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Exploring the application of mind map to enhance students' creative thinking

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ABSTRACT

As a visual thinking tool, a mind map can help people structure complex information and knowledge, stimulate and link new ideas, and thus improve creative thinking. Although there are studies on creative thinking and using mind maps, there are only a few studies in higher learning context. This paper mainly discusses the application of mind mapping in innovation and entrepreneurship courses in higher vocational colleges and explores the influence of mind mapping in improving students' creative thinking. This paper is based on a qualitative study using document analysis. The study includes results from three consecutive lessons where the mind maps and the products from each lesson were analyzed. The three assignments were analyzed to explore the impact of mind mapping on students' creative thinking and whether it could enhance students' creativity. Each mind map represents the knowledge of the students on the given topic. Students who have more knowledge would have more branches. This, in turn, also explains the creativity of the students' thinking. The creative students would add branches that are different from the norm. This also shows how these students view the topic and the world. Although the topic is related to innovation and entrepreneurship courses in higher vocational colleges and universities, the perception of the topic and how to break down ideas exhibit their creative thinking ability. This study proposes directions for future research intending to explore further and optimize the application of mind mapping in innovation and entrepreneurship courses in higher vocational colleges and universities to promote better the cultivation of students' innovation ability and entrepreneurship. This study will help the innovation and entrepreneurship courses in higher vocational colleges and universities utilize mind mapping more deeply and extensively to improve students' creative thinking. This will help improve students' creative and entrepreneurial abilities and contribute to the promotion of innovation and development in education.

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1.0 INTRODUCTION

Today, based on highly competitive and fast-changing society, creative thinking and entrepreneurship are recognized as critical factors for future success. For students in higher vocational colleges and universities, cultivating and enhancing their creative thinking in innovation and entrepreneurship courses have become a common concern for educators and scholars (Avdagic et al., 2021). In recent years, mind mapping, as a visual thinking tool, has been widely used in various learning and working scenarios. It can help people structure complex information and knowledge, stimulate and link new ideas, and improve creative thinking. So, how can we effectively integrate innovation and entrepreneurship courses with mind mapping in higher vocational colleges to enhance students' creative thinking skills? Based on the above discussion, the study aims to provide new perspectives and practical strategies for innovation and entrepreneurship education in higher vocational colleges. This paper first briefly introduces the theoretical background of creative thinking and mind mapping and then adopts the document analysis method to conduct qualitative research. Analyzing the three courses' results, it explores how mind maps can be integrated with the creative entrepreneurship courses in higher vocational colleges and how this can improve students' creative thinking. The article concludes by examining the challenges encountered in implementing such a strategy and a vision for the future.

2.0 BACKGROUND AND THE RELATED LITERATURE

2.1 Creative Thinking

Creative thinking, also known as innovative thinking or creative thinking, centers on generating new, original, and valuable ideas or solutions. This way of thinking is decisive in artistic and literary creation, scientific research, technological invention, business strategy, and everyday problem-solving. The main characteristics of creative thinking are originality, value, divergence, and flexibility. Originality is shown by the fact that the ideas generated are new and different from existing ideas or knowledge, which may be new combinations of existing or entirely new concepts or ideas. Value means that the new ideas generated by creative thinking must have utility; in other words, they can solve problems, fulfill needs, or enhance efficiency. The divergent nature of creative thinking makes it different from traditional, linear, or logical thinking and encourages multiple perspectives or unconventional ways of thinking. In addition, flexibility is an essential characteristic of creative thinking, requiring the ability to adapt to changing problems and circumstances, to change the direction of thinking quickly, or to adapt to new information and challenges. The importance of creative thinking in education is widely recognized. Creative thinking is essential in traditional subject learning, solving complex practical problems, and innovation and entrepreneurship. By fostering creative thinking in our students, we can help them improve their academic performance, better meet future challenges, and become innovative leaders.

2.2 Importance of Creative Thinking in Education

The importance of creative thinking in education has been widely recognized. The essence of education is to impart knowledge and guide and stimulate students' thinking to develop their creative and critical thinking (Fu, 2021). On the one hand, creative thinking helps develop students' independent thinking skills. Encouraging students to go beyond the textbook information and form their opinions and ideas are vital in developing their independent thinking and problem-solving skills. Secondly, creative thinking can increase students' motivation and depth of learning. By guiding students to think creatively, they can discover the joy of learning and thus, increase their motivation. Meanwhile, by understanding and interpreting new knowledge in their own way, students will engage in deeper learning and thinking, thus deepening their understanding. Creative thinking is one of education's core goals that helps students better understand and utilize knowledge, solve problems, adapt to changes, and carve out their future. Therefore, we need to integrate the development of creative thinking into all levels and aspects of education.

Various established literature has discussed social influence. In our research, we discovered three distinct kinds of social influence. These include social networks or friends, family, and organizational influence. According to Fan (2023), the longer seniors utilized technological advances, the more social factors impact their technology adoption behavior. The elderly also demonstrated to be eager to acquire innovation that their children or grandchildren preferred. According to Xie et al. (2022), the opinions of other older people in a community can influence behavior intentions.

2.3 Mind map

A mind map is a visual thinking and learning tool that aims to organize and understand information more effectively, stimulate creative thinking and enhance learning and memory (Hou & Yan., 2023). Mind mapping is a powerful thinking and learning tool that combines visual, structured, and associative thinking to help us process information more effectively, improve our creative thinking, and enhance our learning and memory. The core construction of a mind map starts with a central theme or concept and then branches out to related ideas and information. This branching structure mimics how the brain works, which helps us memorize and understand information. Using keywords and images, rather than lengthy text, is encouraged in constructing mind maps, as this helps us remember information more quickly and stimulates our imagination and creativity. In addition, using colours and other visual elements to highlight important information and distinguish between different ideas or concepts in a mind map can make it more exciting and easier to understand and remember. By showing the hierarchical structure and associations of information, including topics and sub-topics, concepts and sub-concepts, facts, and details, we can understand information's structure and inner relationships more clearly. Mind mapping is a powerful thinking and learning tool that can effectively organize and process information, enhance creative thinking, and strengthen learning and memory skills. Mind maps start with a central theme or concept and then expand on related ideas and information through a branching structure miming how the brain works, providing a more intuitive and natural way to process and remember information (Luangkrajang, 2022). Furthermore, mind mapping emphasizes using keywords and images, not long-winded textual information, which helps to remember information faster and stimulates imagination and creativity. In addition, mind mapping encourages using colours and other visual elements which highlight important information and distinguish between different ideas or concepts. These visual elements make mind maps more exciting and easier to understand and remember. Finally, mind maps show the hierarchy and connections of information. By showing the relationships between topics and subtopics, concepts and sub-concepts, and facts and details, mind maps can help us understand the structure and inner connections of information more deeply.

3.0 METHODOLOGY

3.1 Mind Map Instructional Design

Mind maps are a critical teaching and learning strategy in innovative and entrepreneurial classrooms in higher education institutions, effectively facilitating students' learning and thinking. Mind maps are applied in various ways to enhance students' engagement, improve comprehension, and stimulate innovative thinking.

This research employs a qualitative approach, using document analysis. One intact class was selected for this study, and 20 students, all of whom were freshmen in the College of Art and Design, participated. Through three sessions, this study explored how mind mapping can enhance students' creative thinking.

The first lesson discussed the concept of mind mapping, which was described in the form of a mind map. The homework assignment was to help the students understand how well they have grasped this tool through the course by drawing a mind map explaining the concept of mind mapping.

In the second lesson, students were guided to review the components of a mind map by asking questions at the beginning to deepen their understanding of mind mapping as a tool. Using this combination of old and new knowledge, they were assigned homework to draw a mind map on time planning.

In the third lesson, students were guided in small groups to correct each other's work on the tasks assigned in the second lesson and to select the work that was most correctly drawn and had the most logical branching within the diagram. The three-course assignments were analyzed to explore the impact of mind mapping on students' creative thinking and whether it could enhance their creativity.

3.2 Analysis of the results of mind mapping teaching

Mind mapping takes an approach that includes divergent thinking, integrating the left and right brain, visualizing thoughts, mining deeper connections, and providing a safe environment for thinking (Tarin & Yawiloeng, 2022). Mind mapping uses its branching structure to encourage divergent thinking by expanding from a central theme to various related sub-themes and ideas, allowing students to think about a problem from multiple perspectives and try out different solutions rather than just scratching the surface or following a single train of thought. Taking the two mind maps drawn by students in this study as examples, the author conducted a detailed analysis to demonstrate the role of mind maps in enhancing students' innovative thinking.

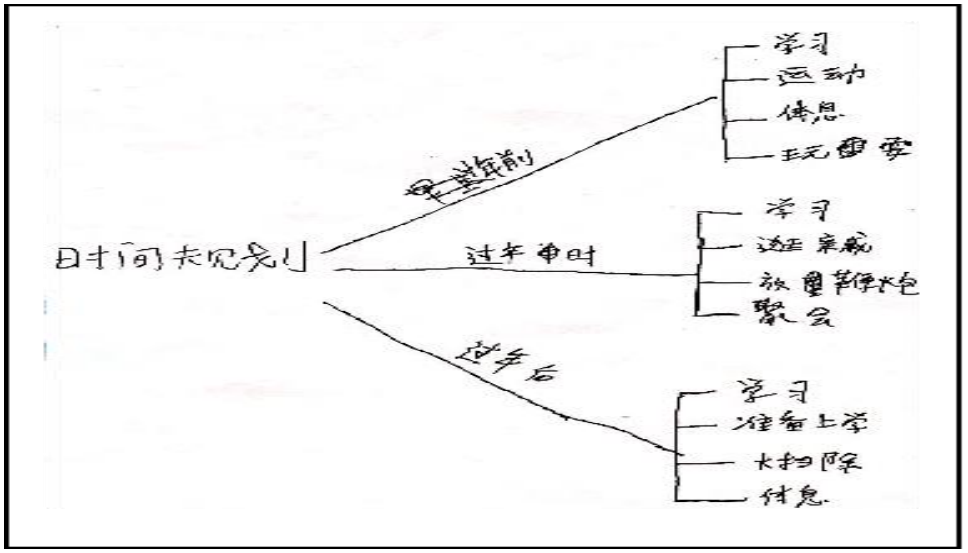

Fig.1. Time planning (Chinese version)

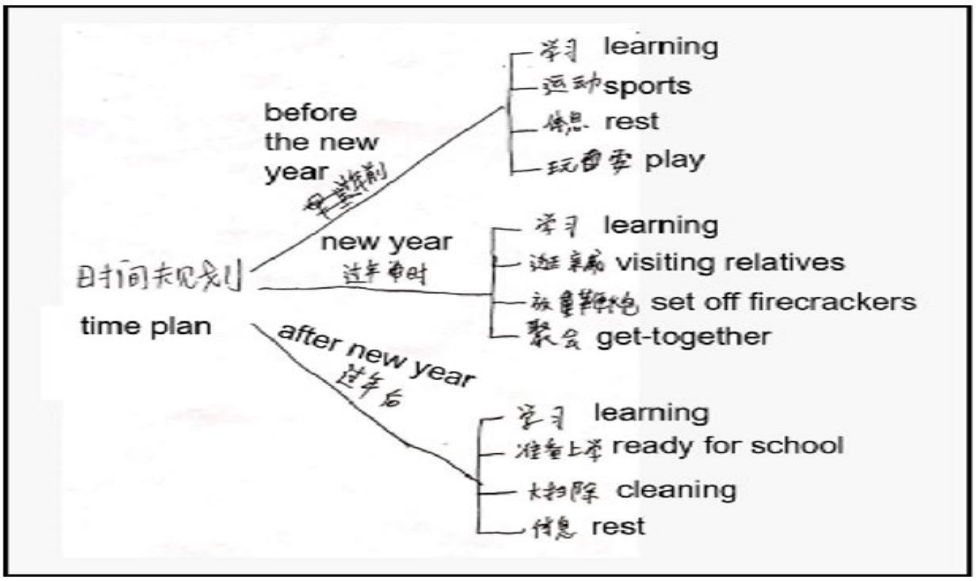

Fig.2. Time planning (Chinese and English versions)

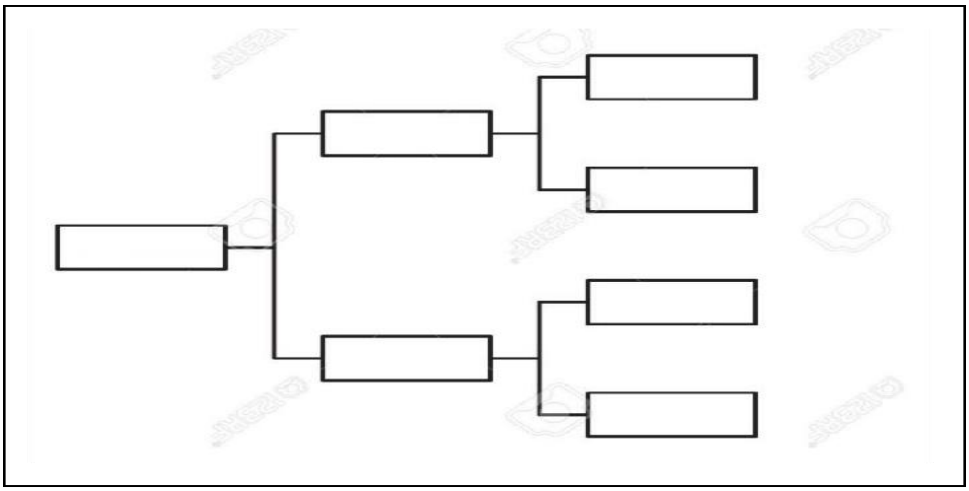

Fig.3. Bracket diagram

Using the theme of time planning, this student had poor understanding of this concept of mind mapping, as can be seen from the image shown in Figure 1 until 3; the student drew a parenthetical diagram, which is mainly used to analyze and understand the relationship between the whole of something and its parts. To the left of the parentheses is the name or image of the thing, and inside, the parentheses describe the main components of the object, helping learners to understand the relationship between an object as a whole and its parts. As shown in Figure 1, students thought of three branches related to the "time planning" theme, which is not much. This shows that drawing as a parenthetical diagram needs to be sufficiently divergent, with fewer associated things. Within the second-level branches, the items listed are more repetitive, with low innovativeness.

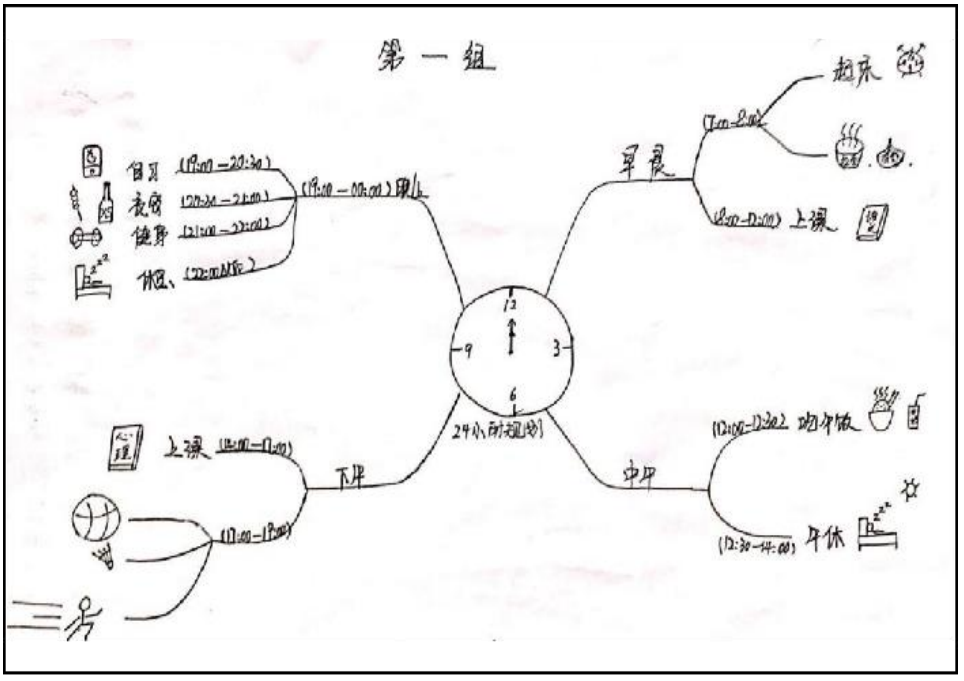

Fig.4. 24-hour time planning (Chinese version)

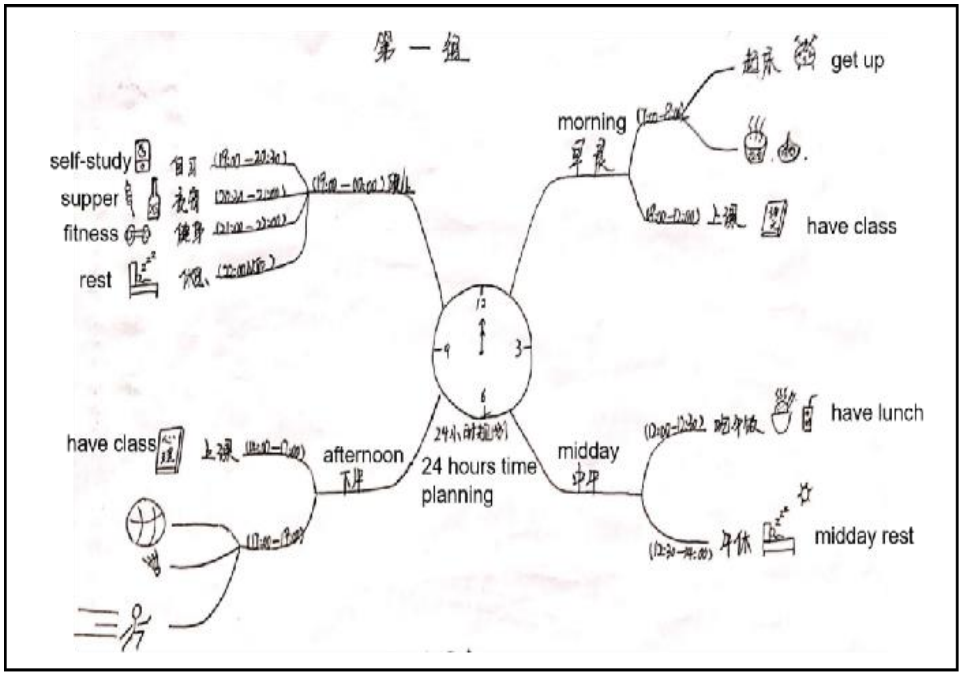

Fig.5. 24-hour time planning (Chinese and English versions)

Similarly, with the theme of time planning, the students who drew Figure 4 began by clarifying the theme and identifying the period as 24 hours and specifying a specific time frame. The thematic form was visualized by replacing it with a clock graphic. Four branches were drawn, focusing on the four phases of 1 day, and the four primary branches were logical and presented. The second-level branches were presented in a graphic form, which made the reader understood the content drawn more clearly, and the graphic icons added much readability to this mind map. The use of indirect drawings to represent the text reflected the creative thinking of the drawing students, and the drawing of the corresponding graphics was also a reflection of the drawing students' ability to link concrete things with symbolic graphics, which showed that the drawing students' ability to think associatively has also been exercised.

4.0 DISCUSSION

4.1 Teaching of Mind Maps

The above examples show how mind maps can promote integrated thinking in students. Using images and keywords, students can develop and utilize their logical and creative thinking to generate more comprehensive and innovative ideas (Wu & Zheng, 2023). Mind mapping provides a visual approach to learning that helps students understand and remember information in new and more intuitive ways.

Mind maps integrate images and keywords to encourage students to utilize their entire brains simultaneously, helping them develop logical and creative thinking and resulting in more holistic and innovative ideas. By encouraging students to think visually using colours, symbols, and images, mind mapping can help students understand and remember information in new and intuitive ways that stimulate creative thinking. By showing the hierarchical structure and associations of information, mind maps help students discover deep connections between different pieces of information and possible new ways of combining them, thus facilitating the generation with new, innovative ideas. In addition, mind maps provide a safe environment for thinking, allowing students to freely add, modify, and reorganize information without fear of error or confusion.

Mind maps demonstrate the hierarchical structure and relevance of information. By clearly showing the connections between topics, subtopics, concepts, and details, mind maps help students understand how information is organized and discover the intrinsic connections between different pieces of information. This facilitates deeper learning and helps students generate new ideas and understandings. Based on the above environment, students are encouraged to experiment with new ideas and solutions that are conducive to developing innovative thinking.

In summary, mind maps play an important role in helping students form and connect new ideas with existing prior knowledge by encouraging divergent thinking, integrative thinking, visualization, and deep learning and providing a safe environment for thinking.

4.2 Strategies for using mind mapping in the classroom

Mind maps are regarded as a critical teaching and learning strategy in innovative and entrepreneurial classrooms in higher education institutions to facilitate students' learning and thinking effectively. Mind maps are applied in various ways to enhance students' engagement, improve comprehension, and stimulate innovative thinking.

For teachers, mind mapping is a powerful tool for planning course content and teaching processes. Teachers can start with the course's central theme and then add a series of related sub-themes, such as essential concepts, principles, and skills, as well as case studies and so on. Teachers can present course content more clearly and systematically. Students can also see the whole picture and inner structure of the course briefly in this way and better understand and master the course content. Second, teachers can instruct students to use mind maps to organize and express their ideas. Students can use mind maps to record and organize their ideas during group discussions or project planning. The branching structure of mind maps

helps present ideas clearly and better identify and understand the connections between different ideas, thus stimulating deeper and more innovative thinking. In addition, mind maps can help students review and summarize their learning more effectively. Teachers can guide students to create revision mind maps that cover the main themes of the lesson, important details, key concepts, and principles, as well as their understanding and reflections, helping to deepen students' understanding of the learning content and enhance their memory, thus improving learning efficiency.

Mind maps can also be used as an assessment tool to help teachers evaluate students' depth of understanding and thinking. Teachers can ask students to submit their mind maps as part of an assignment or project and then assess students' learning outcomes and depth of thinking based on the content and structure of the mind maps. Mind mapping is a highly effective strategy in the innovation and entrepreneurship classroom in higher vocational colleges and universities. It can help teachers better plan their teaching, stimulate students' innovative thinking, improve their learning efficiency, and assess learning outcomes.

4.3 Improving the application method of mind map

In the innovation and entrepreneurship courses of higher vocational colleges and universities, improving the application method of mind mapping can further enhance students' innovation ability and entrepreneurial thinking. On the one hand, traditional mind-mapping tools usually present information as central themes and branches. However, in innovation and entrepreneurship, sometimes a more flexible and diverse expression is needed (Shi et al.,2023). Teachers can guide students to try different mind-mapping tools, such as mind-brain maps, concept maps, timelines, relationship diagrams, etc., to adapt to different innovation and entrepreneurship needs.

When solving complex problems and planning complex projects, students can use a hierarchical mind-mapping approach. They can represent topics and sub-topics in layers, gradually unfolding and refining related concepts and information. The layered structure can help students think and organize complex innovation and entrepreneurship problems more systematically. In addition, mind maps can be used to show the connections and influences between elements. Students can use arrows to indicate the connections and influences between different concepts, demonstrating more clearly the innovation and entrepreneurship process of cause-and-effect relationships, dependencies, and dynamics. In innovation and entrepreneurship courses, teachers can guide students to use mind maps to disassemble complex problems, break them into smaller sub-problems, and record their relationships. Disassembling and organizing help students understand the problem more comprehensively and find entry points for solutions.

In summary, by improving the application method of mind mapping, the innovation and entrepreneurship courses in higher vocational colleges and universities can better cultivate students' innovation ability and entrepreneurial thinking.

4.4 Recognize the importance of divergent thinking and consciously and actively cultivate it

Divergent thinking plays a crucial role in improving innovation, enhancing adaptability, and improving comprehension. On the one hand, it encourages us to be open to new ideas and ways of solving problems, thus promoting innovation and creative problem-solving. On the other hand, divergent thinking enables us to better adapt to changing environments and challenges by considering possibilities. This is especially important when faced with new, unknown, or complex problems. Not only that, divergent thinking helps us understand problems and concepts more deeply and comprehensively by allowing us to think from different perspectives to discover more connections and details.

To consciously and proactively develop divergent thinking, we need to encourage asking questions, which is critical to divergent thinking. We can encourage students or teams to ask questions such as "why," "what if," or "how" to open up a diversity of thinking about an issue. Brainstorming is also an effective way to develop as many ideas as possible within a given time frame, regardless of whether they seem absurd or

impractical. In addition, role-playing can help people see things from different perspectives and thus develop divergent thinking. Finally, it is also essential to practice creative thinking, such as providing time and space for people to try out new ideas and practices, which may include providing time for self-driven projects or resources to try out new solutions.

4.5 Using Mind map to clarify text structure and develop comprehensive generalization skills

Mind maps are essential in improving students' reading comprehension and generalization skills. First, students need to understand the main content and themes of the text by reading the text carefully and writing down the keywords or phrases, which is a very effective strategy. After understanding the text, students can create mind maps centered on the theme or central ideas of the text and then branch outward from that center to include various sub-themes or critical points. Closer to home, students can add more specific information, such as facts, examples, or quotes to each branch, adding details that better support or explain the sub-themes and help students understand the structure and logical relationships of the text. When the mind map is complete, students can attempt to summarize the text. This process begins with themes and sub-themes and progresses to specific details, allowing students to check better that they truly understand whether the text is clearly articulated.

Finally, students can reflect on and improve their mind maps, checking for any omissions or misunderstandings and revising and refining them accordingly. They can also share their mind maps with their peers to learn and build on each other's work. The method of clarifying the structure of the text by using the mind map not only helps students better understand and remember the content of the text but also cultivates their ability to organize, analyze, comprehend, and express the information to improve their ability to make comprehensive generalizations and enable them to have a clear understanding and generalization of various types of texts.

4.6 Using mind mapping as a tool to promote cooperative learning

As an efficient tool, a Mind map can actively promote students' cooperative learning. First, teachers can encourage students to create a mind map around a specific topic or problem, decide on the topic, and branch and sub-branch together. Each student can contribute hisorher thinking and knowledge in the process. Second, online Mind mapping tools such as Mind Meister or X Mind support real-time collaboration, allowing students to create and edit maps together in different locations. In addition, mind maps can serve as excellent project management tools when working on group projects, helping students to clarify the goals, tasks, and responsibilities of the project, thus further facilitating their cooperation and coordination. Finally, teachers can encourage students to share their mind maps and provide feedback to each other, which not only helps them to see problems from others' perspectives but also enhances their critical thinking skills. These strategies can enormously enhance students' teamwork skills and understanding of information and concepts.

5.0 CHALLENGES AND PROSPECTS

5.1 Challenges

Mind mapping, which enhances creative thinking, may face the following significant challenges: technical difficulties are a common problem. Many students may have yet used a mind-mapping tool before or may need help understanding how to use it to organize and present their ideas. To address this issue, teachers can provide specific technology training and tutorials covering the basics of using specific mind-mapping software, choosing keywords, and creating and connecting various nodes. Students can then familiarize themselves with the tool and use it effectively to facilitate their creative thinking.

Secondly, some students may be influenced by stereotypical thinking; they may be accustomed to a linear, step-by-step way of thinking and feel uncomfortable with the discrete, networked way of mind

mapping. To overcome this challenge, teachers can guide students to start using mind maps by providing some simple topics and questions, and then gradually increasing the difficulty and complexity of the topics so that they can slowly adapt to this new way of thinking.

Thirdly, information overload can be a problem. If a mind map is too rich and complex, students may need clarification about how to begin and proceed. In this case, teachers can teach students how to create a mind map in steps and levels, use colors and images to differentiate and highlight different information, and regularly check and adjust the structure and content of the mind map. With these instructions, students can manage their information more effectively and prevent information overload.

5.2 Prospects

Mind mapping has a broad application in innovation and entrepreneurship courses for higher education institutions and can be used in various ways to enhance students' creative thinking. For teachers, they can integrate mind mapping more systematically in course design and teaching activities. Specifically, teachers can design a series of mind mapping tasks and activities related to innovation and entrepreneurship. They can also guide students to use mind maps when solving specific problems, designing projects, or reflecting on their learning. Through this practice, students can deepen their understanding and mastery of mind mapping and creative thinking.

Besides, teachers can utilize online mind mapping tools and collaborative platforms to enhance the functionality and effectiveness of mind mapping with the power of modern technology. These tools and platforms make it easier for students to create, edit, and share their mind maps and support real-time collaboration and discussion, thus improving the efficiency and quality of creative entrepreneurship.

In addition, teachers can also combine mind mapping with other innovative teaching methods and learning resources. They can use mind maps to organize and present the content and structure of teaching and learning activities such as case studies, role-plays, and project-based learning. At the same time, they can link mind maps to external articles, videos, data, and other resources to help students engage in broader and deeper learning and exploration. Finally, teachers can also conduct long-term research and feedback to understand and improve the role and effectiveness of mind maps in enhancing creative thinking. This is done by continuously collecting student performance, feedback, and outcomes and conducting pedagogical experiments and comparative studies to adjust and optimize teaching methods and strategies.

In summary, future innovation and entrepreneurship courses in higher vocational colleges and universities can utilize mind mapping more deeply and extensively to improve students' creative thinking, whether in curriculum design, teaching tools, teaching methods, or research. This will help to improve students' innovation and entrepreneurship ability and contribute to the innovation and development of education.

6.0 CONCLUSION

This paper discusses how mind mapping can enhance students' creative thinking in an innovation and entrepreneurship program at a higher education institution. For example, mind mapping can help students understand and explore problems from multiple perspectives, providing a comprehensive and in-depth way of thinking about innovation and entrepreneurship. However, it is noted that applying mind mapping may cause technical difficulties, stereotypical thinking, information overload, and assessment problems, which require teachers to adopt appropriate strategies and methods in overcoming the above challenges.

More importantly, the potential of mind mapping can be further explored in the future in innovation and entrepreneurship education to become a powerful tool for promoting the development of students' creative thinking. Teachers can integrate mind maps more systematically into curriculum design and teaching activities, utilize modern technology to improve the functions and effects of mind maps, combine them with other innovative pedagogies and learning resources, as well as conduct continuous research and

feedback to understand and improve the effects of mind map in enhancing creative thinking. In conclusion, applying mind mapping to enhance students' creative thinking is a challenging but advantageous path.

We look forward to seeing more teachers and scholars explore and practise this field to help students understand the world in new ways, explore their creative and entrepreneurial potential, and contribute to social innovation and development.

7.0 CONTRIBUTION OF AUTHORS

Jin Ruixuan carried out the research and wrote and revised the article. Geethanjali Narayanan designed the research and provided the research framework. Sheikha Majid supervised the research progress and proofread the article. Lin Chenhui improved on the writing of the article.

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9.0 CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted without any self-benefits or commercial or financial conflicts and declare the absence of conflicting interests with the funders.

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11.0 REFERENCES

Avdagic, E., May, F., McClean, T., Shackleton, F., Wade, C., & Healy, K. (2021). Mind Mapping as a Pragmatic Solution for Evaluation: A Critical Reflection through Two Case Studies. *Practical Assessment, Research & Evaluation*, *26*, 5. https://doi.org/10.7275/sqqw-ht68

Fan, C.G. (2023). Exploration of PBL teaching combined with mind mapping in physiology teaching in higher vocational colleges and universities[J]. *Journal of Henan Higher Medical College, 2023, 35*(03), 339-341. https://doi.org/10.3969/j.issn.1008-9276.2023.03.029

Fu, Y. T. (2021). Study on the Application of Thinking Maps to Cultivate Students' Creative Thinking Ability in High School Biology Teaching. [Master r dissertation, Hefei Teachers College]. https://doi.org/10.27829/d.cnki.ghfsy.2021.000068

Hou, C. L., & Yan, L. Q. (2023). Utilizing mind map to improve classroom efficiency - the application of mind map in high school English teaching[J]. *Scholastic Weekly,2023*, 25, 142-144.https://doi.org/10.16657/j.cnki.issn1673-9132.2023.25.047

Luangkrajang, M. S. (2022). Use of mind-mapping in language learning: a cognitive approach. *Theory and Practice in Language Studies*, *12*(8), 1616-1621. https://doi.org/10.17507/tpls.1208.18

Shi, Y., Yang, H., Dou, Y., & Zeng, Y. (2023). Effects of mind mapping-based instruction on student cognitive learning outcomes: a meta-analysis. *Asia Pacific Education Review*, *24*(3), 303-317. https://doi.org/10.1007/s12564-022-09746-9

Tarin, S., & Yawiloeng, R. (2022). Using mind-mapping to develop EFL students' writing performance. *English Language Teaching*, *15*(11), 14-24. https://doi.org/10.5539/elt.v15n11p14

Wu, W., & Zheng, W. (2023). Using Mind Mapping for English Vocabulary Teaching. *English Language Teaching*, *16*(5), 1-44 https://doi.org/10.5539/elt.v16n5p44

Xie, C. Y., Zhang, H. J., Yu, F. U., Huang, W. F., Zhou, Y. L., Mo, Z. F. & Liao, X. X. (2022). Mind Mapping as a New Strategy to Improve Cardiopulmonary Resuscitation Learning for Medical Interns. Medical-Research, 4(2), 1-7. https://www.researchgate.net/publication/362141332

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