achievement. For example, abilities can be enhanced and study skills can be acquired. Keller's (1987, 2010) ARCS model can be used for competence-oriented regulation. Park and Kim's (2012) intervention to increase reading interest through the learning by teaching technique can be regarded as an example of competence-oriented regulation. Last, the environment path is *design of tasks and learning environments* that deals with improvement of learning and performance contexts. Examples include a clarification of course requirements (i.e., a change relevant to the specificity of goal structure and expectations; e.g., Locke & Latham, 2000), adding choices for an assignment completion (i.e., change relevant to autonomy support; e.g., Ryan & Deci, 2000), and so on. Astleitner's (2000) FEASP approach as well as Keller's ARCS model can be used for the design of learning and social environments.

Pekrun (2006) discussed how education should cultivate learners' positive emotions and emotion regulation through these four paths. For example, he argued that positively perceived value of learning should be induced through learners' communications with and observations of people around them, which can be possible in learning environments corresponding to students' needs (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009; Pekrun, 2006).

How Emotions Can Be Measured

Instructional design starts with needs assessment and instruction is evaluated through formative and summative assessments (Dick, Carey, & Carey, 2008). This means, in order to create interventions cultivating positive emotions and/or emotion regulation, first, there should be an investigation of learners' current emotional states. Also, there should be assessment instruments to evaluate the effect of interventions. In this section, we introduce several instruments and technologies that can be used to measure the types and levels of emotions as well as emotion regulation skills and processes. We also discuss issues with measuring emotions in relation to *situat- edness* of emotions in learning and performance contexts.

Measurement Instruments

The Achievement Emotion Questionnaire (AEQ; Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011) has been widely used in educational emotion research. The AEQ is a self-report instrument designed to assess students' emotions experienced in academic contexts. The AEQ measures nine discrete emotions relating to attending class, studying and doing homework, and taking tests and exams: enjoyment, hope, pride, relief, anger, anxiety, shame, hopelessness, and boredom. The AEQ scales for assessing emotions in the specific context of test-taking have been called the Test Emotions Questionnaire (TEQ; Pekrun et al., 2004). Other self-report instruments used in educational emotion research but measuring emotion regulation are the Emotion Regulation During Test Taking scale (ERT; Schutz, DiStefano, Benson, & Davis, 2004), the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski & Kraaij, 2007; Garnefski, Kraaij, & Spinhoven, 2001), and the COPE scale (Carver, Scheier, & Weintraub, 1989).

Measurement Technologies

The affective computing group at the MIT Media Laboratory, the Emotive Computing Lab at the University of Memphis, and the Affective Learning Companion research group at Arizona State University have developed and tested sensing systems and tools that detect people's psychophysiological responses in order to infer their emotional experience in a variety of contexts (e.g., D'Mello & Graesser, 2010; El Kaliouby, Picard, & Baron-Cohen, 2006; Gonzalez-Sanchez et al., 2011; Picard, 2003; Scheirer, Fernandez, Klein, & Picard, 2002). Such technologies include *Expression Glasses* to collect data of interest, surprise, confusion, satisfaction

from facial expressions, *Galvactivator* to collect data of arousal and excitement from skin responses, *Pressure-sensitive mouse* to collect data of frustration and anxiety from mouse-click behaviors, and *AutoTutor* including an automatic affect coding system based on Ekman's Facial Action Coding System (Ekman & Rosenberg, 1997) to detect affective states (for details, see D'Mello & Graesser, 2010; El Kaliouby et al., 2006; Gonzalez-Sanchez et al., 2011).

Another interesting development of a technology detecting learners' emotions is the *Subtle Stone*. It is a wireless, handheld squeezable ball and permits private communications between students and their teacher about emotional experience in real time (Alsmeyer, Luckin, Judith, & Harris, 2009; Balaam, Fitzpatrick, Good, & Luckin, 2010; Kim & Balaam, 2011). The *Subtle Stone* displays different colors and individual students can choose colors to express different emotions; the unique association between colors and emotions is not revealed to peers. The *Subtle Stone* has potential to be used for formative assessments during learning processes that allow not only the redesign of lessons but also teachers' emotional scaffolding for students (Kim & Balaam, 2011).

Problems in Measuring Emotions

Academic emotion research has often been criticized because of its reliance on self-report data and the lack of real-time data collection (Ainley, 2006; Kim & Hodges, 2012; Pekrun, 2006; Picard, 2010; Schutz & Davis, 2010). The development of advanced technologies such as psychophysiological sensing systems reviewed above is expected to resolve some of the issues. However, emotions are only partially observable; individuals' facial expressions or skin reactions, for example, can have different meanings even in the same situation (Buck, 1999; Hannula, 2006). Also, even if such technologies are capable of detecting accurate data related to learners' emotions, still there is the possibility of their interference with emotion processes. For instance, suppose wearable sensors are used to detect emotional states during test-taking. Even if those are lightweight and interruptions are minimal, they could detract on-task behaviors, which brings up ethical concerns as well (Schutz & Davis, 2010). In addition, emotions tend to constantly occur and change rapidly (Buck, 1985; Folkman & Lazarus, 1985; Op't Eynde et al., 2006; Pekrun, 2006; Schutz & Davis, 2010). The points in which changes are occurring or occurred can be difficult to investigate. Moreover, even if technologies, such as embodied conversational agents, relational agents, and affect-aware tutors (Bickmore & Cassell, 2004; Campbell, Grimshaw, & Green, 2009; Woolf et al., 2009, are implemented to promote positive emotions, it would be difficult to provide just-in-time support corresponding to the detected changes in emotions.

These issues are related to the *situatedness* of emotions, meaning that emotions are reciprocally and dynamically linked to cognitive and motivational processes in a specific, social-cultural context (Op't Eynde et al., 2006; Pekrun, 2006). Emotions should be studied within learning and performance contexts (Pekrun, 2006; Schutz et al., 2006). Therefore, the multilevel approach including several dimensions of analysis for personal, interpersonal, community-level, interactive, socially situated appraisal processes should be employed to fully understand and support learners' emotional experience in learning and performance contexts (Op't Eynde & Turner, 2006; Pekrun, 2006).

Conclusion

This chapter discussed the impact and process of emotions, design possibilities for optimizing emotional experience in learning and performance, and measurement instruments, technologies, and issues. Foundations for creating theory-based interventions and evaluation programs have been presented for instructional design and research on emotion and emotion regulation. Further research should continue to develop a design framework for cultivating learners' positive emotions and thereby motivation to learn and perform better. Also, a multi-method approach (Meyer & Turner, 2002; Pekrun, 2006) using not only self-report instruments and emotion-detecting technologies but also other data collection methods, such as discourse analysis, interviews, observations, interaction analysis, etc., should be considered to minimize limitations in emotion measurement. In addition, in order to test the effects of interventions developed for promoting or reducing certain discrete emotions, interventions should be implemented in the contexts where targeted emotions are present. There have been numerous studies where emotion-evoking stimuli were used, such as movie clips, images, and so on (e.g., Coan & Allen, 2007; DeSteno, Petty, Rucker, Wegener, & Braverman, 2004; Lepper, 1970). However, emotional responses can be different person to person and it is likely unethical to induce intense frustration, anxiety, hopelessness, anger, etc. (e.g., Lepper, 1970; Scheirer et al., 2002). Last, reframing motivation research that considers emotions in the realm of educational communications and technology is necessary (Meyer & Turner, 2002, 2006; Turner & Patrick, 2008).

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