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Gender Differences in Mathematics Ability of Junior High School Students based on Bloom's Taxonomy

Jeri Araiku[1*], Rhodinus Sidabutar[2], Jackson Pasini Mairing[3]

[1] Universitas Sriwijaya, Palembang, Sumatera Selatan 30139, Indonesia
[2,3] Universitas Palangkaraya, palangkaraya, Kalimantan Tengah 73111, Indonesia

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Abstrak

Tujuan dari penelitian ini adalah untuk menganalisis perbedaan kemampuan matematika dalam domain taksonomi bloom berdasarkan gender. Penelitian ini merupakan penelitian kuantitatif dengan 156 siswa sebagai sampel yang terdiri atas 81 laki-laki dan 75 perempuan. Uji anova dua jalur digunakan pada penelitian ini, dengan LSD (*Least Significant Difference*) dan HSD *(Honestly Significant Difference*) sebagai uji lanjutan. Hasil analisis menunjukkan bahwa seluruh uji prasyarat untuk analysis varians terpenuhi. Dari uji anava dua jalur, diperoleh hasil bahwa $F_{hitung} > F_{tabel}$ pada $\alpha = 0.05$ ($F_{hitung} = 10.57$ dan $F_{tabel} = 2.22$) yang berarti terdapat interaksi antara gender dan level kognitif siswa. Uji LSD menunjukan bahwa pada level C1 (mengingat), siswa laki-laki lebih baik dibandingkan perempuan. Tetapi, tidak terdapat perbedaan performa siswa laki-laki dan perempuan secara keseluruhan. Uji HSD menunjukkan terdapat perbedaan signifikan pada performa siswa pada level C1 (mengingat), C2 (memahami), dan C3 (menerapkan), namun tidak di C4 (menganalisis), C5 (mengevaluasi), dan C6 (menciptakan). Oleh sebab itu, penting untuk merancang pembelajaran untuk meningkatkan kemampuan berpikir tingkat tinggi siswa.

Kata kunci: gender; taksonomi bloom; level kognitif; kemampuan matematika

Abstract

The purpose of this research is to analyze the difference of students' mathematics ability in bloom's taxonomy domain based on gender. This research is quantitative research with 156 students taken as sample, consisted of 81 male and 75 female students. Two-way anova employed in this study, with LSD (*Least Significant Difference*) and HSD *(Honestly Significant Difference*) as post hoc test. The results showed that all assumption tests for variance analysis wee fulfilled. From two-way anova test, obtained the result that $F_{count} > F_{table}$ at $\alpha = 0.05$ ($F_{count} = 10.57$ dan $F_{table} = 2.22$) which meant that there was interaction between gender and students' cognitive level. LSD test showed that at level C1 (remember), male students performed better than female groups. However, there was no difference between both groups for overall performance. HSD test also revealed that there was significant difference on students' performance in C1 (remember), C2 (understand), and C3 (apply), but not in C4 (analyze), C5 (evaluate), and C6 (create). Therefore, it's important to design mathematics instruction to promote students higher order thinking.

Keywords: gender; bloom's taxonomy; cognitive level; mathematics ability

*Correspondece Author
Email Address: jeriaraiku@fkip.unsri.ac.id
Handphone : +62 852 5277 8248

I. Preliminary

Gender is a concept that raises many questions and is examined by many parties. In the world of research and education, the concept of gender is important to be explored. The reason for consistently considering gender in implementation research is multidimensional. Gender are important in policy-making to equality (Cuadrado, García-Ael, & Molero, 2015), preferences for the uptake of interventions (Stanley, Ellis, Farrelly, Hollinghurst, & Downe, 2015), also to add insight and enrich strategic intervention for instruction (Uluç, 2017). Furthermore, without proper study, implementation strategies may inadvertently exploit or ignore, rather than transform thinking about gender-related factors (Tannenbaum, Greaves, & Graham, 2016).

According to Sasongko (2009), gender is the difference in roles, functions, and responsibilities between men and women which are the results of social construction and can change according to the times. The difference between women and men is essentially the result of socio-cultural construction resulting in different roles and tasks. This difference is seen as a nature as a result of biological differences (sex) which causes the way to treat men and women differently. Therefore, in order to survive, they must adapt to circumstances that make them more or less different in nature between men and women. This adaptation influenced their attitude, motivation, and even school performance.

On the other hand, gender and education are always interesting to be studied, due to no certainty in results regarding gender and school achievement (Hannover & Kessels, 2011; Stanat, Pant, Böhme, & Richter, 2012; Weis, Heikamp, & Trommsdorff, 2013). For example, Spinath, Freudenthaler, & Neubauer (2010) stated the importance of behavior and motivation based on gender differences in school achievement. They found that a higher level of social life has strong correlation with higher grades for girls but lower grades for boys. Pomerantz, Altermatt, & Saxon (2002) noted that girls’ attitude tends to please adults to a higher degree than do boys, which leads to girls' higher school grades.

Gender is also associated with students’ mathematical abilities very often (Lindberg, Hyde, Petersen, & Linn, 2010; Mcphan, Morony, Pegg, Cooksey, & Lynch, 2008; Strand, Deary, & Smith, 2006). Some mixed evidences suggest that there is a relationship between gender and one's mathematical abilities that could be explained in part by a higher variance of boys' in comparison to girls' school achievement (Machin & Pekkarinen, 2008). The research revealed by Bailey, Watts, Littlefield, & Geary (2014) suggests that at the elementary school level, female students have better mathematics achievements than male students. This is because in working on the questions, female students work more carefully, while for male students, they tend to solve the problems quickly because they are not afraid to be wrong (Bailey et al., 2014). Because they are not careful, they tend to have many incorrect answers and hence the learning outcomes are still under the female students.

But gradually, this pattern of thinking will actually have a reverse impact on learning outcomes when they enter 7th grade and above. Male students will have better results than female students, because they are trained to be faster in thinking compared to female students, with a better level of accuracy than when they were in elementary school. This Bailey’s statement is supported by the research results of Niederle & Vesterlund (2010), stating that there are different responses from men and women in terms of competition. Their research resulted in the fact that men have a greater competitive nature than women. Furthermore, they also explained that there was an influence of competition on the results of mathematics tests.

On the other hand, several studies also mention that gender does not affect a person's mathematical abilities (Hannover & Kessels, 2011). One of them is research conducted by

Cerezo Rusillo & Casanova Arias (2004), where gender does not affect the performance of students achieved in mathematics. Prior study by Hall & Hoff (1988) also stated that there were no significant differences in students' mathematical performance based on gender differences.

Many research try to connect gender and mathematical ability based on motivation, self-regulation, behavior, and mathematics achievement (Cerezo Rusillo & Casanova Arias, 2004; Cleary & Chen, 2009; Lindberg et al., 2010). But the next questions that arise are, “do the differences in abilities found in male and female students occur at all levels of cognitive intelligence?” If their abilities are the same, “do they apply at all levels of cognitive intelligence?”. To date, little to no studies have classified these differences into levels of cognitive intelligence. The conclusions in these studies are still general in nature, meaning that they have not been divided based on the level of one's cognitive intelligence.

In the learning process, assessment for the cognitive domain is the clearest to be measured. According to Anderson & Krathwohl (2003), based on Bloom's Taxonomy, a person's cognitive intelligence is divided into 6 levels, namely: (1) Remember (C1); (2) Understand (C2); (3) Apply (C3); (4) Analyze (C4); (5) Evaluate (C5), and; (6) Create (C6). For the cognitive domain, it can be assessed using practice questions. With the different levels of ability in the cognitive domain, the questions faced by students can also be modified to have different levels of difficulty according to the levels from C1 to C6. Based on the theories disclosed by (Anderson & Krathwohl, 2003), (Fisher, 2005), (Alfeld, 2012), (Krulik, S., Rudnick, J., & Milou, 2003), the criteria of cognitive ability can be seen on Table 1.

Table 1.
Matrix of cognitive ability criteria

Bloom’s Taxonomy		Cognitive Ability Criteria
C1	1.	Recalling mathematics formula, definition, or theorem.
	2.	Pairing elements from two sets.
C2	1.	Transforming mathematical sentences to symbol.
	2.	Making examples and non-examples of a mathematical concept or principle.
	3.	Determining mathematical concept or principle from given example.
	4.	Conjecturing the relation stated in equation which giving some data from some variables
	5.	.
	6.	Explaining mathematics concepts and facts in simpler way.
C3	1.	Using mathematics concepts and principles in doing mathematical procedures (for familiar or not familiar problems).
C4	1.	Determining relevant numbers or statements to solve mathematical problems.
	2.	Making scheme from a set of mathematical formula.
	3.	Explaining causality of mathematics relation.
C5	1.	Giving assessment to a mathematics solution based on internal and external criteria.
	2.	Evaluating two alternative methods, which one is the most effective and efficient.
	3.	Generating conclusion based on mathematics knowledge.
C6	1.	Using alternatives to solve mathematical problems.
	2.	Making plans to solve mathematical problems.
	3.	Solving open ended problem and giving justification towards the solution.
	4.	Producing original, effective, and complex mathematics product.

*Essenced from (Anderson & Krathwohl, 2003), (Fisher, 2005), (Alfeld, 2012), (Krulik, S., Rudnick, J., & Milou, 2003).

Therefore, based on the importance and contribution described above, the purpose of this research is to discover the difference of mathematical cognitive ability based on gender from the perpective of Bloom’s taxonomy.

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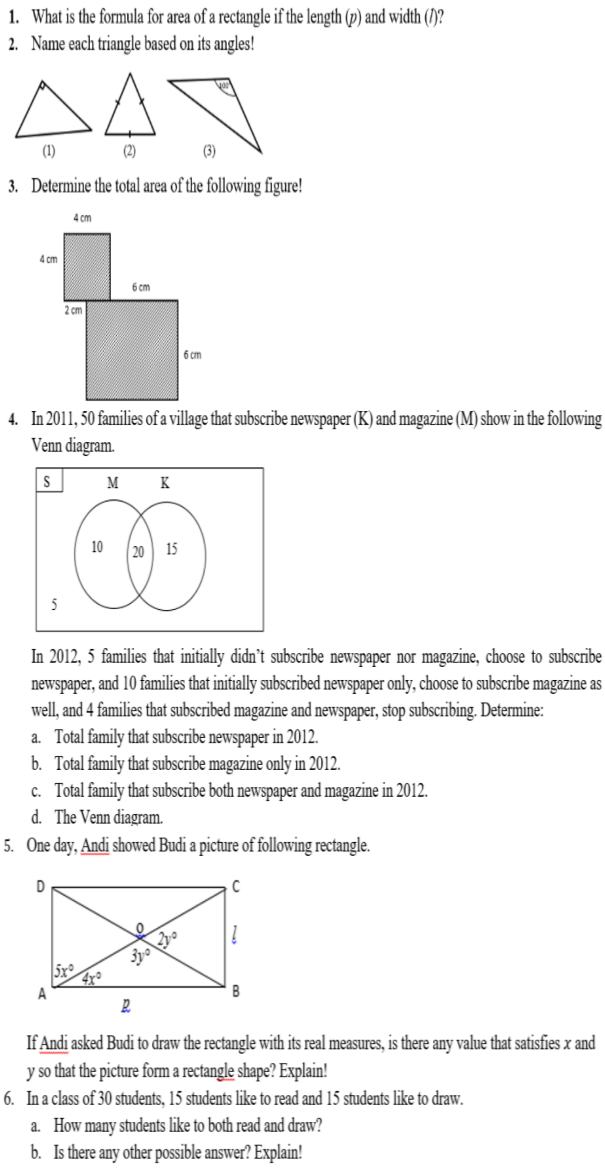
II. Research Method

This study is quantitative research. In this study, researchers conducted a *cross-sectional survey*, by giving tests without artificial treatment to the research subject. The instrument was a test consisted of 6 questions, where each question represents Bloom’s level of cognitive as shown in Figure 1. The materials tested in this research were geometry and set.


1. What is the formula for area of a rectangle if the length (p) and width (l)?
2. Name each triangle based on its angles!
3. Determine the total area of the following figure!
4. In 2011, 50 families of a village that subscribe newspaper (K) and magazine (M) show in the following Venn diagram.

In 2012, 5 families that initially didn’t subscribe newspaper nor magazine, choose to subscribe newspaper, and 10 families that initially subscribed newspaper only, choose to subscribe magazine as well, and 4 families that subscribed magazine and newspaper, stop subscribing. Determine:
a. Total family that subscribe newspaper in 2012.
b. Total family that subscribe magazine only in 2012.
c. Total family that subscribe both newspaper and magazine in 2012.
d. The Venn diagram.
5. One day, Andi showed Budi a picture of following rectangle.

If Andi asked Budi to draw the rectangle with its real measures, is there any value that satisfies x and y so that the picture form a rectangle shape? Explain!
6. In a class of 30 students, 15 students like to read and 15 students like to draw.
a. How many students like to both read and draw?
b. Is there any other possible answer? Explain!

Figure 1. Test item

The research design in this study is factorial design. The results obtained will be classified according to the problem categories based on Bloom's Taxonomy. The design of classification of the results is shown in Table 2.

Table 2.
Design of research results

Gender	Learning Achievement					
	$C1$	$C2$	$C3$	$C4$	$C5$	$C6$
Male	$YMC1$	$YMC2$	$YMC3$	$YMC4$	$YMC5$	$YMC6$
Female	$YFC1$	$YFC2$	$YFC3$	$YFC4$	$YFC5$	$YFC6$

Where:
$YiCj$ = Test result of gender i at cognitive level j.
i = Male (M), Female (F)
j = $1, 2, 3, 4, 5, 6$

Population in this study were 263 8^{th} grade students of one junior high school in Palangkaraya, consisting of 137 males and 126 females. The sampling technique in this study is cluster random sampling, by determining the number of samples using a formula developed by (Isaac & Michael, 1995). From 263 subject, with significance level of 5% (0.05), and degrees of freedom (df) = 1, obtained total sample of 156 students. Subsequently determining sample size is based on the gender ratio, therefore the samples used were 81 male students and 75 female students.

The hypothesis in this study is whether there are differences in mathematics learning achievement between male and female students at each cognitive intelligence level C1 to C6. The hypothesis test used is a Two-way anova. The test employed for two main reasons: (1) the analysis consisted of two independent variables (gender and bloom’s taxonomy, and (2) the analysis should be done at once (to preserve the 5% alpha). Before conducting a Two-way anova test, we will perform assumption tests underlying the analysis of variance (Gaspersz, 1994), namely: linearity, normality, homogeneity, and randomness of errors. The linearity test is done by determining the general linear model for the factorial design factorial. The normality test performed is to use visuals from the normal curve by making a histogram of the residual data of the students' test results. To test the homogeneity, a plot is made between the standard residuals and the estimated value of fit (Groeneveld, 1988). Randomness of errors testing is by creating a residual histogram versus order. The requirement for randomization of the error is said to be fulfilled if the points on the histogram spread randomly around 0.

If the two-way anova test shows that the interaction effect is different, then the researcher will conduct post hoc tests to find out the different components of the results of the study, namely the LSD (Least Significant Difference) test and the HSD (Honestly Significant Difference) test. The LSD test aims to determine the differences in mathematical abilities between male and female students at certain cognitive levels. While the purpose of the HSD test is to determine whether or not the influence of Bloom's Taxonomy or real differences has occurred.

III. Result and Discussion

Descriptive Result

The average score of male and female student groups can be seen in Figure 2.

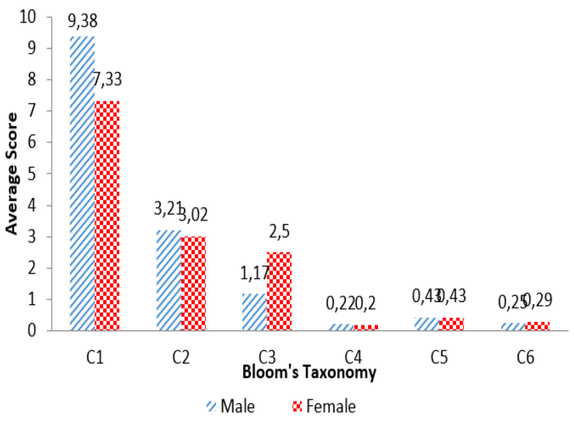


Figure 2. Average score of male and female students

Based on the bar diagram above, it can be seen that:

1. At the cognitive level C1, the average score of male is higher than that of female students. The average value of male is 2.05 or 27.97% higher. Researchers suspect that male have better mathematical abilities in level C1. Example of student's answer is showed in Figure 3.

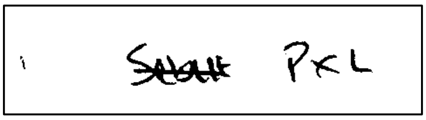


Figure 3. Student's answer for C1

2. At the cognitive level of C2, the average value of male is higher than that of female, but this difference is very small, which is only 0.19 or 6.29%. So, it can be said that at level C2 there is no significant difference. The researchers suspected that there were no differences in mathematical abilities in male and female in the C2 category.
3. At the C3 cognitive level, there is a significant difference that is equal to 1.33 or 113.68%. But at this cognitive level, higher mean values are actually female students. With a difference of 113.68%, it can be said that female students are twice as good as male. Researchers suspect that female have better mathematical abilities in the C3 category.
4. At the cognitive level C4, C5, and C6, there is no significant difference, because all the differences are below the 0.05 level. Even for the C5, there is no difference at all. All students couldn't solve the problem properly, since the problem required not only procedural computation, but also analysis and evaluation. For example in C5, students stated that there's value of x and y so that the plane could form a rectangle. However, if we put any x and y of student's answer, it will not forming the shape of rectangle, since there's no value of x and y that satisfied the condition. Both groups of subjects got a mean of 0.43. Researchers suspect that there is no difference in mathematical abilities between male and female in the C4, C5 and C6 categories. Example of student's answer for item C5 is showed in Figure 4.

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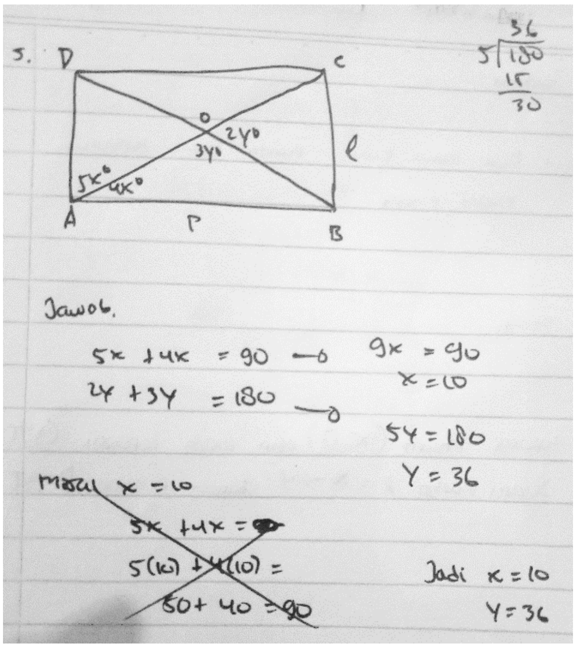

Figure 4. Student's answer for C5

The comparison of the score from each group against the total average, can be seen in Table 3.

Table 3.
Average value

	C1	C2	C3	C4	C5	C6	Avg
M	9.38	3.21	1.17	0.22	0.43	0.25	2.44
F	7.33	3.02	2.5	0.2	0.43	0.29	2.3
Avg	8.36	3.12	1.84	0.21	0.43	0.27	

From Table 3, it can be seen that:

1. For male students, when compared to the average value, only C1 and C2 values exceed the average value, while for C3, C4, C5, and C6 it is below the value of 2.44.
2. For female students, when compared to the average value, the values C1, C2, and C3 exceed the average value, while for C4, C5, and C6 are below the value of 2.3.
3. The average value of male students is higher compared to female students. Thus, it can be concluded that overall, the value of male students is better than female students.

Assumption Tests

The assumptions that need to be fulfilled before perform the two-way Anova test are 4, namely as follows:

1. Linearity

The general linear model of this study is:

$$Y_j = MC_1\beta_1 + MC_2\beta_2 + MC_3\beta_3 + MC_4\beta_4 + MC_5\beta_5 + MC_6\beta_6 + FC_1\beta_7 + FC_2\beta_8 + FC_3\beta_9 + FC_4\beta_{10} + FC_5\beta_{11} + FC_6\beta_{12} + \varepsilon_j$$

Where:
Y_j = response variable in linear combination.
β_l = parameter (coefficient) for each explanation variable x_{jl}.
ε_j = residual value for each Y_j .
MC_i = Male for taxonomy level of bloom i.
FC_i = Female for taxonomy level of bloom i.

Linearity is fulfilled if the effect of treatment is additive. Additive means that it can be summed according to a particular model (Gaspersz, 1994). Because the research model is additive, the assumption of linearity is fulfilled.

2. Normality test

Normality is seen in Figure 5 of the normal curve by using histograms of residual data from the research results with calculations using the help of the Minitab16.2.

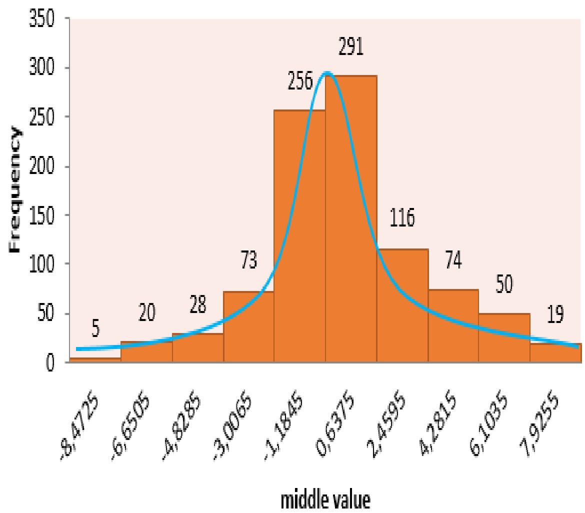

Figure 5. Residual histogram test results

In Figure 4, the distribution value of residual data tends to be normal, even though the normal curve looks sharp.

3. Homogeneity Test

In Figure 6, it can be seen that the points are spread on both the positive and negative sides of the residual. Therefore the residual data meets the requirements of homogeneity test.

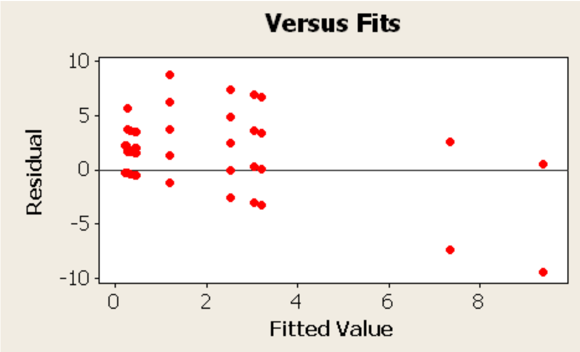

Figure 6. Residual versus fit histogram

4. Randomness of errors

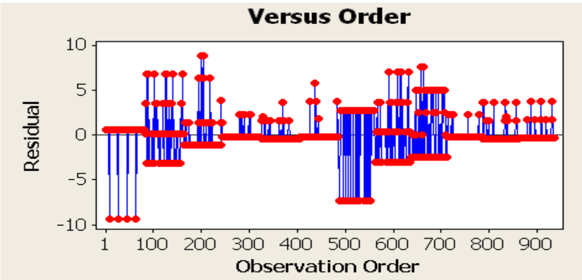

Figure 7. Residual versus Order Histogram

In Figure 7, it can be seen that the points are scattered randomly around 0. Thus, the residual data meets the randomization requirements of the error.

Based on the assumption tests, researchers tend to use the two-way anova test to determine the differences in cognitive ability of male and female students due to the following reasons:

1. Assumptions for two-way anova testing tend to be fulfilled.
2. There are no non-parametric statistics that correspond to the two-way anova with a factorial design.
3. If the researcher compares each combination of research components one by one (for example by the student t-hypothesis test), with each test using a significant level of 5%, then with 6 tests, the researcher will make a mistake of 1 - (0.95) ^{6} = 26. 49%. (Gaspersz, 1994).

Two-way Anova Test

From the data obtained, it can be seen that the average score of male students ($\bar{X}_l = 2.44$) showed better results compared to female student test scores ($\bar{X}_p = 2.295$). However, the result is not convincing if not analyzed further. To test the statistical analysis hypothesis, a two-way analysis of variance was used.

Based on the results of the two-way anova test, the results are as follows.

Table 4.
Summary of two-way anova test

Variance Source	df	Total Square	Mean Square	F count	F table
Bloom's Taxonomy	5	7808.55	1561.71	286.02	2.22
Gender	1	4.93	4.93	0.9	3.85
Interaction (bloom × gender)	5	288.65	57.73	10.57	2.22
Error	924	5048.07	5.46		
Total	935	13090.2			

For interactions between Bloom's Taxonomy and gender, based on df (5:924), then F_{table} = 2.22 for α = 5%. The value of F_{count} = 10.57 > F_{table}. Because the value of F_{count} is more than the value of F_{table}, then H_o is rejected and H_a is accepted. This means that there is an interaction between certain levels of cognitive intelligence based on Bloom's Taxonomy and gender differences in student mathematics achievement.

Because of the real influence of the interaction, the researcher will conduct a post hoc test, namely the LSD test, to see the mathematics ability difference of male and female students at a certain cognitive level, and HSD test to see differences in each category in bloom's taxonomy.

LSD Test

Based on the calculation, the LSD value of 1.5627 is obtained. Because the value $|\bar{Y}_L - \bar{Y}_P| = 0{,}87 < LSD_{0{,}05} = 1{,}5627$, thus, it was concluded, the overall ability of male and female students is not significantly different. The overall ability is not significantly different, meaning that the mean scores of the total scores obtained by the male and female student groups do not differ. But in the two-way anova test, the

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interaction between gender and bloom's taxonomy was significantly different. This means that there are at least one pair of LC_i and PC_i that is differ. After investigate the result deeper, the results are as follows:

1. $|\bar{Y}_{LC1} - \bar{Y}_{PC1}| = 2{,}05 > LSD_{0,05} = 1{,}5627$, then the ability of male and female students at C1 is significantly different.
2. $|\bar{Y}_{LC2} - \bar{Y}_{PC2}| = 0.19 < LSD_{0,05} = 1{,}5627$, then the ability of male and female students at C2 is not significantly different.
3. $|\bar{Y}_{LC3} - \bar{Y}_{PC3}| = 1{,}33 < LSD_{0,05} = 1{,}5627$, then the ability of male and female students at C3 is not significantly different.
4. $|\bar{Y}_{LC4} - \bar{Y}_{PC4}| = 0{,}02 < LSD_{0,05} = 1{,}5627$, then the ability of male and female students at C4 is not significantly different.
5. $|\bar{Y}_{LC5} - \bar{Y}_{PC5}| = 0 < LSD_{0,05} = 1{,}5627$, then the ability of male and female students at C5 is not significantly different.
6. $|\bar{Y}_{LC6} - \bar{Y}_{PC6}| = 0{,}04 < LSD_{0,05} = 1{,}5627$, then the ability of male and female students at C6 is not significantly different.

HSD Test

Based on calculations, the results of the HSD value is 0.231. The difference value of the average absolute value for each level of bloom's taxonomy can be seen as follows.

Table 5.
Different of average absolute value

	C4	C6	C5	C3	C2	C1
Avg	0.21	0.27	0.43	1.835	3.115	8,335
Diff	0.08	0.16	1.405	1.28	5.22	

The HSD value is compared with the absolute difference between the two average values with the criteria:

1. For the two averages are said to be no different, if the absolute difference is less than or equal to HSD.
2. For the two treatment averages are said to be different, namely if the absolute difference is more than HSD.

Thus, it can be concluded as follows:

1. The level of knowledge of students in C4, C5, and C6 there is no difference.
2. The level of students 'knowledge on C4, C5, and C6, is different from the level of students' knowledge on C3.
3. The level of students 'knowledge on C3 is different from the level of students' knowledge on C2. In other words, the level of knowledge of students C4, C5, and C6, is also different from students' knowledge on C2.

The level of student knowledge at C2 is different from the level of knowledge of students in C1. In other words, the level of knowledge of students C4, C5, and C6, is also different from the knowledge of students in C1, and the level of students' knowledge on C3 is also different from the level of knowledge C1 in students.

Disscussion

From Figure 2, we can see that students' average score are consistently decreasing as the cognitive level higher. It means higher cognitive level means harder and more complex problem the students have to solve. If we separate the results, C1 to C3 level (lower order thinking skills) are practically higher than C4 to C6 (higher order thinking skills). There several reasons that potentially cause this phenomenon.

1. The nature of cognitive level is overlapping (see Figure 8). In order to master C1, we don't need to master C2 to C6, or in order to have good computation skill (C3), one doesn't necessary need to master C4 to C6. On the other hand, in order to master C2, mastering C1 is a must. Or in order to possess creative thinking skill, all C1 and C5 must be mastered.

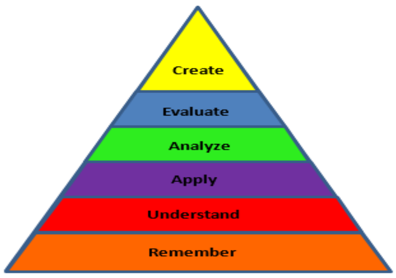

Figure 8. Thinking pyramid

2. The instructions don't take higher order thinking skill (HOTs) learning process into count. Teachers are not considering the importance of HOTs in learning process (Bahar, 2011). It's general sense that education is transferring knowledge from all learning resources to students. This process can take many forms, i.e. demonstration, direct learning, instructional media, and practices (Walle, J., Karp, K., & Williams, 2010). Teacher needs to put students to solve mathematical problem (Susanti et al., 2016), since the learning process mostly depends on the teacher, i.e. to design the instruction as effective as possible to let the students develop their HOTs, from determining the learning objectives, employing various teaching method (like inquiry and problem based learning), through designing HOTs practices (Limbach & Waugh, 2010). This is important to maximize the potential of HOTs which students basically already have.
3. Students' attitude towards solving higher level problems isn't good. Some research suggests that there is strong connection between students' belief, anxiety, and self-regulation towards mathematics learning achievements (Ahmad Tarmizi & Suthar, 2010; Cleary & Chen, 2009).
4. Transition from Lower order thinking skill (LOTs) to higher order thinking skill (HOTs) are not fully develop. In order to solve HOTs, it takes more comprehensive understanding towards mathematical concepts, including algebraic thinking ability. Since C4 to C6 problems handed to students demand algebraic thinking ability, most students made mistakes in solving the problems. This result in line with result from (Pratiwi & Kurniadi (2018), where students still made errors while performing negative number operations even when the transition indicator of the ability of arithmetic thinking to the ability of algebraic thinking achieved well.

In this study it was also known that in the cognitive domain of C1, male were better than female students. The C1 question is quite easy, most students could answer correctly. However, while majority of male students answered that item correctly, around a quarter of total female student left blank answer to the question (see Figure 2).

One of the potential reason is on how male and female brain works. This is supported by the fact revealed by (Gurian, 2002), that the male and female brains are basically different. Boys' brains are better suited to recognize symbols, forms of abstraction, diagrams, images and moving objects than monotonous words. For this reason, Gurian concluded that male are superior in mathematics and physics, especially when the subject is taught abstractly in front of the class.

However, even when there is significant different in C1, there is no significant different of overall score between male and female group. Since the difference is only found in the cognitive domain of C1, so the contribution that causes a difference is in a small total value.

IV. Conclusion

From the result, it shows that there is interaction between gender and bloom's taxonomy. After LSD test, there are no significant difference at cognitive level C2 (understand), C3 (apply), C4 (analysis), C5 (evaluate), and C6 (create), while there is significant difference at level C1 (remember), where male performed better than female students. However, overall performance doesn't show any significant different. It's because that the difference only happen in C1, therefore is it's compared with total score, the contribution of C1 is relatively small. One factor that may cause this is because male and female brain works differently (Gurian, 2002). Boys' brains are better suited to recognize symbols, forms of abstraction, diagrams, images and moving objects than monotonous words. For this reason male are superior in mathematics and physics, especially when the subject is taught abstractly in front of the class.

Furthermore, students' performance is

decreasing as the level of problem increasing. Based on HSD test, there is significant different in cognitive level C1, C2, and C3, while no significant difference in C4, C5, and C6. Many causes could be the factors, like the nature of cognitive level is overlapping, instructional process doesn't consider HOTs to be implemented, students' attitude towards mathematics, and transition from arithmetic to algebraic thinking is underdeveloped. However, these assumptions need to be taken further research. The most important thing for mathematics practitioners, especially teachers, to start consider to design mathematics instruction and employ all media necessary in order to help students develop their HOTs.

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