



Thinking Styles among Technical Students in TVET: Differences in Thinking Styles by Students' Demographic

Nuraffefa Hamdan¹, Yee Mei Heong^{1*}, Tee Tze Kiong¹, Badaruddin Ibrahim¹,
Mimi Mohaffyza Mohamad¹, Kok Boon Ching², Nurulwahida Azid³

¹Faculty of Technical and Vocational Education,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, MALAYSIA

²Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, MALAYSIA

³School of Education and Modern Languages,
Universiti Utara Malaysia, 06010 Sintok, Kedah, MALAYSIA

DOI: <https://doi.org/10.30880/jtet.2021.13.01.006>

Received 04th January 2021; Accepted 22nd January 2021; Available online 31st March 2021

Abstract: A thinking style is the way an individual acquires, processes and organises information, as well as forming ideas and views, solving problems, making decisions and articulating self-expression. Each individual has his or her own style of thinking in learning, solving problems, or even in designing products. The purpose of this study is to analyse the pattern of Chua thinking styles among technical students. A total of 351 technical students comprising of Civil Engineering, Mechanical Engineering and Electrical Engineering students at Sultan Abdul Halim Muad'zam Shah Polytechnic were randomly selected as the study sample. The design of this study was a form of survey study using a quantitative approach. The Yan Piau Creative-Critical Styles Test, developed by Chua (2004), was used as the research instrument. Data were analysed using SPSS software and presented in the form of mean, frequency, and percentage. The findings show that the dominant thinking style is the balanced thinking style, with 166 respondents (47.3%). It is followed by the critical thinking style in 153 respondents (43.6%) and the creative thinking style in 32 respondents (9.1%). However, none of the students has a high creative thinking style and a high critical thinking style. The findings also show that there is no statistically significant difference in Chua thinking styles by gender, age, years of study and field of study. In general, it can be concluded that technical students are most inclined to a balanced thinking style, which is to have a balanced thinking in terms of creative and critical thinking styles. As such, an individual's thinking style will have an impact on learning to solve problems in product design.

Keywords: Thinking style, technical students, TVET, critical, creative, demographic factors

1. Introduction

The Malaysian Ministry of Education (MOE) launched the Malaysian Education Blueprint 2015–2025 (Higher Education) or MEB (HE) on April 7, 2015, as a guideline to meet the challenges to the country's higher education system. MEB (HE) outlines 10 shifts to achieve its system aspirations and student aspirations. The goal of the 4th shift in MEB (HE), which is the quality of TVET graduates, is to provide a main TVET education to improve skills to meet the demand and increase the opportunities for career advancement. Therefore, TVET plays an important role in producing a young generation of students with the skills needed to be competitive in the job market.

Partnership for 21st Century Skills (2010) emphasized that students need to be prepared for their careers by the education system incorporating 21st-century skills well as technical education into the entire system. Students who master

*Corresponding author: mhyee@uthm.edu.my

21st-century skills with critical, creative, and innovative thinking abilities and skills would be able to compete globally (Ismail, Sidek & Mahbib, 2015).

To get the best results for students to have critical and creative thinking, the students' thinking styles should be known first (Hashmi, Shahibuddin & Hazlinda, 2018). Thinking style refers to the method of processing information about individual choice and using it in the execution of tasks (Fan, 2016). Fouladi and Sahidi (2016) argued that thinking style is a mental framework that describes information-processing and problem-solving abilities in special situations. Findings indicate that thinking style influences academic achievement (Sternberg, Grigorenko & Zhang, 2008; Kinshuk, Liu & Graf, 2009; Cheng, Andrade & Yan, 2011). Thus, in recent decades, intellectual style, especially thinking style, has been considered a determinant variable in academic achievement (Lei, 2018; Saif, 2017; Sadeghi et al., 2017).

Each student has different styles in terms of learning and logical thinking ability, and they face problems and challenges in different ways (Negahi, Nouri & Alireza, 2015). Negahi, Nouri, and Alireza (2015) explained that thinking style has a relationship with problem solving, decision making, and academic achievement. Early exposure by students during the teaching and learning process will build a strong foundation in the effort to produce a generation of steady thinking (Ambotang, 2014). Without knowing the thinking style of the students, it is difficult for a teacher to provide teaching strategies and materials that best suit the learning style and thinking of the students (Chua, 2010). This is because thinking style is the way we are most interested or fond of when using knowledge to solve problems (Soenarto, 2011).

However, a study of Kanesan Abdullah et al., (2012) found that technical students do not master the style of thinking well. According to Ali and Noordin (2010), one of the causes of the problem is the lack of emphasis on teaching the style of thinking during the teaching and learning process. This can be evidenced by a survey study conducted on 300 technical students in polytechnics, which showed that 162 (54%) technical students perceived that they have a low level of knowledge of critical and creative thinking styles. A total of 166 (55.3%) technical students also perceived that they have a low level of application of critical and creative thinking styles. A study conducted by Yahya, Sidek, and Jano (2011) also found a lack of emphasis on critical skills in the technical education system. Moreover, the learning by students during lectures is not enough to learn critical and creative thinking (Md Yunos et al., 2011). A teacher or lecturer should know that students' poor performance is not always due to the lack of ability but due to the lack of proportion between the students' thinking style and the teacher's expectations (Negahi, Nouri & Alireza, 2015).

However, students' gender, age, years of study, and field of study can affect their thinking skills. This was proved by Anwar, Khizar, and Musarrat (2020), who clearly indicated that demographic variables are good predictors of creative thinking among undergraduate students. Shubina and Kulakli (2019) showed that gender has a significant impact on critical thinking and creativity skills. In addition, a study by Omar (2014) also showed that there are differences between creative and critical thinking with the students' field of study. A study conducted by Cassotti et al. (2016) also showed that age does influence creative thinking, depending on the task. To achieve one of the leaps in MEB (HE) 2015–2025, students need to learn thinking skills. To learn effective thinking skills, students' thinking styles need to be identified first. Accordingly, this study was conducted to identify patterns of creative and critical thinking styles among technical students. In addition, differences between creative and critical thinking styles by gender, age, years of study and field of study were also identified.

The specific objectives of this study are to:

- i) Identify the pattern of Chua thinking styles among technical students based on demographic factors.
- ii) Identify the differences between creative and critical thinking styles by students' gender.
- iii) Identify the differences between creative and critical thinking styles by students' age.
- iv) Identify the differences between creative and critical thinking styles by students' field of study.
- v) Identify the differences between creative and critical thinking styles by students' years of study.

2. Research Methodology

The design of this study was a form of survey study using a quantitative approach. This is because this study aimed to identify the patterns of creative and critical thinking styles among technical students. The population of this study consisted of all diploma students in the fields of Civil Engineering, Electrical Engineering, and Mechanical Engineering at Sultan Abdul Halim Muad'zam Shah Polytechnic, Jitra, Kedah. Based on the Sample Determinant Table by Krejcie and Morgan (1970), the sample size for this study was identified as a total of 351 students. Meanwhile, the size of the sample for each field was identified using stratified random sampling.

Table 1 - Population and Sample of Study (Student Affairs Division, 2016)

Fields	Population	Sample size
Civil Engineering	1505	158
Electrical Engineering	1196	82
Mechanical Engineering	781	111
Total	3482	351

2.1 Research Instrument

In this study, the researchers used the test form as the research instrument. This test form contained two parts, Part A and Part B, as shown in Table 2. Part A comprised items that collect the respondents' information. The demographic information was intended to encourage respondents to provide honest and accurate feedback. Part B contained 34 items related to creative and critical thinking styles. All items in this study were from The Yan Piaw Creative-Critical Styles Test (Chua, 2004). These test items were constructed based on the rationale that both creative and critical thinking styles can be identified, calculated, and represented by scores (Starko, 2004). This test has a special scoring concept. This is because each item is not based on the correct or incorrect answer. Accordingly, each answer given by the respondents will be taken into account if it is relevant. The scores for each respondent are taken into account using the formula in Figure 1. After obtaining the score, it will be compared using the YCREATIVE-CRITICAL scoring indicator in Figure 2. The result will explain five different indicators, on whether the respondent has a Superior Creative Thinking Style, Creative Thinking Style, Balanced Thinking Style, Superior Critical Thinking Style, or Critical Thinking Style. Table 3 show the YCREATIVE-CRITICAL scoring description for each thinking style.

Table 2 - Instrument of study

Part	Item	Item No.
A	Demographic of respondents	9
B	Creative and critical thinking styles (Chua, 2004)	34

$$\text{Score} = \frac{\text{Total mark for 34 items}}{\text{Total answer chosen}} = \underline{\hspace{2cm}}$$

Fig. 1 - YCREATIVE-CRITICAL Scoring Procedure

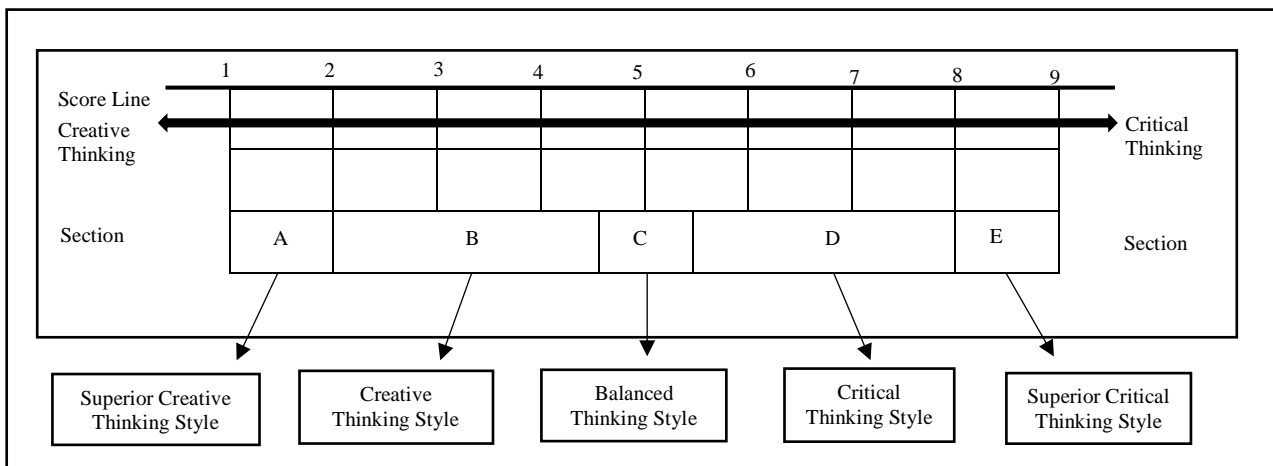


Fig. 2 - YCREATIVE-CRITICAL Scoring Indicator

Table 3 - YCREATIVE-CRITICAL Scoring Description

Type of Thinking Style	Indication
Superior creative	Able to produce original and creative ideas, but has less ability in evaluating the validity and significance of the ideas.
Creative	If critical thinking skill is improved, then the problem-solving ability will be doubled.
Balanced	Average creative thinking and critical thinking styles.
Critical	Problem-solving ability can be improved by enhancing creative thinking skill.
Superior Critical	Less ability in producing unique ideas in problem-solving situations, but superior in evaluating ideas in a logical and rational manner.

2.2 Data Analysis

In this study, descriptive statistics and inference statistics were used. Descriptive statistics are used to summarise a set of data, while inference statistics are used to generalise the population based on data from the population sample (Idris, 2013). Descriptive statistics use mean score and frequency, while inference statistics use independent *t*-test and ANOVA.

For normality test, skewness and kurtosis are used because this method is suitable and quite accurate for small and large samples (Kim, 2013). The results of normality tests have found that the data is normally distributed with test results' skewness (-0.21) and kurtosis (-1.10). The value of skewness and kurtosis considered to be normal by researchers are ± 1.0 (Leech et al., 2005) and ± 2.0 , respectively (Chua, 2008; Lomax & Hahs-Vaughn, 2012). In addition, if the *p*-value of the Levene's test (.504) is more than the significance level (0.05), the obtained differences in sample variances are likely to have occurred based on random sampling from a population with equal variances. Therefore, it can be concluded that there was no difference significantly between the variances in the population. In this study, the variance in the dependent variable, which was the mean of YCREATIVE-CRITICAL test scores across the categories of independent variables, such as gender, age, field of study and years of study, was the same. Thus, the study data met the variance requirements for the independent *t*-test and the ANOVA test.

3. Result and Discussion

Data analysis was done using SPSS 22.0 for Windows. With the use of SPSS, the results of the analysis were presented in terms of frequency, percentage, and differences.

3.3 Pattern of Chua Thinking Styles among Technical Students Based on Demographic Factors

Figure 3 (a) shows that most of the polytechnic students have a balanced thinking style, which was 166 respondents (47.3%), followed by critical thinking style with 153 respondents (43.6%) and creative thinking style with 32 respondents (9.1%). However, none of the students has a superior creative thinking style and a superior critical thinking style. A balanced thinking style has balanced thinking in terms of creative and critical thinking styles (Chua, 2004). A study conducted by Eldy and Sulaiman (2013) showed that around thirty-two percent of students' thinking style fall on the balanced thinking style. According to Chua (2004), a balanced thinking style is capable of solving problems by applying the skills with the whole part of the brain.

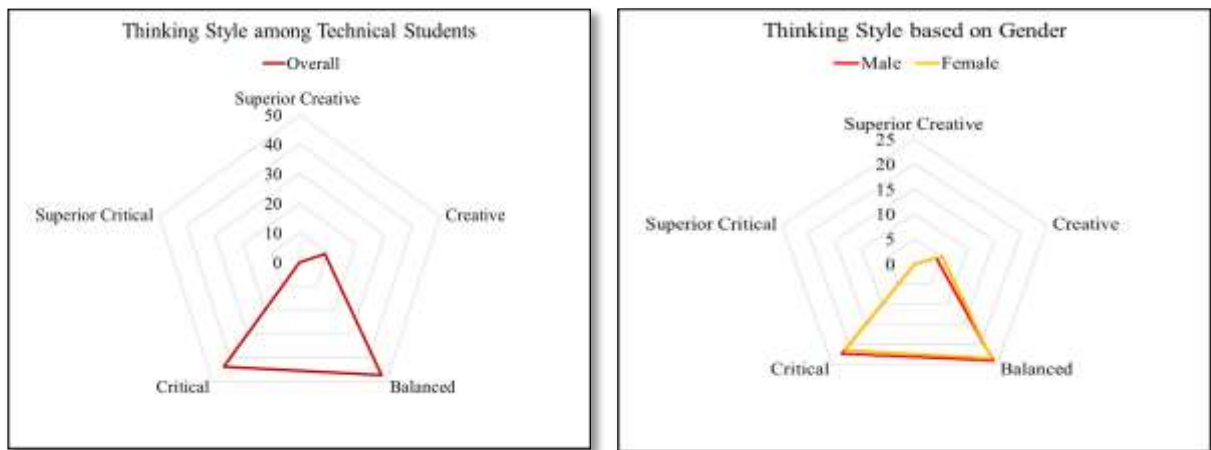


Fig. 3 - (a) Thinking Style among Technical Students

(b) Thinking Style Based on Gender

Result shown in Figure 3 (b), the dominant thinking style for male and female students is the balanced thinking style. A majority of male students have a balanced thinking style, which was 84 students (23.9%), while 78 students (22.2%) have a critical thinking style and 14 students (4.0%) have a creative thinking style. A majority of female students have a balanced thinking style, which was 82 students (23.4%), while 75 students (21.4%) have a critical thinking style and 18 students (5.1%) have a creative thinking style. The number of male and female students who have a balanced thinking style are approximately the same. This is due to the same assignments given by lecturers to all students to achieve the learning objectives that are set in the curriculum syllabus. Therefore, each student uses the same curriculum syllabus regardless of gender. The curriculum syllabus applied in polytechnics does not differ by gender (Ismail, 2016). This indirectly encourages male and female students to think in a balanced style, which is creative and critical thinking.

Figure 4 (a) shows that the most dominant age range is between 19 to 20 years old, which was 230 students (65.5%). For age 19 to 20, a majority have a critical thinking style, which was 103 students (29.3%), while 98 students (27.9%) have a balanced thinking style and 29 students (8.3%) have a creative thinking style. For the age group of 17 to 18 years

old, a majority have a balanced thinking style, which was 44 students (12.5%), while 32 students (9.1%) have a critical thinking style and 2 students (0.6%) have a creative thinking style. For age 21 to 22, a majority have a balanced thinking style, which was 20 students (5.7%), while 16 students (4.6%) have a critical thinking style and 1 student (0.3%) has a creative thinking style. Meanwhile, for age 23 to 24, a majority have a balanced thinking style, which was 4 students (1.1%), and 2 students (0.6%) have a critical thinking style. The findings of this study are in line with a study conducted by Eldy and Sulaiman (2013), which showed that students of age 20 show the highest number in critical thinking style compared with students of age 23, probably because the size of the sample for age 23 was the lowest among the age groups. A study by Lehman (1953) also showed that the peak of creative thinking occurs during the age of 18 to 25. Findings of a study conducted by Jaquish and Ripple (1980) also found that creativity occurs at the age of 18 to 25 for elements of language fluency and flexibility.

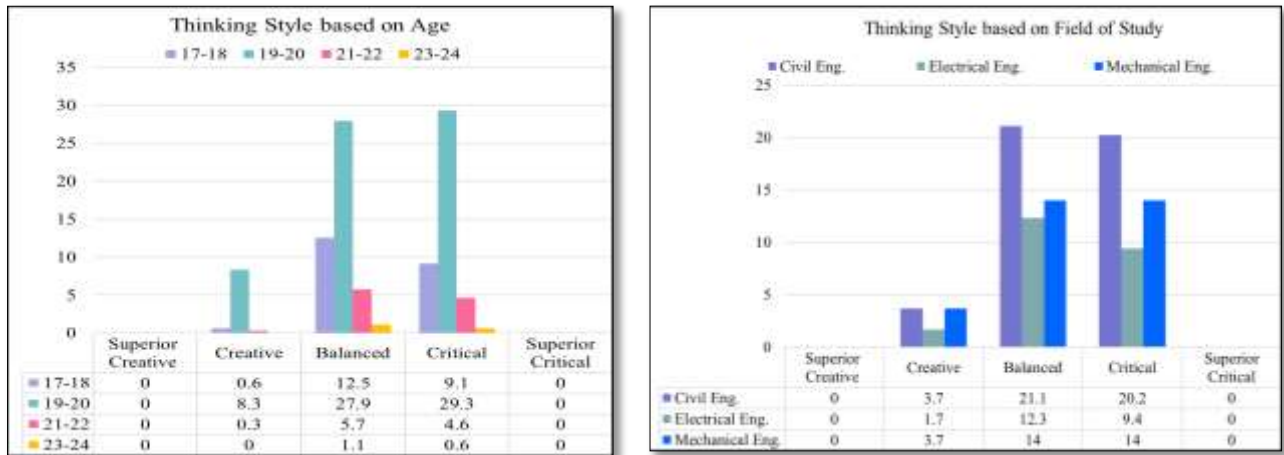


Fig. 4 - (a) Thinking Style Based on Age

(b) Thinking Style Based on Field of Study

Result shown in Figure 4 (b), the most dominant are students from the field of civil engineering. A majority of civil engineering students have a balanced thinking style, which was 74 students (21.1%), while 71 students (20.2%) have a critical thinking style and 13 students (3.7%) have a creative thinking style. Next, for the field of mechanical engineering, a majority have a balanced thinking style and critical thinking style, which was 49 students (14.0%), and 13 students (3.7%) have a creative thinking style. Meanwhile, for electrical engineering, a majority have a balanced thinking style, which was 43 students (12.3%), while 33 students (9.4%) have a critical thinking style and 6 students (1.7%) have a creative thinking style. Overall, students from all three fields of engineering have a balanced thinking style. This is because the teaching and learning methods used by the three fields are the same. According to the Malaysian Department of Polytechnic Education (DPE) (2011), student-centred learning is the main approach to the implementation of learning and teaching (T&L) to achieve the goals and learning outcomes of polytechnic study programmes. Thus, the teaching methods in technical field courses between the three fields are the same.

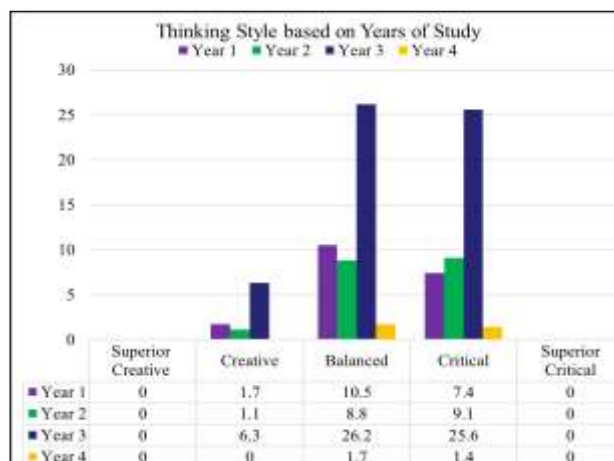


Fig. 5 - Thinking style based on years of study

Result shown in Figure 5, the most dominant years of study in Year 3, which was 204 students (58.1%). Year 3 shows that a majority of the students have a balanced thinking style, which was 92 students (26.2%), while 90 students (24.6%) have a critical thinking style and 22 students (6.3%) have a creative thinking style. This is followed by Year 1, which shows that a majority have a balanced thinking style, which was 37 students (10.5%), while 26 students (7.4%) have a creative thinking style and 6 students (1.7%) have a critical thinking style. Furthermore, Year 2 shows that a majority have a critical thinking style, which was 32 students (9.1%), while 31 students (8.8%) have a balanced thinking style and 4 students (1.1%) have creative thinking style. Meanwhile, for Year 4, a majority have a balanced thinking style, which was 6 students (1.7%), while 5 students (1.4%) have a critical thinking style. With an optimistic view of the research results on the differences seen between the junior and senior students, one can relate it to the positive effects of course training in cultivating critical and creative thinking as well as training problem-solving and decision-making skills (Kermansaravi, Navidian, & Kaykhaei, 2013).

3.3 Differences between Creative and Critical Thinking Styles by Students' Gender

Table 4 shows an independent *t*-test analysis to identify the significant differences in Chua thinking styles by gender. Findings show a significant value of $p = 0.897 > 0.05$, indicating that the result of this test does not reject the null hypothesis that there is no significant difference in Chua thinking style pattern between male and female students. The findings of this study are in line with a study conducted by Omar (2013), who stated that there is no significant difference in creative and critical thinking styles between male and female engineering students at University Tun Hussein Onn Malaysia. The findings of the present study also have similarities with a study conducted by Romeli (2012), who stated that there is no significant difference in the level of creative and critical thinking between students of different genders. A study by Coşkun (2018) also stated that there are no significant differences identified between genders in terms of cognitive thinking style. The reason for the present study's findings is that the male and female students are in the same class and field of study, receiving input, adjusting, and obtaining information at the same time. Therefore, all male and female students will have the same teaching and learning (T&L) effects. According to Maaroff (2013), the effectiveness of the T&L process will influence the lesson in thinking.

Table 4 - Independent *t*-test analysis for differences in chua thinking styles by gender

Gender	Sample size	Mean	Standard deviation	Significant value, P^*
Male	176	5.31	.729	.897
Female	175	5.30	.702	

*Significant difference at $p < 0.05$

3.4 Differences between Creative and Critical Thinking Styles by Students' Age

Table 5 shows the ANOVA test analysis to identify the significant differences in Chua thinking styles by age. Findings show a significant value of $p = 0.977 > 0.05$, indicating that the result of this test does not reject the null hypothesis that there is no significant difference in the pattern of Chua thinking styles by age of the students. The findings of a study conducted by Eldy and Sulaiman (2013) stated that there is no significant difference in age. The curriculum design of the polytechnic study programme is designed based on a student-centred learning approach, with active involvement of the students in the learning activity (Department of Polytechnic Education, 2013). Therefore, all students of every age are fully responsible for their own learning and do not depend entirely on the lecturer for them to learn.

Table 5 – ANOVA Test Analysis for Differences in Chua Thinking Styles by Age

Age	Sample size	Mean	Standard deviation	Significant value, P^*
17–18	78	5.28	.594	.977
19–20	230	5.32	.758	
21–22	37	5.28	.660	
23–24	6	5.33	.908	

*Significant difference at $p < 0.05$

3.5 Differences between Creative and Critical Thinking Styles by Students' Field of Study

Table 6 shows the ANOVA test analysis to identify the significant differences in Chua thinking styles by field of study. Findings show a significant value of $p = 0.226 > 0.05$, indicating that the result of this test does not reject the null hypothesis that there is no significant difference in the pattern of Chua thinking styles by the students' field of study. The findings of a study conducted by Romeli (2012) stated that there is no significant difference in the level of creative and critical thinking among students in different courses of study. Moreover, a study conducted by Aghaei, Souri, and Ghanbari (2012) also supported that there is no significant difference in the critical thinking skill between the physical

education students and the students in other fields of study. In the present study, the reason for the findings is that the teaching and learning methods used by the three fields are the same, namely Problem-Based Learning (PBL) (Instructional and Digital Learning Division, 2014). PBL is a trend of teaching and learning and teaching used in polytechnics and community colleges (Instructional and Digital Learning Division, 2014). The use of PBL can also influence students' thinking style (Kamal, 2008).

Table 6 - ANOVA Test Analysis for Differences in Chua Thinking Styles by Field of Study

Field of study	Sample size	Mean	Standard deviation	Significant value, P^*
Civil Engineering	158	5.37	.695	.226
Electrical Engineering	82	5.20	.736	
Mechanical Engineering	111	5.29	.723	

*Significant difference at $p < .05$

3.6 Differences between Creative and Critical Thinking Styles by Students' Years of Study

Table 7 shows the ANOVA test analysis to identify the significant differences in Chua thinking styles by years of study. Findings show a significant value of $p = 0.514 > 0.05$, indicating that the result of this test does not reject the null hypothesis that there is no significant difference in the pattern of Chua thinking styles by the students' years of study. The findings of a study conducted by Shirazi and Heidari (2019) showed no significant difference between total score and subscale of critical thinking and marital status, age, or years of education. This is because each course in any programme for each year of study uses three learning taxonomies, namely Cognitive, Psychomotor, and Affective (Department of Polytechnic Education, 2013). This is also because, in the education system, these skills can be acquired by students through methods and techniques that are arranged in accordance with the intelligence and abilities of students at all levels of education (Musa, 2020).

Table 7 - ANOVA test analysis for differences in chua thinking styles by years of study

Years of Study	Sample size	Mean	Standard deviation	Significant value, P^*
Year 1	69	5.22	.626	.514
Year 2	67	5.41	.719	
Year 3	204	5.30	.744	
Year 4	11	5.27	.667	

*Significant difference at $p < .05$

4. Conclusion

The results of this study show that technical students have a balanced thinking style. This balance can produce the sharpest thinking and, in turn, enhance learning and problem-solving. It is also believed that combining the two thinking processes—creative and critical thinking—can contribute to becoming a better thinker. More specifically, a thinker with critical and creative thinking abilities can have a full-cycle thinking mode, which in turn achieves momentum. Thus, students with the creative thinking style need to improve their critical thinking skills so that they will have a balanced thinking style. Similarly, for students who have the critical thinking style, their creative thinking skills should be sharpened in order to balance it. In addition, there are no statistically significant differences in Chua thinking styles by factors of gender, age, years of study, and field of study. Therefore, the effects of the teaching and learning sessions can be accomplished even though the students are different in terms of gender, age, years of study and field of study.

The information obtained from the findings of the study is very important for educators to know their students more in-depth and choose the appropriate teaching approach in implementing the teaching and learning process. Students can also use this information for self-improvement in the learning process to obtain excellent academic results and be prepared with the skills required in the 21st century. Most importantly, students can take advantage of both the way they think in academics as well as in their personal lives. They can have a policy of understanding and examining their assumptions and realizing that their thinking habits can restrict their chances of thinking outside the box.

It is suggested for educator to help in improving student's thinking style. This could be done with the use of self-instructional manual on thinking style. Through manual, students have the opportunity to understand their strengths and weaknesses in the learning process. In addition, this manual can accommodate individual differences based on their learning abilities, interests and level of application. The approach of using this manual, students can learn and be able to apply in learning according to their abilities. It is hoped that this study can help all parties in knowing the strengths and weaknesses of the students' thinking style and strive to increase their potential to become employees with high skills and knowledge.

Acknowledgement

The authors would like to express their appreciation to the Malaysian Ministry of Higher Education for supporting this research through MyRIVET Grant Vot No. K113. Apart from that, the author would also like to thank all the students and lecturers at Sultan Abdul Halim Muad'zam Shah Polytechnic (POLIMAS) for the support and cooperation given to make this study a success.

References

- Afsahi, S. E., & Afghari, A. (2017). The Relationship between Mother Tongue, Age, Gender and Critical Thinking Level. *Journal of Applied Linguistics and Language Research*, 4, 116–124
- Aghaei, N., Souri R., Ghanbari S. (2012). Comparison of the Relationship between Critical Thinking and Academic Achievement among Physical Education Students and Students in Other Fields of Study in Bu Ali Sina University, Hamedan. *Management of Sport and Movement Sciences*, 2(4), 35–45
- Ali, M., & Noordin, S. (2010). Hubungan Antara Kemahiran Berfikir Kritis Dengan Pencapaian Akademik Dalam Kalangan Pelajar Fakulti Pendidikan Universiti Teknologi Malaysia [The Relationship Between Critical Thinking Skills and Academic Achievement Among Students in the Faculty of Education, Universiti Teknologi Malaysia]. *Jurnal Teknologi*, 52, 44–45. <https://doi.org/10.11113/jt.v52.136>
- Ali, S. N., Khalid Khan, N. L., & Abdul Ghani, A. T. W. (2018). *Abad 21: Trend Pembelajaran dan Pengajaran Politeknik dan Kolej Komuniti Malaysia*. Putrajaya: Bahagian Instruksional dan Pembelajaran Digital, Jabatan Pendidikan Politeknik dan Kolej Komuniti, Kementerian Pendidikan Malaysia
- Ambotang, A. S. (2014). Menerapkan Kemahiran Berfikir. Minda Pendidikan. <http://eprints.ums.edu.my/8398/1/nc0000003879.pdf>. Accessed 23 October, 2020
- Anwar, M. N., Khizar, A., & Musarrat, A., (2020). Exploring Creative Thinking of Undergraduate Students through the Lens of Selected Demographic Variables. *NICE Research Journal*
- Cassotti, M., Camarda, A., Poirel, N., Houdé, O., & Agogue, M. (2016). Fixation Effect in Creative Ideas Generation: Opposite Impacts of Example in Children and Adults. *Thinking Skills and Creativity*, 19, 146–152. <https://doi.org/10.1016/j.tsc.2015.10.008>
- Cheng, H., Andrade, H. L., & Yan, Z. (2011). A cross-cultural study of learning behaviors in the classroom: From a thinking style perspective. *Educational Psychology*, 31(7), 825–841. <https://doi.org/10.1080/01443410.2011.608526>
- Chua, Y. P. (2004). *Creative and Critical Thinking Styles*. Serdang, Selangor: Universiti Putra Malaysia Press
- Chua, Y. P. (2008). *Asas Statistik Penyelidikan: Analisis Data Skala Ordinal dan Skala Nominal (Buku 3)*. Kuala Lumpur: McGraw Hill
- Chua, Y. P. (2010). Building a Test to Assess Creative and Critical Thinking Simultaneously. *Procedia - Social and Behavioral Sciences*, 2(2), 551–559. <https://doi.org/10.1016/j.sbspro.2010.03.062>
- Coşkun., Y. (2018). A Comparative Study on University Students' Rational and Experiential Thinking Styles in Terms of Faculty, Class Level and Gender Variables. *Universal Journal of Educational Research*, 6, 1863–1868. <https://doi.org/10.13189/ujer.2018.060902>
- Department of Polytechnic Education (DPE) (2011). *Dasar dan Prinsip Perancangan dan Penyampaian Kurikulum Program Pengajian [Planning Principles and Policy, and Program Curriculum Delivery]*. Accessed 23 October, 2020
- Department of Polytechnic Education (2013). *Manual Pembangunan Kurikulum Program Pengajian Politeknik*. Accessed 23 October, 2020
- Eldy, E. F., & Sulaiman, F., (2013). Integrated PBL Approach: Preliminary Findings Towards Physics Students' Critical Thinking and Creative-Critical Thinking. *International Journal of Humanities and Social Science Invention*, 2(3), 18–25
- Eldy, E. F., & Sulaiman, F., (2013). The Capability of Integrated Problem-Based Learning in Improving Students' Level of Creative-Critical Thinking. *International Journal of e-Education, e-Business, e-Management and e-Learning*, 3(4), 347–350. <https://doi.org/10.7763/IJEEEE.2013.V3.257>
- Fan, J. (2016). The Role of Thinking Styles in Career Decision-Making Self-Efficacy Among University Students. *Thinking Skills and Creativity*, 20, 63–73. <https://doi.org/10.1016/j.tsc.2016.03.001>
- Fouladi, N., & Shahidi, E. (2016). Creativity, Thinking Style and Mental Disorders. *Journal of Fundamental and Applied Sciences*, 8(2), 1726–1736. <https://doi.org/10.4314/jfas.v8i2s.110>

- Hashmi, A., Shahibuddin, I., & Hazlinda, H. (2018). A Role of Thinking Styles for Innovation, A Conceptual Framework with a Critical review of Literature. *Asian Journal of Multidisciplinary Studies*, 6(May), 68–75
- Idris, N. (2013). *Penyelidikan Dalam Pendidikan (Edisi Ke-2)*. Selangor: McGraw-Hill Education (Malaysia) Sdn. Bhd
- Instructional and Digital Learning Division (2014). *Garis Panduan Amalan Terbaik Konsep Pembelajaran Teradun bagi Politeknik-Politeknik Malaysia*. Accessed 24 April, 2017
- Ismail, M. H. (2012). Kajian Mengenai Kebolehpasaran Siswazah di Malaysia: Tinjauan dari Perspektif Majikan. *Prosiding PERKEM VII*, 2(2012), 906–913
- Ismail, N. H., Sidek, S., & Mahbib, U. K. (2015). Faktor Keberkesanan Pengajaran dan Pembelajaran Kemahiran Berfikir Aras Tinggi Abad Ke-21 bagi Pelajar Sains. *Seminar Kebangsaan Majlis Dekan-Dekan Pendidikan Universiti Awam 2015*, 14–15 September 2015, pp. 228–238
- Ismail, M. S. (2016). *Gaya Pembelajaran Dan Kemahiran Berfikir Aras Tinggi Dalam Kalangan Pelajar Teknikal*. Master's Thesis. Universiti Tun Hussein Onn Malaysia
- Jaquish, G. A. & Ripple, R. E. (1980). Divergent Thinking and Self Esteem in Preadolescents And Adolescents. *Journal of Youth and Adolescents*, 9(2), 143–152
- Kanesan Abdullah, A. G., Ismail, A, Abdullah, M. H., & Purba, M. (2012). Acquired and Required Competencies in Manufacturing Sector Graduates from Employers' and Employees' Perspective: The Malaysian Case. *Educational Research*, 3(2), 126–136
- Kinshuk, Liu, T., & Graf, S. (2009). Coping with Mismatched Courses: Students' Behaviour and Performance in courses Mismatched to Their Learning Styles. *Educational Technology Research and Development*, 57(6), 739–752. <http://doi.org/10.1007/s11423-009-9116-y>
- Krejcie, R. V, & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
- Kamal, S, (2008). *Status Pemikiran Kreatif Bakal Guru Di Fakulti Pendidikan Teknikal Universiti Tun Hussein Onn Malaysia*. Universiti Tun Hussein Onn Malaysia
- Kementerian Pendidikan Malaysia (2015). Ringkasan Eksekutif Pelan Pembangunan Pendidikan Malaysia 2015–2025 (Pendidikan Tinggi). Accessed 10 December, 2017. <https://www.ptsb.edu.my>
- Kermansaravi, F., Navidian, A., & Kaykhaei, A. (2013). Critical Thinking Dispositions Among Junior, Senior and Graduate Nursing Students in Iran. *Procedia - Social and Behavioral Sciences*, 83, 574–579
- Lehman, H.C. (1953). *Age and Achievement*. Princeton, NJ, USA: Princeton University Press
- Leech, N. L., Barrett, K. C., & Morgan, G. A. (2005). *SPSS for Intermediate Statistics: Use and Interpretation, 2nd Ed*. Mahwah, NJ, USA: Lawrence Erlbaum Associates
- Lomax, R. G., & Hahs-Vaughn, D. L. (2012). *An Introduction to Statistical Concepts, 3rd Ed*. New York, NY, USA: Taylors and Francis
- Lei, S. (2018). A Research on Thinking Styles and Communication Strategies. *International Conference on Social Sciences, Education and Management (SOCSEM) 2018*, pp. 877–882
- Maaroff, A. (2013). *Penggunaan Otak Kiri Dan Otak Kanan Dalam Gaya Berfikir*. Master's Thesis. Universiti Tun Hussein Onn Malaysia
- Md Yunos, J. et al. (2011). Technical & Vocational Education & Training (TVET) from Malaysia Perspective. *2nd International TT-TVET EU-Asia-Links Project Meeting*
- Musa, M. (2020). Investigation of the Relationship between Critical Thinking Levels and Academic Achievement Levels of Students in Faculty of Sports Science. *Educational Research and Reviews*, 15(7), 370–376
- Negahi, M., Nouri, N., & Khoram, A. (2015). The Study of Learning Styles, Thinking Style, and English Language Academic Self-Efficacy Among the Students of Islamic Azad University of Behbahan Considering Their Field of Study and Gender. *Theory and Practice in Language Studies*, 5(8), 1722–1729. <http://doi.org/10.17507/tpls.0508.25>
- Omar, S. (2014). *Kecenderungan Gaya Berfikir Kreatif Dan Kritis Dalam Kalangan Pelajar Kejuruteraan Di UTHM*. Master's Thesis. Universiti Tun Hussein Onn Malaysia
- Osterman, M. D. (2015). *Exploring Relationships between Thinking Style and Sex, Age, Academic Major, Occupation, and Levels of Arts Engagement among Professionals Working in Museums*. FIU Electronic Theses and Dissertations. Paper 2277. <http://digitalcommons.fiu.edu/etd/2277>

- Partnership for 21st Century Skills (2010). *Up to the Challenge: The Role of Career and Technical Education and 21st Century Skills in College and Career Readiness*. USA: Partnership for 21st Century Skills, Association for Career and Technical Education, and National Association of State Directors of Career Technical Education Consortium
- Romeli, N. (2012). *Tahap Kemahiran Berfikir Kreatif Dan Kritis Dalam Kalangan Pelajar Diploma Pendidikan Lepas Ijazah Universiti Tun Hussein Onn Malaysia*. Master's Thesis. Universiti Tun Hussein Onn Malaysia
- Sadeghi, J., Ejei, J., Lavasani, G. M., & Abaszadeh, N. (2017). Making Predictions of the Academic Achievement of the Students of Imam Ali Military University Based on Thinking Styles. *A Research Quarterly in Military Management*, 17(65), 1–28
- Saif, A. A. (2017). *Modern Educational Psychology (Psychology of Learning and Instruction)*, 7th Ed. Tehran, Iran: Dowran Publishing Company
- Shirazi F., & Heidari, S. (2019). I Relationship between Critical Thinking Skills and Learning Styles and Academic Achievement of Nursing Students. *Journal of Nursing Research*, 27(4), e38. <https://doi.org/10.1097/jnr.0000000000000307>
- Shubina, I., & Kulakli, A. (2019). Critical Thinking, Creativity and Gender Differences for Knowledge Generation in Education. *Literacy Information and Computer Education Journal*, 10, 3086–3093
- Soenarto, S. (2011). Pengaruh Strategi Pembelajaran dan Gaya Berpikir Terhadap Hasil Belajar Fisika. *Prosiding Seminar Nasional Penelitian, Pendidikan dan Penerapan MIPA*, Fakultas MIPA, Universiti Negeri Yogyakarta, 14 May 2011
- Starko, A. J. (2004). *Creativity in the Classroom: School of Curious Delight*. New York, NY: Longman
- Sternberg, R. J., Grigorenko, E., & Zhang, L. (2008). Styles of Learning and Thinking Matter in Instruction and Assessment. *Perspectives on Psychological Science*, 3(6), 486–506. <https://doi.org/10.1111/j.1745-6924.2008.00095.x>
- Yahya, A., Sidek, S., & Jano, Z. (2011). Critical Thinking Skills among Final Year Students of Malaysian Technical Universities. *Malaysian Technical Universities International Conference on Engineering & Technology*