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Insights of Using Mobile Application to Assess Creative and Creative Thinking of Indonesian Students

Wahyu Ridhoni[a,*], Tesdiq Prigel Kaloka[a], Punaji Setyosari[b], Dedi Kuswandi[b], Saida Ulfa[b]

[a]*Department of Informatics Engineering, Hasnur Polytechnic, Barito Kuala, Indonesia*
[b]*Department of Learning Technology, Faculty of Education Science, State University of Malang, Malang, Indonesia*

Abstract

World education organizations such as UNESCO and OECD have determined that creative and critical thinking are core 21st-century skills essential for students to master. Indonesia also views these two skills as very important, thus formulating creative and critical thinking into two of the six dimensions of the Pancasila Learner Profile. This study analyzes the data we collected during a creative and critical thinking assessment experiment with university students using the CC Thinker android application. The investigation was conducted on 46 participants with three assessment sessions. The research results showed that Creative Thinking in men showed a higher value than women. The Critical Thinking of men is more consistent than women. Creative Thinking of undergraduate students is more consistent than D3 students. However, the Critical Thinking of undergraduate students has increased. Creative Thinking of exact students is higher than non-exact students. In Critical Thinking, exact students develop as continuous exams are carried out. Creative thinking of students outside Java or Java is equal but in critical thinking Javanese students are better than students outside Java.

Keywords: Assessment, Creative Thinking, Critical Thinking, Pancasila Learner Profile.

1. Introduction

The Indonesian Ministry of Education and Culture formulated the Pancasila Learner Profile as a vision to shape the character of education system graduates in Indonesia. Critical reasoning and creativity are two of the six dimensions in the Pancasila Learner Profile, where these two abilities are needed in lifelong learning for decision-making and generating ideas (Kemendikbudristek, 2022).

This Issue is in line with the OECD (2019b), which considers the importance of both abilities. In the OECD Learning Compass 2030, there are references to learning creative and critical thinking. OECD (2019a) also developed PISA 2021, designed to measure creative thinking. In addition, UNESCO (2014) also suggested that the focus of assessment should shift from traditional academic knowledge to creativity and critical thinking.

The importance of creative and critical thinking in today's digital era is based on the fact that electronic systems and machines are taking over more and more jobs. Only non-routine cognitive jobs are difficult to replace (Heath, 2020; The Economist, 2016), and require creative and critical thinking skills. Since the first literature incorporating the importance of these two types of thinking was written by Moore (1967), these two abilities have become increasingly important. They are two of the four core 21st-century skills (Battelleforkids.org, 2020).

This study was conducted to confirm the research of Perdana et al (Perdana et al., 2019), which states that male students' creative thinking is better than female students and female students' critical thinking is better than male students. This starting point directs the development not only to look at gender differences in creative and critical thinking but also to look at differences in education levels, types of study programs, and regions. Research questions are detailed as follows:

a. How do male and female students compare in creative and critical thinking?
b. How do D3 and S1 students compare in creative and critical thinking?

* Corresponding author.
E-mail address: xxxx@xxxxxx.edu

c. How do Exact and Non-Exact students compare in creative and critical thinking?
d. How do Java and Outer Java students compare in creative and critical thinking?

2. Literature Review

Although these two abilities may seem contradictory, they are interconnected and complementary (DiYanni, 2016). Table 1 makes the comparison explicit.

Table 1. Creative Thinking vs Critical Thinking

Creative Thinking	Critical Thinking
Intuitive	**Analytical**
Taking action in a spontaneous and random moves	Taking action in an orderly and logical move
Innovation	**Problem Solving**
Finding a method to gain more than what has been achieved	Finding a method of achieving the expected results that was failed to gain
Alternative Making	**Decision Making**
Aiming at creating a various alternatives	Aiming at deciding out of several alternatives choices
Possibility	**Probability**
Taking action without any definite assurance	Taking action based on a definite assurance
Imagination	**Data**
Based on an imagination to be proved in the future	Based on valid data gained as the proof
Divergent	**Convergent**
Deconstruct one unity into several different parts	Combining differences into one unity
New Direction	**Right Direction**
Avoiding the previous direction to explore the new one	Avoiding the wrong direction to reach the right direction
Lateral	**Vertical**
Finding solutions in an abnormal or uncommon method	Finding a solution in a normal method that is commonly used

Creative thinking and critical thinking are part of the 4C Skills or 21st century skills including communication, collaboration, critical thinking, and creativity (Fuldiaratman & Ekaputra, 2023; Harizon & Ekaputra, 2023). To foster these two abilities, innovation in learning and integrating them into subjects associated with digital learning technology is needed. Such innovation and integration are encouraged by school principals to motivate teachers (Khoirul Anwar et al., 2022). For students, creative thinking and critical thinking can be used in problem-based learning so that later they can continue to be used in real life outside school (Riwayatiningsih, 2022). Of the two, creative thinking requires extra attention because it is considered more difficult (Ahmar et al., 2023). Creative projects are needed to foster the ability to develop new ideas (Adzra et al., 2024).

3. Research Methods

Usually, research for creative and critical thinking is done with a quasi-experimental approach (Putri et al., 2023), where there is a control group and an experimental group. However, in this study, two groups were divided into each criterion according to the research question. Data were obtained from 46 participants consisting of 24 males (52.2%) and 22 females (47.8%). The 46 students comprised 31 undergraduate students (67.4%) and 15 D3 students (32.6%). The Exact majors were 35 people (76.1%) and non-exact 11 people (23.9%). The distribution of regions with 30 people from outside Java (65.2%) and 16 people from Java (34.8%). All 46 participants did three assessment sessions to see if there was a change in scores in the measurement of creative and critical thinking between sessions. The assessment was carried out based on android mobile using the CC Thinker Assessment application, which is available on Google Play (Figure 1). The data visualization was analyzed using python with the Seaborn library version 0.11.2.

On the CC Thinker Assessment application, Parse (C1), Deviate (C2), and Modify (C3) serve as the sub-test in creative thinking. The correlation among the three previous theories is illustrated in figure 2. Meanwhile, Verify (C4), Compare (C5), and Conclude (C6) are selected as the sub-test for critical thinking, and the correlation among the three previous theory is illustrated in figure 3 (Ridhoni et al., 2022). The average score of Parse (C1), Deviate (C2), and Modify (C3) is the score for Creative Thinking and the average score of Verify (C4), Compare (C5), and Conclude (C6) is the score for Critical Thinking (Ridhoni et al., 2023).

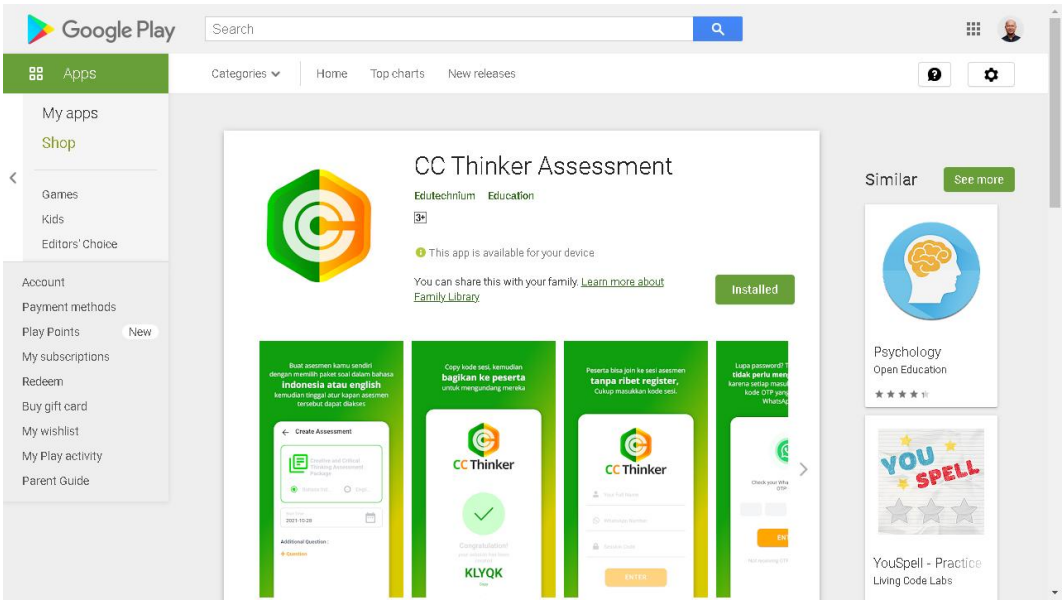

Figure 1. CC Thinker Assessment Application in Google Play

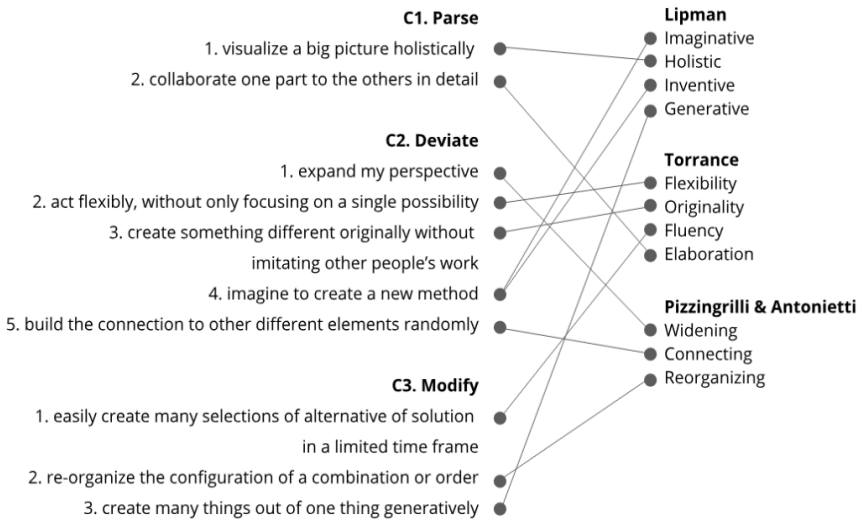

Figure 2. Construct of Creative Thinking

4. Results and Discussion

There was an increase from session to session, both in creative and critical thinking, as shown in Table 2. The average score for critical thinking was higher than for creative thinking. Deviate (C2) is the creative thinking sub-test with the highest score, and Conclude (C6) is the critical thinking sub-test with the highest score. These results were consistent from the first session to the third session. The average value of creative thinking from sessions 1 to 3 is included in the moderate category (50-75). The average weight of critical thinking from sessions 1 to 2 is in the medium category, and session 3 is in the high category (>75).

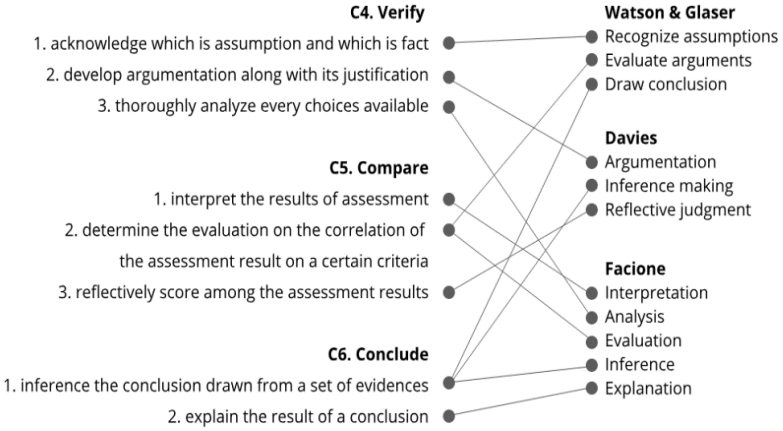

Figure 3. Construct of Critical Thinking

Table 2. Mean score of creative and critical thinking

Session	C1	C2	C3	C4	C5	C6	Creative	Critical
1	67.37	70.54	41.12	62.14	68.96	78.74	59.68	69.95
2	70.48	77.89	57.09	67.93	71.75	83.06	68.48	74.25
3	74.23	83.00	63.93	75.18	71.18	84.30	73.72	76.89

4.1. Comparison of Gender

The distribution of Creative Thinking scores, in the first exam shows that the median score (Q2) of males is 61.7 higher than the Q2 of females which is only 52.4. In addition, in the first exam, the distribution of women's Creative Thinking scores was wider, as shown by the larger boxplot shape. The comparison of male and female Creative Thinking in the second exam showed similar results to the first exam. The distribution of men's Q2 is higher than that of women. What is different is that there is an increase in the Q2 value of men and women. The male Q2 was at 72.3 and the female Q2 was at 62.2. In the last exam session, there was another increase in the Creative Thinking scores of males and females. The male Q2 was 75.1 and the female Q2 was 74.9.

Another thing that can be compared is the Critical Thinking between male and female students, namely the Critical Thinking of men in the first exam is lower than that of women, as seen from the male Q2 is 72 and the female Q2 is 72.6. In the first exam, the distribution of women's scores was more diverse, even the lowest score of women was smaller than men. In the second exam session, women's Critical Thinking was higher than men. Another thing that can be observed from the second exam is the increase in Critical Thinking scores of men and women. In fact, the most interesting thing is in the results of the last exam session. Men's Critical Thinking scores were higher than women's. The male Q2 was 82.4 and the female Q2 was 78.7. Another interesting thing is the third session female Q2 which is 78.7 and the second session female Q2 which is 80.8. There was a decrease from the second session to the third session.

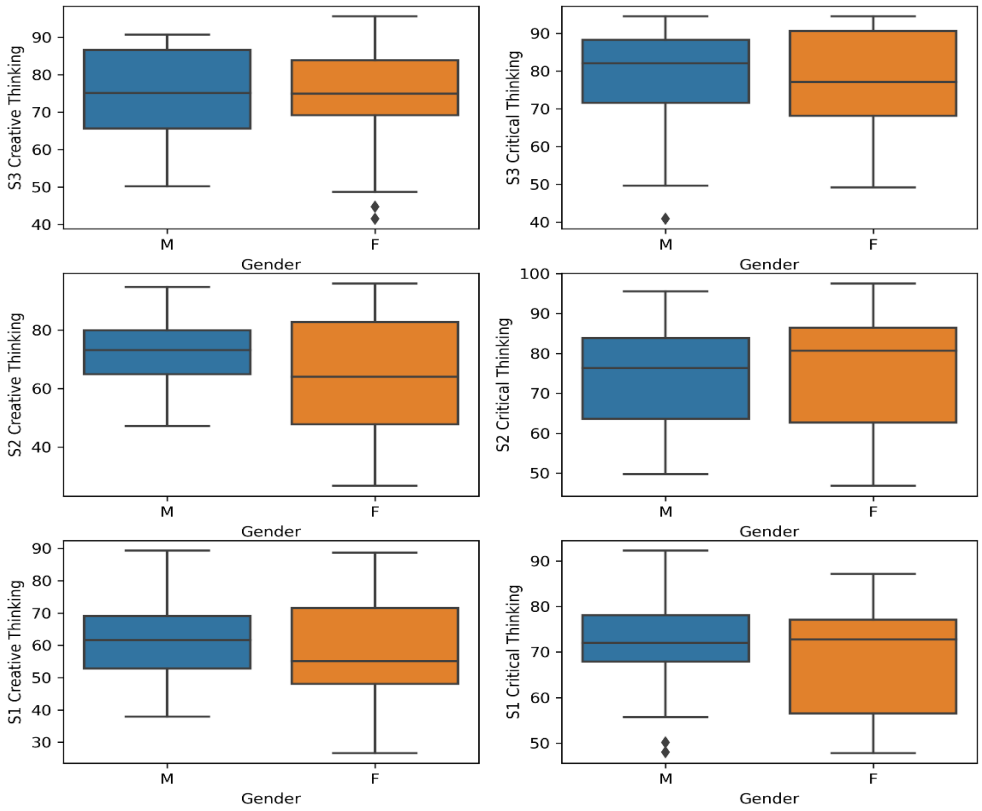

Figure 4. Comparison of Creative and Critical Thinking Data Distribution by Gender

4.2. Comparison of Education Levels

There are 31 students with an undergraduate education level and 15 students at the D3 level. From these two levels of education, we can see the comparison of Creative Thinking and Critical Thinking as shown in Figure 5. In the first exam session, the distribution of Creative Thinking scores of undergraduate students was smaller than D3 students, with the Q2 S1 value being 55.1 and Q2 D3 being 62.7. In the second exam session, the same thing happened again. Creative Thinking undergraduate students are smaller than D3 students. Q2 S1 value in the second session was 70.2 and Q2 D3 value in the second session was 79.7. Different results were seen in the third exam session, the Creative Thinking value of undergraduate students was higher than D3 students. More specifically, we can see that the Creative Thinking value of undergraduate students was initially relatively low, with a Q2 value of only 55.1.

Based on Figure 5, it can be seen again the comparison of Critical Thinking scores of undergraduate and D3 students. In general, Critical Thinking of undergraduate students in the first, second, and third exam sessions is always higher than that of D3 students. Interesting things can be seen in the Critical Thinking value of D3 students there is a decrease in value in the third exam session. In the second exam session the D3 Q2 value was 73.7 while the third exam session Q2 dropped to 69.9.

4.3. Comparison of Study Program Types

A comparison of the Creative Thinking scores of students majoring in exact and non-exact majors can be seen in Figure 6. In the first exam, the median score was 59.04, the second exam was 71.39 and the third exam was 78.65. Furthermore, for non-exact (yellow) students, when examined more specifically, there are changes but not striking. Specifically, in the first exam, the median score was 55.21, the second exam was 63.78 and the third exam was 66.35.

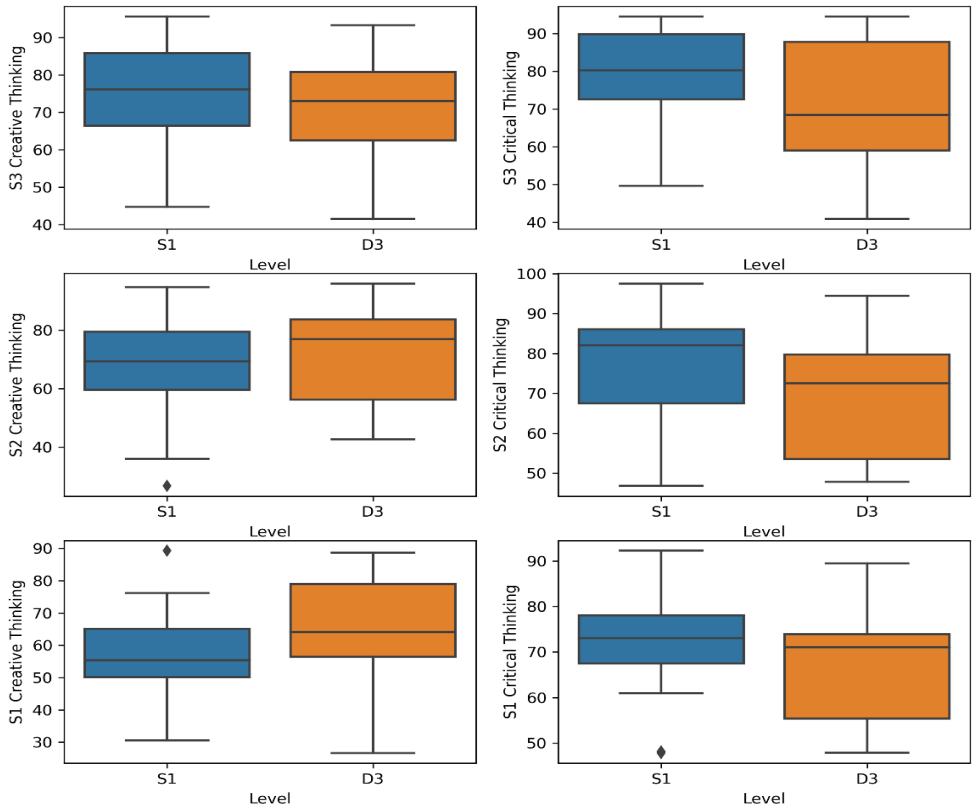

Figure 5. Comparison of Creative and Critical Thinking Data Distribution with Education Levels

Another comparison that we can look at is between Critical Thinking with exact and non-exact majors. Based on Figure 6, there are several interesting things that we can see. First, the distribution of exact value data increases in each exam process. For the distribution of non-exact score data, it increased from the first exam to the second exam, but in the third exam the distribution of data decreased when compared to the distribution of the second exam data. More specifically, in the second exam, the distribution of exact values is greater than that of non-exact values. In the exact Critical Thinking score, the data is spread between 61 to 85 while the non-exact is 76.5 to 84.4. This indicates that in the second exam, students with non-exact majors have a more uniform mindset than those with exact majors.

4.4. Comparison of Regions

Other data that can be seen is the comparison of Creative Thinking and Critical Thinking features is the location of the student's college as shown in Figure 7. The distribution of Creative Thinking data for students outside Java and Java seems to increase in each session. If seen more specifically, then in the first exam, the distribution of data for students outside Java 58.2 and Java 60.1 is similar, in the second exam there is a distribution of scores of students outside Java 68.6 lower than Javanese students 71.8 and in the third exam the distribution of Javanese students is higher 79.8 than outside Java 72.5.

The next comparison that we can see is the critical thinking score of students outside Java and Java. In general, the critical thinking of Javanese students is higher than that of students outside Java. Specifically, there are things that are quite interesting in the first exam, outside Java students are 72.6 and Java students are 72.9. In the second exam, students outside Java were 73 and Javanese students were 84.1. In the last exam, the Q2 value of students outside Java was 74.2 and Q2 of Javanese students was 87.9.

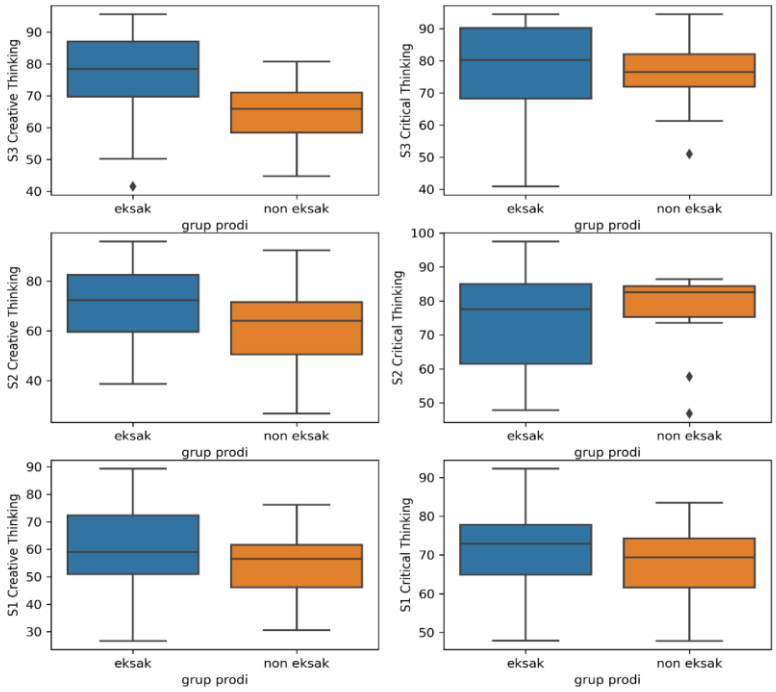

Figure 6. Comparison of Creative and Critical Thinking Data Distribution with Student Majors

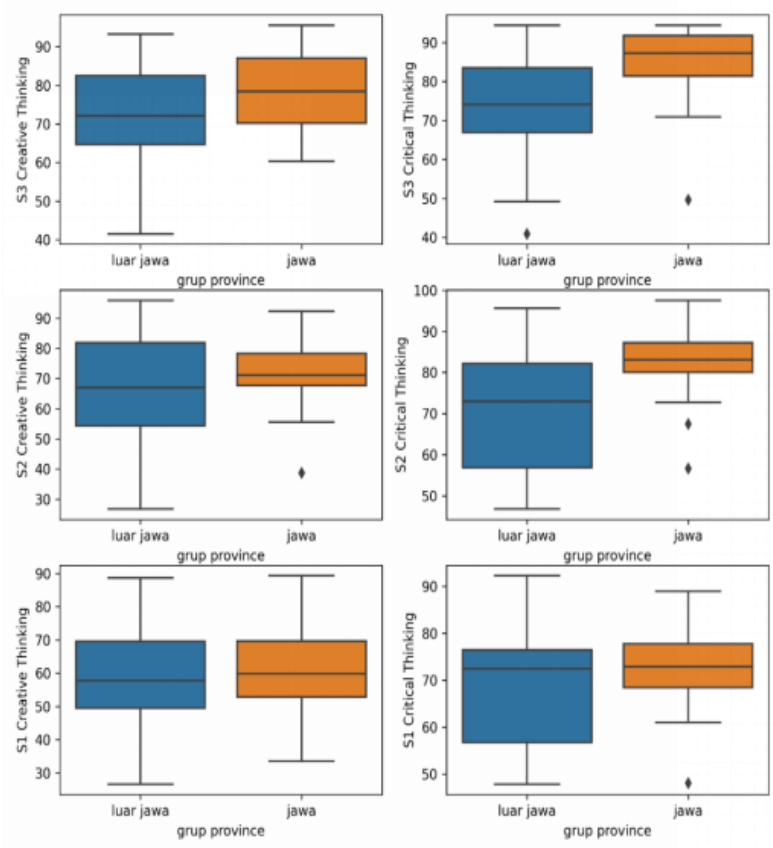

Figure 7. Comparison of Creative and Critical Thinking Data Distribution with Regions

5. Conclusion

Male Creative Thinking showed higher scores than female Creative Thinking. In addition, the Creative Thinking scores of both males and females continue to increase as the test is conducted continuously. The Critical Thinking of men is more consistent but slow to start while women experience a decline if the exam is conducted continuously. Along with the continuous exams, the adaptation of undergraduate students is seen with an increase in grades for each session. Different thing happened to the Creative Thinking score of D3 students, the score increased from the first session to the second session, but the score dropped in the third exam session. This means that D3 students cannot be said to always improve. From the comparison results, it can be concluded that the development of Creative Thinking of undergraduate students is more consistent than D3 students. As for Critical Thinking, the pattern that occurs is similar to the comparison of Creative Thinking. It is quite clear that Critical Thinking undergraduate students are more consistent in improving grades.

It is also clear that the distribution of Creative Thinking value data of exact students is higher than non-exact students. But not only that, if we look more carefully, the distribution of exact students' scores has increased for each exam. Specifically, Creative Thinking of students majoring in exact sciences is better than students majoring in non-exact sciences. As for Critical Thinking, exact students develop along with continuous exams, while non-exact students cannot be said to develop continuously. The data also shows that it cannot be concluded that creative thinking of students outside Java or Java is better. As for critical thinking, Javanese students are better than students outside Java.

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