Study on Strategies for Cultivating Critical Thinking Skills of College Students

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Abstract: *Critical thinking is the core ability that talents in the 21st century should have, which directly affects the cultivation of innovation ability. With the increasing importance of critical thinking in the cultivation of talents, the study of college students' critical thinking ability has become an important topic in the study of educational psychology in China. In this paper, through the research on the development process, influencing factors and measuring tools of college students' critical thinking ability, we put forward cultivation strategies to achieve the purpose of synergistic development of college students' knowledge skills and critical thinking.*

Keywords: *Critical thinking; college students; developmental strategies*

1. Introduction

Critical thinking, as a kind of higher-order thinking, is regarded as a core competency in almost all professional fields and academic disciplines [1]. In addition to training college students to master professional knowledge and practical skills, colleges and universities must also develop their thinking skills so that they can better apply their theoretical knowledge to social practice. Students can cope well with the changes and difficulties in their personal life and work by thinking and inferring. Especially in fields such as artificial intelligence and information engineering, where cutting-edge technologies are updated and iterated at a fast pace, it is more important for practitioners to improve their ability to think and solve problems independently, and even challenge existing theories and practices to advance new knowledge[2]. However, there are still many problems in developing students' critical thinking skills in the teaching and learning process. Some of the studies provide some tips and exercises on teaching scientific argumentation or reasoning, training and intervening in critical thinking skills in a certain teaching session, without considering the development of critical thinking skills as a continuous and complete process, and the complete integration of critical thinking into teaching is lacking. This study focuses on the necessity, development process, influencing factors and measurement tools of critical thinking in higher education, aiming to deepen the understanding of the characteristics of critical thinking and to provide strategies and suggestions for the future application of critical thinking in higher education practice.

2. Definition of the concept of critical thinking

According to research surveys, different scholars tend to perceive critical thinking differently. The earliest prototype of critical thinking is Probing Questioning, which was proposed by Socrates. Dewey first defined critical thinking as "the active, sustained, and careful consideration of any belief or assumed form of knowledge, with insight into the reasons supporting it and the conclusions to which it leads" [3]. Ennis, one of the pioneers of critical thinking in the United States, believed that critical thinking is a series of rational and reflective thinking when faced with decisions about what to believe and what to do [4]. Since then, with the continuous deepening of the study of critical thinking, many experts and scholars have made different definitions, but they all include "analyzing evidence", "making inferences using inductive-deductive reasoning", "judging and evaluating" and "making decisions". "And "making decisions or solving problems" are the four basic components of critical thinking[5]. Regarding the definition of critical thinking, most scholars currently define it as "purposeful,

self-calibrated judgments, which are manifested in interpretations, analyses, evaluations, inferences, and explanations of the arguments, concepts, methods, criteria, or contexts on which the judgments are based" [6].

3. Research Related to Critical Thinking Skills of College Students

3.1. A Study of the Content of Critical Thinking Skills in College Students

Developing students' critical thinking is an important topic of research in the field of education, and a clear process of critical thinking development is the basis for promoting the development of students' critical thinking, and current research on the process of critical thinking development can be categorized into three types:

The first category of researchers regard the process of problem solving as the process of critical thinking development, such as Paul (1989) expanded critical thinking to all aspects of problem solving research and included the two dimensions of moral characteristics and emotions in the framework of critical thinking to form the study of critical thinking dispositions [7].Garrison's [8] viewpoint is that the process consists of a triggering event stage, an exploratory stage, integration stage, and solution stage; while Guo Jiong[9] believes that it includes the stage of discovering problems (or generating opinions), collecting and processing information, and problem solving (or argumentation of opinions).

The second type is to regard the cognitive process of critical thinking as the process of examining the situation, analyzing relevant information, making judgments, and obtaining results. For example, Dewey's systematic study of "reflective thinking" summarizes critical thinking as eight processes: conceptualization, analysis, synthesis, judgment, comprehension, reasoning, hypothesis, testing, etc[10]. Jenicek[11] proposes seven steps of critical thinking: analyzing and identifying the problem, clarifying the significance of the problem, collecting the evidence, evaluating the evidence, deducing conclusions and evaluating others. Wu Yajie [12] divided the cognitive process of critical thinking into nine steps: understanding the content, identifying reasons and arguments, making judgments, asking questions and doubts, gathering information from multiple sources, making decisions, expressing the results, self-monitoring and reflection, and reconceptualization.

The third category views the cognitive process of critical thinking as the sequential application of the core skills of critical thinking. For example, Ennis (1993) focuses on critical thinking skills, incorporating elements of skills such as observation and reasoning into a model of critical thinking that revolves around induction, deduction, and argumentation[13]. The six elements of critical thinking development proposed by the Delphi Report published by the American Philosophical Association are interpretation, analysis, evaluation, inference, explanation, and self-regulation[14]. Calm[15] divides critical thinking development into five stages: identifying, understanding, analyzing, evaluating, and innovating.

From the above analysis, it can be seen that the first two types of views emphasize the description of the development process of critical thinking from the perspective of students' external behaviors, and the latter type of views emphasize the application of students' core skills in the process of critical thinking development, and in general what the above three types of views emphasize together is to focus on the change of students' external behaviors as well as the development of core skills in the process of critical thinking development.

3.2. Factors Influencing Critical Thinking Skills of College Students

The factors affecting the development of college students' critical thinking ability are very diverse, including university level or type, course study, emotional and personality factors, in addition to the important influencing factors such as students' basic characteristics and family background [16] [17].

Some scholars have found that: the higher the level of the university is, the more helpful it is for the improvement of students' critical thinking ability[18]; the change of college students' critical thinking is in a non-linear relationship with the change of grade level[19]; there are significant differences in the critical thinking ability of students majoring in different disciplines and the change of their enhancement in the university period [20]. The research results of Li Na et al. (2019) showed that college students' critical thinking tendency showed significant differences in different disciplinary types, training levels, cognitive degrees, etc., and the total mean score of critical thinking tendency of specialized students was higher than that of undergraduates, indicating that specialized students are

more inclusive of different opinions [21]. Innovative teaching methods such as blended teaching can effectively promote the development of college students' critical thinking ability [22]; students who are more proactive and open-minded in the curriculum have significantly better critical thinking ability than conservative students[23]; learning inputs, especially social learning inputs focusing on communication and interaction, have a significant positive effect on the value-added of critical thinking ability [24].

Zhao Mei et al. (2008) investigated the critical thinking ability of medical undergraduates and showed that the total score of students' critical thinking ability was significantly positively correlated with their interpersonal relationship, life adaptability, and physical health[25]. Gao Zhiyuan (2013) conducted a survey on the current situation of critical thinking tendency of 489 college students, and the results showed that 94.68% of the students' thinking tendency belonged to the range of contradiction, and proposed that attention should be paid to the cultivation of personalized cognitive and emotional tendency of critical thinking[26]. Jiang Jiyong (2012) investigated the current situation of critical thinking among college students in Shanghai and its relationship with personality, and the results showed that college students' critical thinking tendency and skills were in the lower middle level in the overall level, and the results suggested that the Big Five personality would affect critical thinking skills through critical thinking tendency [27].

3.3. Tools and Techniques for Measuring Critical Thinking Skills in College Students

Assessment tools are crucial for measuring the level of students' critical thinking and enable students' critical thinking skills to be monitored and assessed in a timely manner. By analyzing the development process of critical thinking assessment tools, based on the form of assessment tasks or questions, critical thinking assessment tools can be divided into four categories.

First, the result-oriented closed assessment tools. This type of assessment tool mainly uses closed questions in the form of multiple-choice questions and Likert scales, which are mainly evaluated by analyzing test papers and scales before and after learning. The more representative scales are "California Critical Thinking Skills Test Scale" (CCTST) and "California Critical Thinking Disposition Inventory" (CCTDI) by Facione et al. The most widely used instruments in China are the Chinese translation of the California Critical Thinking Skills Test Scale (CCTST) and the California Critical Thinking Dispositions Inventory (CCTDI-CV), which were Chinese-language versions of the CCTST and the CCTDI, which were revised by Luo, Qingxu et al. (CCTDI-CV). These assessment tools do not require a high level of assessment environment, are simple to operate, require a short time to collect data and are rich in data, are easy to use on a large scale, and can be used to obtain measurement results quickly. However, the common problem of closed questions is that it is difficult to explain the reasons for learners' choices and thinking process, and the measurement results lack a certain comprehensiveness.

The second is the result-oriented open-ended critical thinking assessment tool, which refers to the use of essay writing, constructive feedback and multiple-choice questions in the form of a combination of assessment tools. In response to the labor- and time-consuming drawbacks of the essay-writing format, researchers have gradually begun to shift to a tool that combines constructive feedback with multiple-choice questions, adding semi-open or open-ended questions, which lack continuity in the assessment results compared to closed questions, and allow for a certain degree of flexibility in the respondent's answers.

Third, the process-oriented closed assessment tool. It is mainly a tool that uses standardized test questions based on an online platform in the teaching and learning process and conducts assessment based on data such as scoring or information authentication. Compared with the result-oriented assessment tools, this type of assessment is more detailed and multidimensional, which helps optimize the evaluation process; however, this type of assessment tends to analyze data from a quantitative point of view, and the results of the assessment present a static feature, making it difficult to analyze the process of change in critical thinking, and it is also more demanding in terms of technology.

Fourth, process-oriented open assessment tools. It mainly adopts the combination of quantitative analysis and qualitative analysis to analyze the performance of learners in the learning process and evaluate their critical thinking ability from multiple perspectives. The advantage of this type of assessment is that the use of multivariate data can be dynamically assessed and then give students personalized learning guidance to promote learner learning. For example, Huang Dan[28] used a combination of cognitive network analysis, test scales, and content analysis to evaluate the subject's critical thinking from multiple perspectives. Currently, this kind of tool is less applied in actual

teaching, but the combination of quantitative and qualitative analysis can complement each other's strengths well and provide new ideas for the development of assessment tools.

Through the above research, it is found that the result-oriented assessment represented by questionnaires is being replaced by the process-oriented assessment based on online platforms, and the assessment of critical thinking ability has also gradually transitioned from learning result orientation to learning process orientation, which gradually fits the multidimensional and dynamic characteristics of critical thinking.

4. Strategies for Cultivating Critical Thinking Skills in College Students

4.1. Teachers need to focus on strengthening their own training in critical thinking teaching strategies

Critical thinking is not an innate ability, but needs to be cultivated and trained later in order to be better utilized and applied in problem solving or practical situations. At present, however, few teachers have received specialized training in critical thinking development methods. As teachers, they are familiar with classroom content and possess certain teaching skills, but they are rarely exposed to instruction that specifically integrates critical thinking skills into classroom instruction. To better integrate critical thinking skills into the classroom, first, teachers should first create a relaxed active learning environment for students and actively guide them to seize opportunities for active learning and critical thinking. Second, teachers should plan classroom instruction that takes into account the purpose of the instruction, the level of the students, and the types of questions that will help achieve the goal. This process requires teachers and students to work together, rationalizing the setting of questions and time arrangements as much as possible, so as to guide students step by step to think in the direction of the depth and breadth of the questions. In addition, teachers should design different instructional activities in the classroom that make full use of visual representations, such as concept maps, which can help improve students' critical thinking, and argument mapping, which can also enhance critical thinking. Finally, teachers should explicitly teach students what critical thinking is and should self-assess and review their lessons during the teaching process to ensure that effective teaching strategies are used to help students develop critical thinking. Therefore, following up on all classroom activities is an effective way to record reflections on the classroom and strategies for improvement in a timely manner in the teacher's journal.

4.2. Pay attention to the feedback of students' learning process and carry out peer-to-peer assessment

Students' self-assessment and peer feedback are very important for the development of critical thinking, and the process of peer mutual assessment activities can correspond one by one with the development process of critical thinking, which is one of the effective ways to cultivate and develop students' critical thinking. Teachers can integrate critical thinking development strategies into all aspects of mutual assessment activities so as to realize continuous and complete interventions to carry out formative assessment, self-assessment and peer assessment. Teachers can use a variety of techniques and methods to obtain students' evaluations and feedback throughout the process, and further grasp and analyze students' various data so as to adopt a more comprehensive and detailed approach to measuring students' critical thinking skills. For example, Tao Zhang, in "A Study on Promoting the Development of Critical Thinking in Online Peer Mutual Assessment Learners," designed peer mutual assessment activities from the perspectives of reflection and discussion, and verified them through cognitive network analysis, which showed that online peer mutual assessment could enable learners' critical thinking to develop from low-order to high-order [29].

4.3. The development of critical thinking requires the integration of theory and professional practice

The cultivation of college students' critical thinking in higher education is conducive to the cultivation of students' sense of discernment in the learning process, the formation of their own judgments and predictions in combination with the accumulation of professional knowledge, and the formulation of critical opinions and suggestions. Professional knowledge is constantly developing and updating, and conducting critical analysis and inquiry is conducive to recognizing the nature of things and the potential direction of development. It is very important for teachers to plan their lessons wisely to provide students with various types of experiences or practices. Students are provided with

information and ideas based on classroom or extra-curricular instruction, then relevant experiences in doing, observing, or simulation activities, and finally guided to reflection, which may be in the form of writing essays, journals, and reports[30].

5. Conclusion

Critical thinking can be understood as a skill that applies across disciplines. Critical thinking requires the ability to understand what kind of knowledge is justified and to evaluate and use that knowledge. In higher education, critical thinking is essential, and schools should emphasize the development of students' critical thinking and fully understand the factors that can affect the development of students' critical thinking. Schools should support teachers to develop critical thinking skills in the development of their teaching abilities in different disciplines. Teachers are trained to integrate critical thinking development strategies into all aspects of classroom instruction so that they can guide and intervene in student learning, and students are more likely to learn to think critically when procedural and self-regulated knowledge in a given domain are interconnected. Teachers still have much to learn about critical thinking in teaching and learning to make critical thinking a quality that students are equipped with. Given the importance of critical thinking in higher education and the current situation of insufficient critical thinking ability of college students in China, it is particularly important to establish the concept of critical thinking education and strengthen the cultivation of critical thinking ability of college students.

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