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Creative, Critical, and Balanced Thinking Styles among Vocational Education (General Machining) Students

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Abstract

Creative and critical thinking styles are pivotal for TVET students as they enhance problem-solving capabilities, innovation, creativity, and collaboration, all of which are imperative for success in the contemporary and future sustainable economy. This study aims to identify the creative, critical, and balanced thinking styles among Bachelor of Vocational Education (General Machining) students using the Yanpiaw Creative-Critical Styles questionnaire. The study employs a descriptive design with a quantitative approach. A total of 137 students from the Bachelor of Vocational Education (General Machining) program at the Faculty of Technical and Vocational Education (FPTV), University Tun Hussein Onn Malaysia (UTHM), were selected through a centralized method. The findings reveal that 35 % of students exhibit a critical thinking style, 35% possess a balanced thinking style, 24 demonstrate a creative thinking style, and 6% exhibit an excellent creative thinking style. This study provides a comprehensive overview of the thinking styles among TVET students and underscores the necessity of integrating critical and creative thinking skills into the curriculum to adequately prepare students for future challenges.

1. Introduction

Creative and critical thinking styles are essential cognitive skills for TVET students to solve problems effectively and create innovative solutions. These skills aid in the development of innovative solutions to real-world problems and support a sustainable future. Additionally, they foster creativity and collaboration, which are crucial for success in today's economy. Students who can think creatively and critically can generate new ideas, objectively analyse information, and make informed decisions, which are fundamental requirements for success in the modern economy (Omar et al., 2022; Wahab et al., 2022).

The application of creative and critical thinking styles also encourages students to think independently and develop strong communication and collaboration skills. This is important in vocational education, where students need to combine practical skills with soft skills to innovate (Kiong et al., 2020). With these skills, TVET students can enhance their ability to analyse and evaluate situations, identify problems, and develop innovative solutions in various situations. This is also crucial for business success and adapting to new challenges in a constantly changing world (Yanuarto et al., 2022; Dewanto et al., 2018).

The critical element in thinking styles is important for higher education students to master interpersonal skills as competent graduates (Institut Pendidikan Guru Malaysia [IPGM], 2019). According to Benjamin Bloom, critical thinking styles such as analysis, synthesis, and evaluation are essential for academic advancement (Bloom,

1956). E. Paul Torrance stated that creative thinking drives innovation and the ability to generate original ideas (Torrance, 1962). These skills enable students to take a flexible approach to challenges and create creative solutions.

1.1 Problem Statement

The critical thinking style among TVET students is often at a low level due to their focus on practical skill acquisition and the neglect of critical thinking and media literacy (López et al., 2023; Omar et al., 2022). Traditional teaching methods that are monotonous and lack interactivity hinder students from actively engaging, resulting in a deficiency in creativity and innovation (Fadipe et al., 2021; Wahab et al., 2022). Fear of evaluation and the passive reception of information further obstruct the development of critical thinking (Aouaf et al., 2023). The COVID-19 pandemic has accelerated changes in learning styles; however, the reliance on online platforms has further exacerbated the decline in critical thinking skills among students (Tommasi et al., 2023). Limitations in infrastructure, teachers' lack of knowledge about critical thinking, and language barriers also adversely affect this development (Aouaf et al., 2023; Cahyaningrum et al., 2022). Socio-cultural factors and curricula that fail to emphasize creative thinking are additional contributing factors (Wahab et al., 2022). In the machining field, students are often not encouraged to think creatively, even though their profession requires problem-solving skills (Janata et al., 2022). Thinking styles among students vary by year of study due to differences in curricula, cognitive development, and exposure to diverse educational environments (Simpson et al., 2020; O'Brien, 2019). Therefore, educational interventions are essential to address these challenges and ensure that TVET students are equipped with balanced critical and creative thinking skills.

2. Literature Review

2.1 The Torrance Test of Creative Thinking (TTCT)

The Torrance Test of Creative Thinking (TTCT), developed by Ellis Paul Torrance in 1982, is one of the most widely used instruments for assessing creativity. The TTCT is designed to measure an individual's creative abilities across various dimensions, including original thinking, the capacity to generate diverse and unique ideas, and the ability to perceive unusual relationships between objects or concepts. TTCT have demonstrated that this test possesses good accessibility and high validity in measuring creativity. Torrance's own research (1982) confirmed that the TTCT has the capability to accurately measure the dimensions of creativity. Other studies, such as those conducted by Goff and Torrance (2002), have shown that the TTCT can predict creative achievement in various fields such as arts, sciences, and problem-solving.

TTCT is a valuable tool for assessing creativity by providing systematic measurement of key dimensions of creativity such as fluency, flexibility, originality, and elaboration. Despite some limitations in its use, the TTCT remains one of the principal instruments in creativity research and assessment. Literature studies indicate that the TTCT has wide applications in education, psychology, and professional settings to promote and understand creativity.

2.2 Watson-Glaser Critical Thinking Appraisal

The Watson-Glaser Critical Thinking Appraisal (WGCTA), developed by Watson and Glaser in 1980, is one of the most respected assessment tools for measuring critical thinking abilities. This tool is designed to evaluate various aspects of critical thinking, including skills in analysis, evaluation, and inference related to logical and objective thinking. Literacy studies on the WGCTA provide deep insights into the theory behind this instrument, its applications, as well as the results and interpretations from various studies conducted using the WGCTA. The WGCTA is built upon the theory of critical thinking, which emphasizes the importance of the ability to assess and make decisions based on strong evidence. Studies using the WGCTA have shown that this tool possesses high accessibility and validity in measuring critical thinking abilities. Research by Watson and Glaser (1980) demonstrated that the WGCTA is an effective tool for assessing key dimensions of critical thinking and can predict individual performance in situations requiring logical and objective thinking. Other studies, such as those conducted by McCormick and Goff (1991), indicate that the WGCTA can be used to identify strengths and weaknesses in an individual's critical thinking abilities, as well as to design interventions to enhance these skills. The Watson-Glaser Critical Thinking Appraisal (WGCTA) is an essential tool for evaluating critical thinking abilities, providing systematic measurement of key dimensions of critical thinking such as inference, recognition of assumptions, deductive reasoning, evaluating arguments, and logical reasoning. Despite some limitations in its use, the WGCTA remains a principal instrument in critical thinking research and assessment. Literacy studies indicate that the WGCTA has wide applications in education and professional settings, offering valuable guidance in improving and understanding critical thinking abilities.

3. Methodology

3.1 Research Design

The survey study was be conducted using a quantitative approach. This method requires the researcher to collect data to test the research hypotheses, examine the relationships between variables, and provide answers to the research questions (Maliki, Musaffa & Ali, 2019). This study aims to identify the levels of critical, creative, and balanced thinking styles among ISMPV FPTV students.

3.2 Instrument

The study utilized a structured questionnaire, "The Yanpiaw Creative-Critical Styles Test," as the primary instrument for data collection. The questionnaire consisted of two sections: Section A collected demographic data of the respondents, while Section B included 34 items designed to measure creative and critical thinking styles. To ensure the reliability and validity of the instrument, a pilot study was conducted involving 28 students from the Bachelor of Vocational Education (Electrical and Electronics) program. The pilot test yielded a Cronbach's Alpha value of 0.901, indicating high reliability. Data analysis was conducted using both descriptive and inferential statistical methods. Descriptive statistics were employed to analyze trends and patterns in the levels of critical, creative, and balanced thinking styles among students. Inferential statistics were used to examine the relationships and differences in thinking styles across different years of study. Spearman's Rank Correlation was applied to evaluate the relationship between thinking styles and the year of study, as it is suitable for non-parametric or ordinal data. The Kruskal-Wallis H Test was used to assess differences in thinking styles among students across different years of study, considering the non-normal distribution of the data. All analyses were performed using SPSS software (version 21), ensuring accuracy and consistency in data interpretation.

3.3 Research Population and Sampe

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Table 1 *Research population and sample*

Year of Study	Population	Sample
Year 1	40	39
Year 2	38	38
Year 3	41	40
Year 4	20	20
Total	**139**	**137**

4. Results and Analysis

4.1 Creative, Critical and Balanced Thinking Styles Among Undergraduate Vocational Education Students

Table 2 shows the distribution of thinking styles among Bachelor of Vocational Education (ISMPV) students at the Faculty of Technical and Vocational Education (FPTV), University Tun Hussein Onn Malaysia (UTHM) for the 2023/2024 session. This data encompasses five categories of thinking styles: Excellent Creative Thinking, Creative Thinking, Balanced Thinking, Critical Thinking, and Excellent Critical Thinking, divided according to the year of study.

Overall, the dominant thinking styles are Critical Thinking (35%) and Balanced Thinking (35%), followed by Creative Thinking (24%). Additionally, a small number of students excel in Excellent Creative Thinking (6%). However, no students exhibited Excellent Critical Thinking.

First-year students demonstrated the highest number of thinking styles, with 39 students (31.2%). In this category, Critical Thinking was the most dominant, with 12 students (8.8%), followed by Creative Thinking with 17 students (12.4%). However, no students exhibited Excellent Creative Thinking or Excellent Critical Thinking.

This indicates that although first-year students have a variety of thinking styles, Critical and Creative Thinking are the most prominent.

In the second year, there were 38 students (26.2%). Critical Thinking and Creative Thinking accounted for 15 students (10.9%) and 11 students (8%), respectively. Similar to the first year, no students exhibited Excellent Critical Thinking. However, Creative Thinking still remained a relatively significant choice.

Third-year students showed a relatively high number with 40 students (25.3%). In this category, Balanced Thinking emerged as the most dominant thinking style with 12 students (8.8%). However, there were also 8 students (6%) who demonstrated Excellent Creative Thinking. Critical Thinking and Creative Thinking had almost the same number of students.

In the fourth year, there were 20 students (15.6%). Creative Thinking was the most prominent with 8 students (5.8%), while Critical and Balanced Thinking each had 8 students (5.8%). No students exhibited Excellent Critical Thinking or Excellent Creative Thinking in this year.

Table 2 *Thinking styles among ISMPV students at FPTV UTHM session 2023/2024*

Year of Study	Thinking Style										Total	
	Excellent Creative Thinking		Creative Thinking		Balanced Thinking		Critical Thinking		Excellent Critical Thinking			
	f	%	f	%	f	%	f	%	f	%	f	%
1	0	0	10	7.3	17	12.4	12	8.8	0	0	39	31.2
2	0	0	10	7.3	11	8	15	10.9	0	0	38	26.2
3	8	6	7	5.4	12	8.8	13	9.5	0	0	40	25.3
4	0	0	4	4.0	8	5.8	8	5.8	0	0	20	15.6
Total	8	6	31	24	48	35	48	35	0	0	137	100

4.2 The Relationship Between Creative, Critical and Balanced Thinking Styles Among Undergraduate Vocational Education Students and Years of Study

The results of the Spearman correlation test indicate that there is no relationship between thinking styles and year of study, with the Spearman correlation coefficient (rho) valued at 0.079. This value suggests that the relationship between the two variables is positive but very weak. Additionally, the significant value (Sig. (2-tailed)) is 0.360, which is well above the alpha level of 0.05. Therefore, these results are not statistically significant, and the null hypothesis (H_0) stating that there is no significant relationship between thinking styles and the year of study cannot be rejected.

Overall, this analysis shows that there is insufficient evidence to support the existence of a significant relationship between creative, critical, and balanced thinking styles and the year of study among undergraduate vocational education students. These findings suggest that the year of study does not play a significant role in influencing students' thinking styles within the context of this study.

Table 3 *Spearman correlation test*

Variable	N	Correlation Coefficient (rho)	Sig. (2-tailed)
Thinking style	135	0.079	0.360

4.3 Differences in Creative, Critical and Balanced Thinking Styles Among Undergraduate Vocational Education Students by Year of Study

To determine whether the thinking style data is normally distributed for each student year group (1, 2, 3, and 4), the Kolmogorov-Smirnov and Shapiro-Wilk normality tests were conducted. The significant values (Sig.) obtained from both tests are less than 0.05 for all groups. This indicates that the data is not normally distributed for each student status group. These results suggest that the thinking style data for all three student groups is not normally distributed. Therefore, non-parametric statistical analysis will be used in subsequent analyses to test the study hypotheses. This study uses the Kruskal-Wallis H test to determine whether there are significant differences in creative, critical, and balanced thinking styles among undergraduate vocational education students based on their year of study.

Table 4 *Kolmogorov-Shirnov and Shipiro-Wilk Test*

Status	Test	Statistic	df	Sig.
1	Kolmogorov-Smirnov	0.353	19	0.000
	Shapiro-Wilk	0.722	19	0.000

2	Kolmogorov-Smirnov	0.224	96	0.009
	Shapiro-Wilk	0.851	96	0.001
3	Kolmogorov-Smirnov	0.225	20	0.000
	Shapiro-Wilk	0.803	20	0.000
4	Kolmogorov-Smirnov	0.235	20	0.000
	Shapiro-Wilk	0.813	20	0.000

The Kruskal-Wallis H test shows that the Chi-Square (χ^2) value is 4.703 with 3 degrees of freedom (df) and a p-value of 0.095. Since the p-value > 0.05, the researcher does not reject the null hypothesis. This indicates that there are no significant differences in creative, critical, and balanced thinking styles among undergraduate vocational education students based on their year of study. These results suggest that creative, critical, and balanced thinking styles do not differ significantly across the years of study. There is no strong evidence indicating that the year of study has a significant impact on the students' creative, critical, and balanced thinking styles.

Table 5 *Statistic*

	Thinking style
Kruskal-Wallis H	4.703
df	3
Asymp. Sig	0.095

5. Discussion and Conclusion

5.1 Creative, Critical and Balanced Thinking Styles Among Undergraduate Vocational Education Students

Based on the data analysis, the distribution of thinking styles among ISMPV students at FPTV UTHM for the 2023/2024 session shows significant variation. The overall findings indicate that balanced and critical thinking styles are the most dominant, followed by creative thinking. A few students exhibit excellent creative thinking, but none demonstrate excellent critical thinking.

Several factors contribute to this variation in thinking styles, including differences in curriculum, teaching approaches, practical experiences, a supportive learning environment, and individual factors such as motivation and interest (Han, 2020; Ma-Kellams, 2020; Khemlani et al., 2010; Mora, 2017; Olga et al., 2024).

First-year students primarily exhibit balanced thinking styles, which may be due to their transition from secondary to higher education (Eshet et al., 2022; Belousova et al., 2023). Second, third, and fourth-year students tend to lean towards critical thinking, influenced by deeper academic engagement and practical experiences (Janata et al., 2022). Curriculum changes and evolving teaching methods also play a role in these differences (Bitran, 2019; Hadi, Subarinah, Triutami & Hikmah, 2022).

As students' progress in their academic journey, cognitive and psychosocial development occurs, leading to shifts in thinking styles (Apriyani, 2021). Senior students prepare for professional life, where critical thinking becomes essential (Nainggolan, 2023).

Overall, this analysis highlights the dynamic and evolving nature of thinking styles among ISMPV students. Educational institutions must support and encourage the development of critical and creative thinking by providing a conducive learning environment, comprehensive curriculum, and effective teaching methods. This ensures students can fully develop their potential and be well-prepared for future challenges (Saglam et al., 2019; Amalia, 2021; Mutmainnah et al., 2022).

5.2 The Relationship Between Creative, Critical and Balanced Thinking Styles Among Undergraduate Vocational Education Students and Years of Study

Based on the analysis of the relationship between creative, critical, and balanced thinking styles and students' year of study, the Spearman correlation test was conducted. The results indicate a very weak correlation between thinking styles and the year of study, suggesting a positive but extremely weak relationship between the two variables.

Overall, there is insufficient evidence to support a significant relationship between thinking styles and the year of study among undergraduate vocational education students. This suggests that the year of study does not significantly influence students' thinking styles in this context.

Several factors could contribute to the lack of significant relationship, such as an assessment system focused on basic knowledge rather than critical or creative thinking (Teszenyi et al., 2020), inconsistency in teaching quality and methods (Mutmainnah et al., 2022), and other dominant factors like previous educational background,

peer influence, family support, and diverse learning environments (Ma-Kellams, 2020). Additionally, students might already possess strong thinking foundations before entering the vocational program, allowing them to maintain and develop their thinking styles consistently (Solberg et al., 2023).

In conclusion, the study indicates that creative, critical, and balanced thinking styles among undergraduate vocational education students are not significantly influenced by their year of study. Therefore, other factors may be more crucial in shaping students' thinking styles. Educational institutions should continue to support the development of critical and balanced thinking through effective teaching approaches and a conducive learning environment.

5.3 Differences in Creative, Critical and Balanced Thinking Styles Among Undergraduate Vocational Education Students by Year of Study

Based on the analysis conducted, this study examines creative, critical, and balanced thinking styles among undergraduate vocational education students, considering their year of study. The Kolmogorov-Smirnov and Shapiro-Wilk tests indicate that the data is not normally distributed for each year group, with significant values (Sig.) less than 0.05 for all groups.

Data analysis shows that most students exhibit critical and balanced thinking styles, likely due to teaching approaches and curricula that emphasize critical thinking and balance in problem-solving (Ma-Kellams, 2020). Practical experiences during studies also shape their thinking styles, as students involved in practical activities tend to apply critical thinking and maintain balance in their approaches (Sucilestari et al., 2023; Widiastuti et al., 2023).

The lack of significant differences in thinking styles across years suggests that students at all levels have similar capabilities in mastering creative, critical, and balanced thinking styles. This consistency may be due to the university's supportive and consistent learning approaches throughout the study period (Suwistika et al., 2024). Early-stage students may already have a strong foundation, enabling continuous development without significant differences as they advance (Greiff et al., 2015).

Overall, the study indicates that while there is variation in student thinking styles, there are no significant differences by year of study. Factors such as teaching approaches, curricula, and practical experiences may influence student thinking styles more than their year of study. Educational institutions should continue to support the development of critical and balanced thinking to prepare students for workplace and daily life challenges effectively.

5.4 Conclusion

This study successfully achieved its main objective of measuring and comparing the creative, critical, and balanced thinking styles among undergraduate vocational education students at FPTV UTHM. It also examined the relationship between these thinking styles and the students' year of study. From the extensive discussion of findings, several key conclusions can be drawn to understand the context, challenges, and implications in TVET education.

Firstly, the study provides a clear picture of the thinking styles among TVET students, particularly within the Bachelor of Vocational Education (General Machining) program at University Tun Hussein Onn Malaysia. The analysis indicates that these students exhibit a strong tendency towards critical and balanced thinking styles. Creative thinking, while present, is not as dominant. In the first year, students tend towards balanced thinking, likely due to initial adaptation to the university's academic environment. By the second year, there is an increase in critical thinking as students face more complex academic challenges. The third year shows a slight rise in excellent creative thinking, though critical thinking remains dominant. In the fourth year, students demonstrate a balance between critical and balanced thinking styles, reflecting their academic maturity.

Overall, the study concludes that the creative, critical, and balanced thinking styles of undergraduate vocational education students at FPTV UTHM are dynamic and evolve with their academic progression. Although there is variation in students' thinking styles, no significant differences were found based on the year of study. This indicates that other factors, such as teaching approaches, curriculum, and practical experiences, may have a greater influence on students' thinking styles than their academic year. Therefore, educational institutions should continue to support and encourage the development of critical and creative thinking among students through effective teaching approaches and a conducive learning environment.

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