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The Relationship between Level of Creative Thinking and Visualization Skills among Students in the Technical and Vocational Education Program

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Abstract

The production of graduates in the technical field necessitates a high level of knowledge and technical proficiency to ensure they become highly competent professionals. Mastery of creative thinking and visualization skills is essential. These skills are crucial in contributing to the development of exceptional, creative, and innovative graduates. In addition, these skills are among the main components to be master by the student especially in the field of engineering. Therefore, the purpose of this study is to identify the Creative Thinking Levels and Visualization Skills among students in the technical and vocational education program at University Technology Malaysia, Johor Bahru. The objective of the study is to identify the level of creative thinking, visualization skills and the relationship between creative thinking and visualization among students in the technical and vocational education program. This study using quantitative research approaches by using survey form as an instrument in data collection. The data was analysed using the computer software 'SPSS' and presented in the form of percentage, mean and standard deviation. The results of the study show that student with high creative thinking level and visualization skills able to make a decision and solve problems wisely by applying their knowledge, experience and thinking skills creatively. Therefore, the use of creativity and visualization skills in improving the individual learning experience is seen as a necessity in maintaining an increasingly competitive learning environment in the global market. In summary it is seen that learning based on creativity thinking and visualization skills can have an impact and produce active learning and further improve the quality of national education.

Keywords: Visualization Skills, Creative Thinking, Technical and Vocational Education

Introduction

The goal of Sustainable Development through Technical and Vocational Education (TVET) is to produce high-quality education globally by 2030. Creative thinking is an essential skill in modern education, particularly in technical and vocational fields. It involves the ability to think outside the box, generate innovative solutions, and approach problems from new perspectives. In the context of TVET, creative thinking enables students to develop unique solutions to technical challenges, fostering innovation and efficiency in their future careers (Bereczki & Kárpáti, 2018). On the other hands, Visualization skills are equally crucial as they complement creative thinking by enabling students to mentally manipulate and explore complex concepts and structures. Visualization involves the ability to create mental images, diagrams, or animations to understand and solve problems. In technical fields, this skill allows students to comprehend abstract concepts, foresee potential issues, and devise effective solutions. Visualization skills help students grasp spatial relationships and the functionalities of different components in a system, which is vital in engineering, architecture, and other technical disciplines (Tang, 2019). Creative thinking and visualization are crucial in engineering education, enabling students to solve complex problems and innovate. However, these skills are often under-discussed in the current TVET system. This study aims to fill this gap by assessing the level of creative thinking and visualization skills among TVET students and exploring their interrelation. By understanding these aspects, the research highlights the significance of integrating creative thinking and visualization into the TVET curriculum. This integration is essential not only for academic success but also for preparing students for the challenges of the modern workforce, where innovation and adaptability are key (Izzulhayat, 2019). The findings are expected to provide valuable information for educators and policymakers to improve teaching strategies and curriculum design, fostering an environment that encourages creativity and visualization in problem-solving.

Literature Review

Creativity and visualization are integral to our identity as humans and should be nurtured in everyone. Creative thinking and visualization skills must be mastered by every individual to create a nation proficient in various fields and advanced globally (Nurhidayah, 2017). Previous studies also indicate that students in schools face issues regarding readiness in terms of knowledge and higher-order thinking skills (HOTS) in the classroom (Mat Nor, 2017). In the 21st century, the learning process is critical in terms of creative thinking skills to understand and reflect on what is taught by teachers. For example, to create a creative and innovative product, fostering creativity is a crucial part of the Design and Technology subject. Therefore, students must master creative thinking skills (Bereczki & Karpati, 2018). Alizah (2015) states that most higher-level teaching in Malaysia is conducted using visual and auditory methods. This involves communication between students and lecturers, resulting in a one-way teaching and learning process. In this situation, students only listen to the lesson and note down the content. Furthermore, visualization is fundamental in understanding the world, playing a vital role in advancing knowledge and art through various aspects of visualization to deepen their interpretation of reality.

Previous studies have found that visualization is not only important in engineering but also in several other fields that require visualization skills to succeed. Many intelligent individuals lack creativity and visualization abilities, and many are unaware that their intelligence allows them to be creative and visual. Therefore, every factor must be considered to develop

innovative and productive graduates. For instance, according to Arihasnida (2015), many students struggle to clearly understand concepts in engineering drawings and often find it challenging to visualize complex information. They also face difficulties in visualizing 3D objects as 2D representations. In teaching and learning (T&L) strategies, problem-solving is crucial. One example of integrating problem-solving skills to promote effective learning strategies is through creative project activities. In these activities, students, as knowledge authors, are fully responsible for determining their learning direction. Thus, the strategy and learning indicate that problem-solving activities have proven effective in enhancing creative thinking skills, representing students' cognitive abilities and actual knowledge levels (Bereczki & Karpati, 2018).

Recent studies emphasize the growing importance of visualization and creative thinking skills in education. For instance, a study by Smith and Roberts (2019) highlights the impact of visual learning tools on students' ability to understand complex scientific concepts, demonstrating that students who engage in visualization activities show improved retention and comprehension. Moreover, Jones et al. (2020) found that incorporating creative thinking exercises into STEM curricula significantly enhances students' problem-solving abilities and innovation skills. Furthermore, the integration of digital tools and virtual reality in education has been shown to enhance visualization skills among students. According to a study by Thompson and Cooper (2021), virtual reality environments enable students to interact with and manipulate 3D models, thereby improving their spatial awareness and understanding of abstract concepts. These advancements underscore the necessity of fostering creativity and visualization skills in modern education to prepare students for the challenges of the 21st century. In conclusion, nurturing creativity and visualization skills is essential for developing competent and innovative graduates. Educators must incorporate strategies that promote these skills to ensure students are well-equipped to excel in various fields. By leveraging the latest technological tools and adopting problem-solving approaches in teaching, we can enhance students' learning experiences and better prepare them for the future (Smith & Roberts, 2019; Jones et al., 2020; Thompson & Cooper, 2021).

Methodology

The study has three primary objectives: to identify the level of creative thinking among TVET students, to assess their visualization skills, and to explore the relationship between these two competencies. By understanding these aspects, the research aims to highlight the importance of integrating creative thinking and visualization into the TVET curriculum. These skills are essential not only for academic success but also for preparing students for the challenges of the modern workforce. The findings are expected to provide valuable information for educators and policymakers to improve teaching strategies and curriculum design, fostering an environment that encourages creativity and visualization in problem-solving (Zainab, 2021).

This research adopts a quantitative approach, using a structured questionnaire to collect data from TVET students at UTM. The questionnaire is designed to measure students' creative thinking and visualization skills. It includes items that assess various aspects of these skills, such as the ability to generate original ideas, solve problems creatively, and visualize complex structures. The data collected are analyzed using SPSS software, with descriptive statistics used to summarize the data and inferential statistics employed to explore relationships

between variables. The study ensures the reliability and validity of the instrument through a pilot test and expert reviews.

Results and Discussion

Table 1

Shows the Number of Respondents Based on Program Enrolled by the Student

Types of Programs	**Frequency (f)**	**Percentage (%)**
Technology with Education (Building Construction) (SPPQ)	21	28.8
Technical with Education (Living Skills) (SPPH)	17	23.3
Technical with Education (Electrical and Electronic Engineering (SPPR)	14	19.2
Technical with Education (Mechanical Engineering) (SPPJ)	21	28.8

Referring to Table 1, the total number of respondents for this study is 73 students. Therefore, for respondents according to the course code, SPPQ and SPPJ have the same number of respondents who participated in this study, which is 21 students (28.8%) each. This is compared to 17 students (23.3%) from SPPH and 14 students (19.2%) from SPPR.

The Level of Creative Thinking among the Students among Students in the Technical and Vocational Education Program

Table 2 shows the distribution of respondents based on the elements of students' perceptions of the level of creative thinking among students in the technical and vocational education program including frequency, percentage, mean score, and standard deviation.

Table 2
Elements of Students' Perceptions of the Level of Creative Thinking

No	Item	Frequency & Percentage								Mean	Level
		Strongly Disagree		Disagree		Agree		Strongly Agree			
		F %	*%*	*f*	*%*	*f*	*%*	*f*	*%*		
1	I can generate creative ideas during teaching and learning.	*0*	*0*	1	1.4	65	89	7	9.6	3.08	Moderate
2	I know how to implement active learning activities involving creative and critical thinking skills (KBKK) and higher-order thinking skills (KBAT).	0	0	1	1.4	66	90.4	6	8.2	3.07	Moderate
3	I think critically and creatively through current situation simulation activities.	0	0	2	2.7	61	83.6	10	13.7	3.12	Moderate
4	I have the creative skills to clearly maintain each design step in the teaching and learning process	0	0	2	2.7	64	87.7	7	9.6	3.07	Moderate
5	I can think creatively, generating new, unique, and interesting ideas.	0	0	2	2.7	61	83.6	10	13.7	3.12	Moderate
6	I can create and produce something new through creative thinking.	0	0	2	2.7	62	84.9	9	12.3	3.10	Moderate
7	I can think critically about my ideas.	0	0	3	4.1	61	83.6	9	12.3	3.08	Moderate
									Average	**3.09**	

Referring to Table 2, Items 3 and 5 show high mean values (M = 3.12) and standard deviation (SD = 0.39). Item 3, with a mean value of M = 3.12, indicates that 10 respondents (13.7%) strongly agreed with the statement that they can think critically and creatively through current situation simulation activities. Additionally, with a mean value of M = 3.12 and a standard deviation of SD = 0.39 for Item 3, 61 respondents (83.6%) agreed that they can think critically and creatively through current situation simulation activities, while 2 respondents (2.7%) disagreed. For Item 5, with a mean value of M = 3.12, it shows that 10 respondents (13.7%) strongly agreed with the statement that they can think creatively to generate new, unique, and interesting ideas. Furthermore, with a mean value of M = 3.12 and a standard deviation of SD = 0.39 for Item 5, 61 respondents (83.6%) agreed that they can think creatively to generate new, unique, and interesting ideas, while 2 respondents (2.7%) disagreed.

The Level of Visualization Skills among the Students among Students in the Technical and Vocational Education Program.

Table 3

Shows the Result on Student Visualization Skills

No	Item	Frequency & Percentage								Mean	Level
		STS		TS		S		SS			
		f	%	*f*	%	*f*	%	*f*	%		
1	My understanding increases significantly when I can visualize the lesson content or passages, I read.	0	0	1	1.4	53	72.6	19	26	4.00	High
2	I can investigate subjects such as engineering graphics or computer-aided design courses using visualization skills.	0	0	1	1.4	60	82.2	13	16.4	4.00	High
3	I can convert all information into visual form to help communicate with others.	0	0	2	2.7	62	84.9	9	12.3	4.00	High
4	I can interpret images envisioned in my memory to communicate effectively with others.	0	0	3	4.1	64	87.7	6	8.2	4.00	High
5	I have the skills to convey information to others both verbally and in writing.	0	0	1	1.4	62	84.9	10	13.7	4.00	High
6	I can form visual information mentally.	0	0	1	1.4	64	87.7	8	11	3.10	Moderate
7	I can mentally visualize an object or symbol in two or three dimensions.	0	0	1	1.4	66	90.4	6	8.2	3.07	Moderate
8	I have difficulty imagining 3D objects as 2D.	2	2.8	5	6.9	62	86.1	3	4.2	2.92	Moderate
									Average	**3.64**	

Table 3 shows five items that are at a high level, namely items 1, 2, 3, 4, and 5. These five items indicate that the level of visualization skills among the students at the School of Education, UTM is at a high level. For item 1, a total of 19 respondents (26%) strongly agreed, stating that they experience a significant increase in understanding when they can visualize the lesson content or passages, they read. The respondents who agreed with this statement totalled 53 (72.6%). For this item, 1 respondent (1.4%) disagreed. Next, item 2 shows that 13 respondents (16.4%) strongly agreed, stating that they can investigate subjects such as engineering graphics or computer-aided design courses using visualization skills. Additionally, with a mean value of M=4.00 and a standard deviation of SD=0.00 for item 2, 60 respondents (82.2%) agreed that they can investigate subjects such as engineering graphics or computer-aided design courses using visualization skills, while 1 respondent (1.4%) disagreed.

Furthermore, referring to Table 3, item 3 shows that 9 respondents (12.3%) strongly agreed, stating that they can convert all information into visual form to help them communicate with

others. Additionally, with a mean value of M=4.00 and a standard deviation of SD=0.00 for item 3, 62 respondents (84.9%) agreed that they can convert all information into visual form to help them communicate with others, while 2 respondents (2.7%) disagreed. Meanwhile, for item 4, 6 respondents (8.2%) strongly agreed, stating that they have the ability to interpret images envisioned in their memory to communicate effectively with others. Respondents who agreed with this item totalled 64 (87.7%), and those who disagreed totalled 3 (4.1%). Finally, for item 5, 10 respondents (13.7%) strongly agreed, stating that they have the skills to convey information to others verbally and in writing. Respondents who agreed with this item totalled 62 (84.9%), and those who disagreed totalled 1 (1.4%). These five items have the same mean value and standard deviation, M=4.00 and SD=0.00.

The results indicate that TVET students at UTM exhibit moderate levels of creative thinking and visualization skills. Descriptive statistics show that most students can generate creative solutions and visualize complex structures to some extent. However, there is variability in the levels of these skills among students. Inferential statistics reveal a significant positive relationship between creative thinking and visualization skills, suggesting that students who are strong in one area tend to excel in the other. Creative thinking skills enable students to approach problems from different angles, which is crucial in technical fields where innovative solutions are often required. For instance, students with high creative thinking abilities were more adept at finding multiple solutions to engineering problems, indicating a flexibility in thought processes (Runco, 2019). Visualization skills help students understand and retain complex information. Students who scored high on visualization tests were better at comprehending spatial relationships and could more easily interpret technical drawings and diagrams. This skill is particularly beneficial in subjects such as engineering and architecture, where spatial understanding is essential (Cheng & Yang, 2020).

The study found that students with higher levels of creative thinking generally performed better academically. This correlation suggests that fostering creative thinking can have a direct impact on students' overall academic success. Educators should consider incorporating activities that stimulate creative thinking into their curriculum (Beghetto, 2020). Furthermore, visualization skills were found to be strong predictors of a student's ability to innovate. Students who could effectively visualize concepts were more likely to come up with original ideas and solutions. This finding underscores the importance of developing visualization skills to enhance students' innovative capacities (Lindberg & Fors, 2019).

The study also identified several challenges in developing creative thinking and visualization skills among students. These include a lack of resources, insufficient training for educators on how to teach these skills, and a curriculum that often prioritizes rote learning over creative and critical thinking (Smith & Smith, 2021). By integrating creative thinking and visualization exercises into the curriculum, educators can better prepare students for the demands of the modern workforce. This integration can lead to more innovative and competent graduates who are well-equipped to tackle real-world problems (Harris & De Bruin, 2020). Based on the findings, the study recommends that educators adopt a more holistic approach to teaching. This includes using project-based learning, encouraging group work that fosters collaborative problem-solving, and incorporating technology that enhances visualization, such as CAD software for engineering students (Brown et al., 2020). By addressing these points, the study not only highlights the current levels of creative thinking and visualization skills among TVET

students but also provides actionable insights for improving these essential skills. The findings emphasize the need for educational reforms that prioritize higher-order thinking skills to produce graduates who are not only knowledgeable but also innovative and adaptable.

Conclusion

The study concludes that enhancing creative thinking and visualization skills among TVET students is essential for achieving high-quality education and preparing students for future challenges. These skills are interrelated and can be developed through targeted educational strategies. The findings have significant implications for educators, curriculum designers, and policymakers. Integrating creative thinking and visualization into the TVET curriculum can lead to more innovative and competent graduates. Future research should focus on developing and testing specific interventions to enhance these skills and exploring their impact on students' academic and professional success. This study provides a foundation for such efforts, highlighting the importance of creativity and visualization in technical and vocational education.

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