**UNIVERSITI TEKNOLOGI MARA**

# ENHANCING INNOVATIVE THINKING WITH STRUCTURED THINKING TOOLS: A CASE STUDY OF HIGHER VOCATIONAL STUDENTS IN NINGXIA, CHINA

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# ABSTRACT

This study employed a case study with a convergent parallel mixed research design, integrating quantitative data from questionnaires and CRAT conducted within an experimental setting with qualitative insights derived from rubric-based content analysis of students' mind map usage. The study integrates Edward de Bono's TEC framework to scaffold structured thinking. Although existing literature emphasizes the importance of innovative thinking in addressing complex problems, limited research has examined how structured thinking tools can be systematically integrated into vocational education to cultivate such abilities. This research selects 60 students from the School of Art and Design of Ningxia Vocational and Technical College in China as the research sample and divides equally into experimental and control groups. An eight-week intervention with the experimental group explores the role and specific impact of six thinking tools (mind map, circle map, bubble map, double bubble map, tree map and bridge map) on the cultivation of students' thinking ability. The research integrates the Chinese Remote Association Test (CRAT) data, questionnaire feedback and students completed assignments based on six thinking tools and uses quantitative and qualitative analysis methods to deeply explore the role of different thinking tools in promoting students' innovative thinking development. The results show that the teaching application of the six thinking tools significantly improves students' thinking ability in multiple dimensions, especially in divergent thinking ($p<0.001$), imaginative thinking, critical thinking and intuitive thinking. It is worth noting that different thinking tools have a positive impact on the development of students' thinking ability during the intervention process. Among them, the thinking tool teaching model combined with group cooperative learning further improves students' thinking performance. Experimental data show that compared with assignments completed independently by individuals, assignments completed by group cooperation show higher quality in terms of logical clarity, innovation, and problem-solving ability, highlighting the synergistic effect of thinking tools in teamwork. In addition, survey data show that students have consistent positive emotional tendencies in their experience of using the six thinking tools, with no negative emotional feedback. 93% of the students said that they will continue to use these tools in academic research and practical applications in the future to optimize cognitive processes and improve problem-solving efficiency. This study not only further verifies the wide applicability of thinking tools in educational practice, but also provides empirical evidence for future curriculum design, teaching method innovation, and thinking training, and has important educational practice value.

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# TABLE OF CONTENTS

# CHAPTER 1
# INTRODUCTION

## 1.1 Foreword

In the era of globalization and rapid technological development, innovation-driven development has become a core strategy for promoting economic and social progress.

Generally, innovation is regarded as the primary productive force, which is immeasurable important to China's long-term development, enhancement of competitiveness, and consolidation of its international position. With innovation, it reflects the fundamental transformation of the economic growth model, which further demonstrates the scientific and technological progress of China. According to Liu (2014), with further innovation capabilities to be established, the core competitiveness of China is enhanced in the future.

In recent years, the Chinese government has deeply recognized the central role of innovation in the country's overall development. Accordingly, the focus for innovation has gradually intensified. A series of long-term science and technology innovation plans have been developed by the government, which clearly define the goals and pathways for innovation-driven development. To promote innovation, policy support has been delivered, including increased investment in research and development, optimization of the innovation environment, and the improvement of the intellectual property protection system, among other multidimensional measures. These efforts are aimed at providing strong institutional guarantees and resource support for innovation activities. At the same time, financial support for technological innovation has been increased, with a focus on promoting science and technology projects and facilitating the transformation of scientific achievements. With the policy support and reinforcement, it further fostered a strong innovation atmosphere across society, which stimulated innovation vitality in various fields.

The construction of China's innovation system began in the late 1990s. In 1998, the country introduced the Knowledge Innovation Project, and by the end of the decade, the national innovation system was proposed. Under the system, there are five major components, being the knowledge innovation system led by universities and research