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A Review of Domestic and International Research on the Correlation Between Critical Thinking and Emotion

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Abstract: Critical thinking is a key component of essential literacy skills, and it plays a crucial role in students' learning and development. Research shows that emotions have a significant influence on individual thinking activities, and they are important non-intellectual factors in developing students' critical thinking. Up to now, research scholars at home and abroad have conducted a lot of empirical studies to explore the possible relationship between the two variables. However, there is still a lack of research to systematically provide a holistic view. The current study is trying to present a comprehensive network of critical thinking and emotions through the discussion on the four-aspect correlation, that is, the correlation between critical thinking and negative emotion, critical thinking and emotional intelligence, critical thinking, emotion and academic achievement, and critical thinking, emotion and psychological cognition. The study also puts forward the limitations of the current research from the perspectives of research methods, research objects, and research contents, as well as the prospect of future research.

Keywords: critical thinking, emotion, academic emotion, emotional intelligence

1. Introduction

Thinking and emotion are important cognitive and psychological factors that influence individual development. The white paper *Youth of China in the New Era* issued by the State Council Information Office of China reaffirms the importance of psychological quality to the individual development of Chinese youth[1], and a good psychological quality is based on stable mental activities and emotional state. Critical thinking (abbreviated as CT), is intricately connected to individual emotions. After Brookfield[3] proposed that emotion is central to CT, numerous scholars embarked on further investigations to explore the relationship between these two constructs. Subsequently, several studies revealed a significant correlation between emotion and CT[4][5][6]. So far, there are still some limitations in the literature examining the correlation between CT and emotions. The present study endeavors to enrich the research by providing an overview of the current research on the correlation between CT and emotions. This review provides a summary and analysis of the research content, while also suggesting potential areas for future research within the current context.

2. Definition of terms

2.1 Critical thinking

CT is the ability to make reasonable decisions on what to do and what to believe[7]. It means that individuals can make rational judgments and self-regulatory judgments after evaluation and thinking based on appropriate criteria[8][9]. The discussion on CT stems from the concept of "reflective thinking" proposed by American scholar Dewey, which encompasses the qualities of initiative, persistence, and thoughtfulness[10]. Chinese research team leaded by Wen has constructed a hierarchically theoretical model of CT, which consists cognitive-related CT skills and quality-related emotional traits, namely CT temperament[11]. In this study, CT is defined to encompasses the capacity for both rational and logical thinking. Specifically, it involves traits such as a disposition for seeking truth, analytical reasoning, systematization, maturity, self-confidence, skepticism, open-mindedness, as well as the ability to analyze, reason, and evaluate.

2.2 Emotions and related concepts

Emotion is an outward manifestation of individual psychological state and emotional process, which occurs when they are involved in specific activities. It also comprises their attitude towards whether objective circumstances fulfill their personal needs, as well as the reflection of the connection between objective events or situations and subjective requirements. Emotion primarily comprises three components: subjective experience, which pertains to the personal feelings of individuals towards various emotional states; external expression, which quantifies the actions of different body parts during the occurrence of emotional states, involving facial expressions, posture expressions, and intonation expressions; and physiological arousal, which denotes the physiological response to emotions[12]. Academic emotion, is a kind of emotion in the learning context first put forward by Pekrun in 2002 on the basis of previous studies. It is one of

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the most important theories of educational psychology in the 21st century, mainly refers to all kinds of emotional experiences related to students' academic activities in teaching and learning[13]. Academic emotion and emotional intelligence are inseparable. Emotional intelligence (abbreviated as EI), also indicated "emotional quotient," which includes an individual's holistic capacity to recognize, perceive, assess, comprehend, and adapt to both their own emotions and those of others[14].

3. Review of researches at home and abroad

Emotion is an important factor that affects an individual's thinking activities. At present, studies have shown that emotion and motivation play a key role in perception, attention, memory, executive control and decision-making[15]. At the same time, different thinking patterns of individuals can affect their emotional performance, prompting them to show different emotions and behaviors in the face of stress and adversity[16].

Based on the content, the author divided the research on the correlation between CT and emotions into four research themes. These themes include the correlation between CT and negative emotions, the correlation between CT and emotional intelligence, the correlation between CT, emotions, and academic achievement, and the correlation between CT, emotions, and other cognitive psychological factors. These were displayed in the literature review.

3.1 CT and negative emotion

At present, reseach at home and abraod has extensively examined the relationship between CT and negative emotions, particularly anxiety. However, there is still a lack of research on the relationship between CT and positive emotions. Generally speaking, negative emotions consist of a range of affective states that elicit negative subjective experiences, including but not limited to anxiety, sadness, shame, and anger. Related studies have found that CT is closely to individual negative emotions, and CT activities will also be affected by their emotional state. In the realm of higher education, the notable incidence of psychological issues in college students has garnered considerable interest among researchers. Anxiety is one of the prominent symptoms of students' psychological problems. Huang et al.[17] found that college students have high levels of speech anxiety and CT. Chen et al.[18] studied the relationship among CT dispositions, boredom and generalized anxiety with 962 college students from eight universities in China as participants. It was concluded that negative emotions were positively correlated with each other and that CT dispositions was negatively correlated with both negative emotions (generalized anxiety and boredom), while boredom played a complete mediating role between the open-mindedness dimension of CT dispositions and generalized anxiety. It suggested that college students with higher CT tendencies experienced lower levels of boredom and generalized anxiety. This result also shows that the development of students' thinking skills has a moderating effect on their mental health status. In the field of psychology, Duan[19] used psychological experiments to study the current status of cognitive inhibition, CT, and emotion in 102 college students, examining the relationship between cognitive inhibition and CT as well as the mediating role of emotion. He found a significant positive correlation between the overall level of CT and the dimensions of cognitive inhibition with emotion played a moderating role between cognitive inhibition and CT. Compared to individuals with high CT, cognitive inhibition of individuals with low CT is prone to be affected by the individual's emotional state. Qin and colleagues[20] assert that individuals exhibit varying degrees of emotional motivation, which constitutes a significant factor influencing CT. After the investigation of 1610 undergraduates by random sampling from the first batch of 12 universities selected in the "Top Program", her research group found that emotional dynamic factors play a regulatory role in the relationship between students' learning engagement and CT. However, compared to learning engagement, emotional motivation has a more significant impact on the development of CT.

At the same time, the improvement of individual CT ability will also reduce the production of negative emotion. Aghajani et al.[21] conducted a study to examine the relationship between CT skills and foreign language reading anxiety of 177 college students in Iran. The researchers utilized the CCTST scale and FLCAS scale to measure CT skills and foreign language reading anxiety, respectively. The findings revealed that each CT skill had a significant negative predictive power for foreign language reading anxiety. Specifically, deductive and inferential skills demonstrated the highest negative predictive power for students' anxiety. The study suggests that enhancing students' CT skills has a positive impact on their critical reading abilities, while also reducing their anxiety in the foreign language reading process. The findings of this study align with the research conducted by Villavicencio[4], indicating that students' application of CT can enhance their cognitive abilities, enabling them to successfully complete tasks and mitigate negative emotions such as anxiety and disappointment. In the field of medicine, Yu[22] conducted a study involving 89 groups of epileptic children to assess the impact of an experiment on their negative emotions. To achieve this, she established both a control group and an observation group. The negative emotions of the children were measured before and after the experiment. The assessment of anxiety and depression was conducted utilizing the Self-assessment of Anxiety Scale (SAS) and Self-assessment of Depression Scale (SDS). The objective of this study was to examine the effects of the CT nursing model on patients' negative emotions. The study showed that the observation group with the CT nursing model had lower negative mood scores compared to the control group. This indicates that the CT nursing model plays an important role in enhancing patients' confidence in their recovery and reducing negative emotions such as anxiety, tension, and depression.

In addition, some researchers have explored the influence of external factors, such as major category, on the interaction between CT and negative emotions. Frolova et al.[23] used FLCAS to assess the foreign language anxiety level of 200

third-year undergraduate students in different majors, and explored the relationship between foreign language anxiety, CT, and their majors. The study highlighted that various academic disciplines exert varying degrees of impact on an individual's cognitive processes and emotional experiences. Compared to students of liberal arts, science students had higher levels of CT but also relatively higher levels of foreign language anxiety.

In summary, negative emotions impact the development of CT skills. For various student groups, it is important to pay more attention to their emotional well-being and foster positive emotions and emotional motivation to enhance the development of their CT skills. Based on the studies mentioned above, limitations are concluded in two aspects. On the one hand, the majority of studies have primarily concentrated on the impact of negative emotions on critical thinking, disregarding the influence of positive emotions. Nevertheless, positive emotions may assume a pivotal role in fostering the growth of individual thinking and enhancing problem-solving skills. On the other hand, individual mental activities in distinct contexts are also influenced by a plethora of individual factors, including gender, age, profession, and certain contextual factors. These factors necessitate further exploration.

3.2 The interplay between CT and EI

Ding et al.[24] have pointed out the close association between EI and individual innovative behavior, emphasizing the role of EI in facilitating the generation of novel behavioral ideas. CT serves as a fundamental requirement for fostering innovation. A considerable body of research across multiple disciplines has presented diverse findings regarding the extent of the correlation between CT and EI.

First, EI is significantly correlated with CT dispositions. Sahanowas et al.[25] conducted a study to investigate the impact of EI on CT dispositions among a sample of 500 college students in India. The findings of the study revealed that EI had a significant positive association with CT dispositions, indicating that higher levels of EI were predictive of greater CT abilities. Stedma et al.[26] conducted a study to investigate the correlation between EI and CT dispositions among 164 college students majoring in leadership and development. The researchers found a significant positive correlation between the sub-dimensions of EI and CT dispositions. Hasanpour et al.[27] further demonstrated a significant correlation between the empathy factor of EI and CT. The results of this study are consistent with the findings of Madadkhani et al.[28] on the various dimensions of EI in enhancing CT dispositions in 118 working female nurses in hospitals, which showed that the overall EI and some of its dimensions exhibited a significant positive correlation with CT. In addition, a study conducted by Hashish et al.[29] sought to investigate the current state of EI and CT dispositions and examine the impact of EI on CT with a total of 300 nursing students from Saudi Arabia as participants. The results indicated that a majority of nursing students demonstrated a high level of EI along with a moderate degree of CT dispositions, and revealed a noteworthy and favorable association between the two variables, which also exhibited that EI played a significant role in the prediction of CT dispositions. Similarly, Kaya et al.[30] conducted a one-year longitudinal study to investigate fluctuations in EI and CT ability among a cohort of 182 first-year nursing students, and found that after one academic year, changes to some extent emerged in students' CT and EI. The study showed a moderate level of correlation between CT and EI.

Secondly, the improvement of individuals' EI is proved to be a boon for their thinking ability. This means individuals with higher EI are more inclined to apply their CT to analyze and solve problems. Yao[6] conducted a study on the fundamentals of the brain structure of CT dispositions, examining its correlation with EI and associated brain mechanisms. This investigation utilized magnetic resonance imaging (MRI) to analyze a sample of 296 college students who participated in the study. The findings of the study indicated a significant and positive correlation between EI and CT dispositions. Additionally, the study revealed that EI played a moderating role in the impact of temporal pole gray matter volume on individuals' CT dispositions. This study suggests that the higher the level of EI of individuals are, the smaller the volume of their temporal pole gray matter will be. It aids the individual's ability to better perceive and process emotions, makes the extraction of information more effective, and also be of great help for individuals' thinking ability. Li et al.[31] conducted a study aimed at investigating the present condition of CT, EI, and conflict management skills among a sample of 269 undergraduate medical students. CT exhibited a significant and positive correlation with EI, and EI emerged as a significant positive predictor. The results of this study confirmed the findings on the correlation between CT and EI of 282 undergraduate medical students, that is, undergraduate medical students' CT was significantly and positively correlated with EI, and that the perception of emotion and self-emotional regulation, two dimensions of EI could positively predict an individual's CT[32]. In addition, the results of Arockiasamy's study on the correlation among EI, CT and stress regulation of 560 high school teachers showed that the correlation between EI and CT of high school teachers in all dimensions was generally significant, and EI and CT also had a significant effect on teachers' stress regulation[33].

To sum up, there are different degrees of correlations between CT and EI in various dimensions, and the improvement of EI is of great importance for individuals' CT ability. Nevertheless, there are still some inadequacies. Firstly, there has been relatively little attention paid to this topic in academic fields other than medicine and nursing. Secondly, the subjects in current studies are highly homogeneous, with a predominance of college students and relatively few participants of other ages. Furthermore, many studies have failed to effectively control influencing factors such as gender, age, and living area.

3.3 The interplay between CT, emotion, and academic achievement

In his control-value theory, Pekrun[34] pointed out that academic emotions have a certain cognitive motivational impact on academic achievement, and different academic emotions have different impacts on academic achievement[35][36], and individuals' EI is closely related to their academic achievement[37]. Meanwhile, there is also a significant and positive correlation between CT and academic achievement[38][39][40].

Some studies have shown that there is a correlation between CT, EI and academic achievement. AkbariLakeh et al.[41] studied the correlation between CT, EI skills and academic achievement of 50 senior nursing students in the Department of Nursing, Zahedan University of Medical Sciences in Iran, based on Bar-On's model of EI. It was found that students' outstanding academic achievement was significantly correlated with both their CT and EI skills. This finding is consistent with the findings of Afshar et al., aiming at evaluating the extent of EI among a sample of 100 Iranian university English language learners. The researchers also explored the correlation between CT, EI, and students' oral proficiency. The study found that EI and CT, as well as their dimensions, were significantly and positively correlated with the students' oral proficiency[42]. Gurubasappa[43] explored the correlation between CT, EI, creativity, and students' academic achievement among 600 high school students in the same area via random sampling. It was found that CT, EI, creativity, and academic achievement were significantly correlated. Additionally, CT, EI, and creativity were significant and positive predictors of academic achievement.

In addition, the training of CT has a significant impact on the regulation and stabilization of emotions, as well as personal growth and development. Villavicencio[4] examined the correlation between CT, negative emotions and academic achievement among 220 engineering students and found that CT was significantly positively correlated with academic achievement, and that negative emotions such as anxiety, shame, boredom, and disappointment were negatively correlated with academic achievement and played a fully mediating role in the effect of CT on academic achievement. Further studies show that students are able to mobilize other cognitive resources to reduce negative emotions such as anxiety and disappointment when using CT to help them complete their learning tasks, thus contributing to their academic achievement.

In conclusion, the academic performance of students is closely associated with their ability to think critically and their emotional well-being. Improving students' CT ability can help students regulate their negative emotions, thus improving their learning efficiency and achieving certain academic achievements. The above studies also reveal certain research limitations. Most of the studies conducted employed a cross-sectional research design, which might not capture the possible dynamic relationships between variables. Methodologically, various studies utilized diverse measurement tools and assessment methods, making it challenging to compare and integrate the findings. Furthermore, there might be other factors that were not considered in the research above. For instance, previous studies have been proved that parenting styles, teachers' instructional methods, and social support are significant predictors of students' cognitive abilities and psychological development[44][45][46]. These factors might influence the findings of the aforementioned studies as well and should be taken into consideration in the future.

3.4 CT, emotion and psychological cognition

Learning is a meaningful mental process. Rogers, a representative of humanism, stated that learning is the outcome of the collective interaction between learners' behavior, cognition, and emotion. Students are major participants of complex learning activities, and interactions between CT and emotions are closely related to their cognitive ability, motivation and self-efficacy and other cognitive psychological factors.

Both CT and emotions are related to individuals' cognitive ability. CT requires core cognitive abilities such as elucidation, analysis, inference, and evaluation[47]. Emotion is also an important factor that affects individuals' cognitive ability[48][49] and has a significant impact on expanding their cognitive categorization[50][51]. Duan[19] conducted a study to examine the impact of emotions on cognitive inhibition in individuals with varying levels of CT. The study involved 201 college students as research participants. It was found that the cognitive interference of individuals with high and low levels of CT was closely related to their emotional states, and that different emotional states had a more significant effect on the cognitive inhibition of individuals with low levels of CT compared to those of high levels. This result suggests that individuals with high levels of CT are less susceptible to emotional states and have more stable cognitive inhibition than those with low levels.

Besides, both CT and emotions are related to individual self-efficacy. Li et al.[52] studied the relationship between academic emotions and academic self-efficacy among 334 college students using random stratified sampling and found that academic emotions were significantly correlated with self-efficacy. This result is consistent with Gao[53] who found that college students that experienced more positive academic emotions usually had higher self-efficacy. Meanwhile, self-efficacy is associated with CT. Huang[39] studied 384 college students in five institutions of higher education in China and discovered that sub-dimensions of general self-efficacy, academic self-efficacy, and self-regulation efficacy all had significant and positive correlations with CT dispositions.

In addition, both CT and emotions are related to individual learning motivation. Pekrun[34] highlighted the multifaceted nature of academic emotions, emphasizing their influence on cognitive processes, motivation, information retention and retrieval, information processing strategies, as well as the allocation of limited attention resources. Zhang et al. [54] showed in their study that emotions have a mediating role among learning strategies, motivation, and academic achievement, with emotional states influencing their motivation of different degree of intensity. Meanwhile, there is a significant correlation

between learning motivation and CT. Different types of learning motivation, such as intrinsic interest motivation and learning context motivation, have varying degrees of influence on students' CT[55]. These studies suggest a strong correlation between students' CT ability and their emotional states, highlighting the potential influence of learning motivation on the interplay between CT and emotions.

In summary, CT and emotions are influenced by various cognitive factors such as individual cognitive ability, motivation and self-efficacy. To investigate the relationship between CT and emotions, it is necessary to elucidate various factors and mechanisms involved in this process. facilitating the enhancement of students' CT skills and emotional regulation abilities.

4. Limitations of the research

At present, some scholars have made significant progress in the correlation between CT and emotions domestically and internationally. However, generally speaking, there are still some shortcomings, concerned with research methods, subjects, and content.

First of all, research methods adopted in those previous studies were relatively limited, primarily in terms of their design and structure. Regarding the research design, studies conducted have predominantly relied on quantitative data, and neglected the collection of qualitative ones. Even though quantitative data provide insights into the overall performance of the research subjects, it fails to account for the individual differences among them in different educational settings and stages of career development at the micro level. This limitation weakens the accuracy and comprehensiveness of the researches. As for the research design, most studies have opted for cross-sectional approaches, which cannot fully capture the dynamic nature of the interaction between CT and emotions during the cognitive development process. According to Piaget's cognitive development theory, individual cognitive development occurs through the dialectical interaction between the individual and the environment, leading to dynamic changes in the relationship between emotions and thinking. Therefore, longitudinal study on the correlation between CT and emotions holds particular importance.

In addition, the participants in the researches are limited in a certain group. The current researches mostly center on college students, but draw less awareness to the students in primary and middle schools together with teachers at the stage of elementary education. This reflects a lack of a comprehensive understanding about the relationship between students' CT and emotions at different educational levels.

Finally, the research content is more holistic, macro and single, which is mainly reflected in the research field and theme. Researches pertaining to the intersection of CT and emotion are predominantly centered within the domains of medicine, nursing, and psychology, while receiving comparatively less attention in other academic disciplines. The current situation has led to an imbalanced allocation of research focus, which still necessitates its expansion. Furthermore, as for the research topic, much emphasis on CT and emotion is mainly displayed on the interaction between CT, EI, and negative emotions especially the anxiety. However, few scholars have explored the correlation between CT and positive emotions, as well as other negative emotions apart from the anxiety. It is noteworthy that the majority of studies only concentrate on testing the correlation. However, the interactive mechanism and potential influencing factors between CT and emotion still need further exploration, particularly in the context of long-term personal development. These limitations also suggest that current understanding of the relationship between CT and emotions is not comprehensive and deep enough.

5. Implications of the research

To address the potential shortcomings mentioned above, the following recommendations are put forward for further enhancement, which are based on the four aspects.

Firstly, in the study of CT and academic emotions, it is of significance to enhance the investigation of the impact of positive emotions on CT in order to obtain a more comprehensive understanding of the relationship between CT and emotions. Additionally, variables such as age, gender, and major should be taken into consideration to compare the differences in the influence of academic emotions on the development of CT in different student groups. Combining quantitative and qualitative research strategies can help reveal internal mechanisms and underlying motives of the interaction between CT and emotions at both the macro and micro levels.

Secondly, future studies on the impact of CT and emotions on students' development should employ a longitudinal research design. This approach would allow the observation of how thinking and emotional variables influence students' development over a long period of time with a tracking research method. By doing so, researchers can more accurately explain the causal relationship between CT, emotions, and academic achievement. In addition, longitudinal studies should also consider the potential impact of control variables on the study results in order to enhance the rigor of study.

Thirdly, in the study of CT and EI, researchers can further enrich the scope of the inquiry by incorporating behavioral variables, such as learning strategies, to explore the multivariate relationships between cognition, emotion, and behavior. Besides, the study sample can be broadened, which provides a more comprehensive understanding of the performance and impact of CT and EI in diverse groups. Additionally, future research can integrate relevant theoretical models and research methods to thoroughly investigate the inherent connections between CT and EI, as well as their influencing factors. This will enable the provision of more targeted guidance for practical applications in related fields.

Furthermore, in the realm of CT, emotion, and psychological cognition, there are intricate interrelationships between students' CT, emotion, and other psychological factors such as motivation and self-efficacy. Therefore, future research can

delve deeper into the mechanisms and influencing factors of these relationships to offer more useful insights for educational practice. For instance, teachers can stimulate students' motivation by focusing on their emotional states and self-efficacy and cultivating their CT and affective skills. Accordingly, students can enhance their motivation and CT skills by regulating their emotional state and improving their self-efficacy.

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