Academic Emotions on Learning Effects

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Academic emotions can have different influences on learning effects, but these have not been systematically studied.

academic emotions learning effects facial expressions cognitive

1. Introduction

1.1. Academic Emotions

The psychologist Reinhard Pekrun believes that academic emotions are all kinds of academic emotional experiences that students feel in learning or teaching situations [1]. When considering academic emotions, we should not ignore the two dimensions of academic emotions: arousal and valence. Academic emotional valence refers to whether the stimulus is pleasant or unpleasant, while academic emotional arousal describes the academic emotional intensity that a stimulus can cause [2]. Based on this classification, emotions can be divided into four groups [3]: positive arousal emotions (e.g., enjoyment, pride), positive emotions (e.g., relaxation), passive arousal emotions (e.g., anger, anxiety), and negative emotions (e.g., extreme depression, despair).

In educational settings, academic emotions are considered to be a key factor affecting learning [1], and a lot of studies have shown that positive academic moods experienced by learners are capable of promoting learning [1][3]. Studies on the role of multimedia learning have shown that inducing positive academic emotions can accelerate learning [4][5][6].

1.2. Learning Effects

If the purpose of education is to accelerate students' learning, then the goal of testing is to assess students' learning results. Learning effects refers to individual changes in knowledge, skills, emotional attitude, or values after learning the knowledge points [7]. The evaluation of the learning effect can be based on scores in testing, and the skill class is mainly to provide learners with operational training for scoring.

Many studies have shown that cognition, including multimedia learning [4][6][8][9], problem solving [10], influence [11], N-UNCOUNT [12], estimation and policy-making ability [13][14][15], cognitive flexibility [16], complex learning [17], and memory [18][19], play important roles in academic emotion in many aspects. Studies have shown that potency (from passive to active) and arousal (from quiet to excited) have different results in the cognitive process, and different effects on the relevant neural matrix [20][21][22][23]. Some researchers have emphasized the role of arousal and

strengthening emotional memory [24][25][26]. These other factors may play a significant role in memory and cognition [27].

Yerkes and Dodson [28] put forward the inverse U hypothesis that there is a negative quadratic relationship between arousal and learning. Moreover, in terms of the optimal arousal level, an easier learning mode has a higher arousal level than a more difficult learning mode. Different intervention conditions can induce a positive arousal effect, thus improving learning performance. A lot of related research results show that there is a strong relationship between academic emotions and learning effects, but causality has not been widely studied, and whether academic emotions are suppressed or promoted for learning success has always been an elusive question [2]. Nevertheless, some studies have not taken negative academic emotions into account [4][6][8]. Negative academic emotions [29] usually lead to poorer attention to learning materials [30], distraction [31], and reduced efficiency, leading to poor learning performance. In addition, Zeng et al. [32] argued that high-intensity academic emotional load unrelated to learning tasks can impair learning performance. Passive and positive academic emotions have negative effects on consciousness [33] and memory [34]. Studies have shown that negative academic moods can stimulate learners to improve learning effects by adjusting their learning strategies [35][36][37]. Furthermore, studies have clearly stated that negative academic moods have no significant impact on learning effects [38]. Therefore, we believe that negative academic emotions can have various effects on learning. Positive academic moods generally have beneficial effects on the cognitive process and studying [4][6][8][11][12]. For instance, Park et al. [8] found in an eye movement study that positive academic emotions before learning can produce a much better learning effect in exams, and the retention of textual information is longer.

Recently, it has been suggested that motivation and academic emotions are linked, because motivational behaviors involve negative and positive academic emotions [39]. Specifically, positive academic emotions may be profitable in most cases, but negative academic emotions, such as dissatisfaction and uneasiness, can have contradictory effects. Moreover, it should be noted that students' performance often responds to their academic emotions. For example, success can increase expectations of future success, which in turn increases hope and reduces uneasiness. Positive academic emotions may be important for learning and achievement, and academic emotions other than uneasiness may be of equal importance even in areas of negative impact. They may be important for both cognitive and motivational components of self-control learning. Specifically, positive academic emotions may be important for developing intrinsic and sustained motivations. Therefore, in order to better understand how different academic emotions affect learning effects, we included studies of negative and positive academic emotions to analyze the roles played by various academic emotional states in the learning process.

1.3. Facial Expressions

For the capture of academic emotions, both subjective and objective methods can be used. Facial expressions are a powerful nonverbal communication method and provide a lot of information about subjective personal experience (e.g., mental state, interest, viewpoint, physiological state, emotions). The development of artificial intelligence technology adds credibility to the recognition of various human emotions through facial expressions [40], indicating the feasibility of using objective methods to capture academic emotions. However, studies of academic mood have

long-term dependence on self-reporting [41][42]. Self-reporting is a valuable data source, but the desire to analyze students' academic emotions in real time during the learning process has created a demand for other forms of academic emotional analysis. As a result, facial expressions, often seen as emotional derivatives, have become a viable channel for such exploration. Since Ekman put forward the general concept of using facial expressions as a data source, people have become more and more interested in facial expressions, and with the development of facial recognition technology over the last 10 years, there has been some related research in the field of education [43][44][45][46]. Especially in scientific experiments, we find that when the experimental results are revealed, the dominant expression of students is first surprised, then negative, and the probability of knowledge change is higher [47]. Surprise, sadness, and disgust are also key facial expressions used to predict the change in students' knowledge based on conflicting scenarios [48].

2. Academic Emotions on Learning Effects

Cognitive imbalance is an uncomfortable state [49], which can lead to negative academic emotions. Cognitive imbalance is a necessary condition for students to deeply understand learning [50]. Negative academic emotions (such as anxiety and disappointment) play an important role in the learning process. Other recent research has examined the effects of confusion and frustration on learning. Research performance, confusion, and frustration bring about better learning effects for learners [51][52][53]. However, this may only apply to certain activities. For instance, if students are confused when reading multimedia materials because they do not understand the content, they may not be able to resolve their confusion, which will cause them to feel frustrated, and finally, bored. This illustrates the importance of analyzing academic emotions in each situation, so that we can understand when learners are confused or frustrated, thus helping students to learn effectively. The difference in academic emotions in the study [36] depends on the positive or negative outcomes associated with solving the puzzle.

However, two other studies [38][54] have shown that academic emotional guidance has no significant influence on learning effects. An intervention study [38] suggested that academic emotional guidance is related to behavior, learning strategies, and cognitive regulation, while an observational study [54] suggested that, after academic emotional guidance occurs, it can improve memory and mental load without affecting learning effects. The evidence in this review extends the knowledge gained from the previous literature and suggests that positive academic emotions may have an advantage over negative academic emotions in terms of learning effects. Frequent participation in active academic emotional activities may influence behaviors conducive to learning strategy regulation [55]. Another intervention study [56] used graduate students as subjects to improve performance by promoting the active and flexible use of learning strategies. In the process of learning, with the increase in the difficulty of learning materials, there will be more negative academic emotions, but students can adopt more adaptive coping strategies to defuse negative academic emotions.

Due to the learning environment being constructed by different intervention conditions (learning forms and learning materials), feature-based academic emotions include the tendency of individuals to make stable and consistent responses in a specific way. In addition, immediate academic emotional response constitutes state-based academic emotion [57]. Cues in learning situations can affect this response and may fluctuate over time. However,

feature-based and state-based academic emotions are often very similar, and need to be carefully distinguished [57]. Finally, the research [58] is on state-based academic emotions, focusing on students' short-term academic emotional experience in a specific game situation rather than their general experience. The academic emotions guided by learning materials focus on what is experienced by students under the particular intervention conditions. However, in certain cases, individual characteristics may be more advantageous. Games have promoted students' science achievement in the long term [58]. Some studies have proposed a spiral emotional learning model, which includes a right-to-left academic emotional axis level positive price, which explains the correlation between academic emotions and scientific learning [59].

The model consisted of a right-to-left horizontal academic emotional axis of positive valence, a top-to-bottom representational constructive learning, and a bottom-to-top learning vertical learning axis, and identifies four quadrants. At the origin, the third axis of knowledge is perpendicular to these two axes. Some studies have proposed that in the process of science learning, learners' academic emotions will change with the learning process, and knowledge will be acquired with their movement in the quadrant and spiral up along the knowledge axis [59]. In addition, available evidence suggests that the difficulty of learning materials may have different effects on the use of learning strategies and academic emotional state [60][56]. Due to the challenge of learning materials, it is difficult for students to self-regulate their learning. Therefore, in the game-based learning environment, students can autonomously learn and practice, which enables them to maintain a high level of motivation and participation [61]. However, there is still some debate about which academic emotions may be more effective at improving learning effects. Therefore, from now on, we should make further efforts to clarify the differences and relationships between the two types of academic emotions. In addition, in subsequent studies, the characteristics of academic emotions may need to be considered as a covariable to control their effects.

In summary, the results of this systematic review indicate that, compared with negative academic emotions, positive academic emotions may be more effective at improving certain aspects of learning effects, especially in high school and college students. The research results not only contribute to an understanding of the different learning effects of academic emotions, but also have some practical significance. There is growing support for incorporating the regulation of students' academic emotions into classroom teaching plans, perhaps through different learning materials, learning environments, teaching methods, and facial recognition tools, to study students' academic emotions throughout the learning process as an effective way to improve learning effects [58][62][63]. Gee [64] argues that learning should not be divorced from experience, because it is always best when people identify and generalize patterns in a given environment through concrete experience over a long period of time. It is important to note that passive academic emotions may be more conducive to long-term learning and memory, and the beneficial effect on learning effects should not be ignored, even though it may lead to poor academic performance. Therefore, a series of academic emotions (positive and negative) will appear in science learning experience, which may contribute to the learning effect. In addition, the lack of a social component (person–person interaction) in our learning scenarios may lead to more academic emotions being expressed through facial expressions [65]. Social interactions that occur during the learning process may have further positive effects on learning effects [66].

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