

# The Profile of Students' Critical Thinking Measured through Science Virtual Test on 9<sup>th</sup> Grade in The Theme of Living Things and Environmental Sustainability

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**ABSTRACT** The aims of this study are: (1) to investigate the level students' critical thinking skill on living things and environmental sustainability theme, (2) to examine the critical thinking difference among gender, learning styles, and students' motivation, and (3) to investigate the correlation between students' critical thinking and students' motivation. This research was conducted to get current skill description as the basic information to improve critical thinking in junior high school. The method of this study was descriptive research method which compiles both descriptive comparative and descriptive correlational that utilized the data collection and analysis techniques that results was concerned on measuring tendency, variation, comparison, and correlation. One hundred and ten students from three junior high school in Kuningan was tested with Science Virtual Test on Living Things and Environmental Sustainability Theme for 9<sup>th</sup> Grade as the measurement tool of critical thinking based on Inch critical thinking elements, and was given learning style questionnaire and science motivation questionnaire. Generally, the mean scores on six elements and overall critical thinking score from descriptive statistics showed a moderate critical thinking attainments level, with the range  $43.33 \leq \text{score} < 69.75$ , while other two elements showed low critical thinking attainments level ( $\text{score} \leq 43.33$ ). At significant level 0.05 there was no significant difference between male and female, and also there was no significant difference among visual, aural, read/write, and kinesthetic learning style in critical thinking, while significant difference was founded on three different students' motivation (Low, Moderate, High) groups on four critical thinking element skills. Hence to support the tendency, the correlation test is conducted. The correlation test shows there was no correlation between critical thinking and students' motivation ( $r = 0.155$ ,  $p = 0.81$ ).

**Keywords** Critical thinking, science virtual test, Students' learning style, Students' motivation.

## 1. INTRODUCTION

Throughout history, many diversified goal of education is set for honing the student's needs and reflecting a better and more relevant education (Kaufman, 2013). For instance, to get the better improvement in education the push for 21<sup>st</sup> century skills continuously launched. The 21<sup>st</sup> century skills are seen to be skills that students need for being successful. People believe that those skills are revolutionary skills that demand a new and different ability. But in fact, those skills which students needed is not new. Problem solving and critical thinking, as the example, which have been the components of human progress throughout history from the development of early tools, agricultural advancement, information literacy, to the global awareness (Rotherham & Willingham, 2010). Thus, 21<sup>st</sup> century skills show up as worthy challenge skills.

The ability to think critically appear as one of student's competence that encouraged by government on 2013 national curriculum (Kemendikbud, 2014). This ability is expected to be actualized in educational setting such as in science learning. On the explanation of the concept and implementation of 2013 curriculum (2014) that for years, science contents tend to be memorized and not too deep. The 2013 curriculum has goal to make the science contents are focused to enrich student's knowledge which in accordance with student's need to think critically (Kemendikbud, 2014).

Rainbolt and Dwyer (2012) simply define critical thinking as a skill that use for evaluating arguments made

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by others and composing good arguments by ourselves about any subjects. Critical thinking is not about knowing the facts but is the skill to understand facts and put them into context to see the connection of the context. In line, Stobaugh (2013) stated that critical thinking is not a simplistic recalling of previous information or illogical and irrational thinking. In other words, critical thinking is not a memorized answer or reactive thinking.

Halpern (2003) stated critical thinking can be learned through gaining life experiences and teaching it to others. Inch et al. (2006) identified critical thinking as a complex process occurred in critical thinking to examine ideas systemically for understanding both issue and the consequence acting on it. This process needs judgment that can out all relevant arguments, fact, and reasons that lead to a good decision making.

Throughout years, researchers argued about the factors which influence the students' critical thinking. Ghazivakili et al. (2014) indicated that critical thinking, learning style, and academic performance are associated each other. Gender also become an upcoming issue that researched related to critical thinking skills especially on how male and female groups use those skills (Andreou et al., 2014; Hunter et al, 2014; Nikou and Economides, 2015; Oguz and Atasaven, 2016). But, most of research regarding the critical thinking and factors that influence it, used university students as the subject of the research (Hunter et al, 2014; Azizi-Fini et al, 2015). Beside that the number of research which focus on the relationship between students' critical thinking and learning styles or students' motivation to learn science is still rare to find (Ghazivakili et al., 2014; Nosrantinia & Soleimannejad, 2016). Researcher intended to view the critical thinking on this point of view. Therefore, the profiling as the main focus of this study arose. Although, most of students profiling is done in higher education level (Hunter et al, 2014; Azizi-Fini et al, 2015). Differently, this study used junior high school students as the target of profiling.

On this study, the profile of students' critical thinking is based on critical thinking which developed by Inch et al (2006) that focus on generates purpose, raises question at issue, embodies point of view, makes assumption, uses information, utilizes concepts, makes interpretation and inference, and generates implication and consequences. Those elements are the building blocks whenever reasoning take place (Paul and Elder, 2012).

Stobaugh (2012) stated to make critical thinking skills infused to assessment, it needs interpretive materials. Interpretive materials require students to utilize their higher-level thinking skills. The challenge of creating high-level task and assessment can be faced by providing graphics, scenarios, and quotes and also videos to the assessment. Meanwhile, most critical thinking assessments are not externally validated against measures that reflect how adults think in real-world situations. Most researchers

use academic achievement and aptitude measures (e.g. grades, standardized test scores), or measures of cognitive abilities (e.g. fluid intelligence, tests of reasoning) to establish the validity of their instruments (Butler, 2012).

The theme of living things and environmental sustainability is one of science theme that is learned since elementary school. As seen on the core competence of 2013 curriculum in Science, students learn living things from the topic of what is the living things itself and how its interaction with environment. On 7<sup>th</sup> grade the theme focus on the living things, biotic and abiotic components, environment, and energy. On the 8<sup>th</sup> grade the theme focus on the structure of the living things mainly on plants and the technology which inspired by it. While on the 9<sup>th</sup> grade the focus is on the environmental sustainability. About how ecological sustainability as the connection between human needs and ecosystem service will meeting the human needs without compromising the health of ecosystem where human activities take place (Callicot & Mumford, 1997).

This research introduce the science virtual test as an interactive and attractive computer based test to assess critical thinking in such interesting way. Hence the profile of this study is measured through Science Virtual Test in Living Things and Environmental Sustainability Theme for 9<sup>th</sup> Grade which constructed based on Inch critical thinking elements. To make the critical thinking profile description more distinctive, the students' critical thinking profile also will be viewed based on the factors that considered to influence critical thinking, i.e. gender, learning style, and learning motivation.

## 2. METHOD

This study use descriptive method which compiles both of descriptive comparative and descriptive correlational (McMillan & Scummacher, 2001). This kind of research concern in the current or past status of something which in line with the focus of this study. This study will describe or capture junior high school students' critical thinking profile in general, to examine the difference toward the independent variable and find out the correlation between students' critical thinking and other variables. Therefore, this research utilize the data collection and analysis techniques that results is concerned on measuring tendency, variation, comparison, and correlation.

Descriptive research do not involve manipulation of independent variables and pay close attention on the nature of subjects and instruments (McMillan & Schummacher, 2001). Descriptive comparative method examine whether the value of dependent variable in one group is different from the value of the dependent variable in other group. Descriptive correlational method examine variables in natural environments and do not infer causation because of third non-measured variables and the inability to assess causal direction between two variables.

**Table 1.** Students' Attainments on Overall Critical Thinking Score (n = 110)

Critical Thinking Element	Minimum	Maximum	Mean	SD
1. Purpose	0.0	100.0	72.72	22.60
2. Question at Issue	0.0	100.0	31.14	24.46
3. Assumption	0.0	100.0	30.00	30.19
4. Point of View	0.0	100.0	66.14	27.59
5. Information	0.0	100.0	57.73	25.16
6. Concepts	0.0	100.0	54.24	30.24
7. Interpretation and Inference	0.0	100.0	62.42	24.36
8. Implication and Consequences	0.0	100.0	69.70	29.80
Overall Score	26.90	92.30	56.54	13.21

The respondents were one hundred and ten of ninth grade students taken from 3 different school in Kuningan. The sampling technique was purposive sampling that allow the researcher to selects the particular elements from the subjects which can support or be representative of the research interest (McMillan & Schummacer, 2001). Thus, the schools was chosen because of the school have good computer literacy, use 2013 curriculum, and represent the quality of national education standard schools: referral school, model school, and national standard school. A total 110 critical thinking attainments and questionnaire were collected. For the response rate, 43% were male students and 57% were female students.

The critical thinking measured by Science Virtual Test (SVT) on living things and sustainability theme which developed by Rusyati and Firman (2017) that had high reliability (Cronbach alpha 0.71) and moderate difficulty level (Arikunto, 2013). The SVT contained 26 multiple choice test item that include eight elements of critical thinking skill: generates purpose, raises question at issue, makes assumption, embodies point of view, uses information, utilizes concepts, making interpretation and inference, and generating implication and consequences (Inch et al., 2006). Based on mean and standard deviation of each element and overall critical thinking score, the critical thinking skill attainments can be categorized into low, moderate, and high (Arikunto, 2013). Hence, the students' critical thinking attainments are categorized on three following levels, low (score < 43.33), moderate (43.33 ≤ score < 69.75), and high (score ≥ 69.75).

The students learning style is described through VARK questionnaire. In this research the VARK questionnaire that used is appropriate for junior high school students. It consisted of 16 items with 4 multiple option which each option represent the one sensory modality, visual, aural, read/write, and kinesthetic learning style. VARK questions can be viewed as test-lets because respondents can select multiple items within a question

Science Motivation Questionnaire (SMQ) (Glynn et al., 2011) is 25-item included five-item scales: intrinsic motivation, self-efficacy, self-determination, grade motivation, and career motivation. Students respond to each item on a Likert-type rating scale: never (0), rarely (1),

sometimes (2), often (3), or always (4). The raw scores should be interpreted carefully, as the scales are ordinal. The Likert-type data is reported using mean and standard deviation. Thus, the motivation are categorized into three levels, low (attainments ≤ 56.14), moderate (56.14 ≤ attainments ≤ 81.92), and high (attainments ≥ 81.92) (Chumbley et al., 2015).

Data analysis was conducted using IBM SPSS version 23.0. Descriptive statistics (means and standard deviations) and inferential statistics t-test, one way ANOVA and partial correlation) were used. Students' independent t-test were used to determine the difference between critical thinking and gender. Students' one way ANOVA were used to determine the difference between critical thinking and learning styles, and critical thinking and motivation to learn science. Correlation coefficient was used to test the relationship between students' critical thinking and students' motivation.

### 3. RESULT AND DISCUSSION

#### 3.1 Profile of Students' Critical Thinking on Overall and Each Critical Thinking Elements

The first objective to this study is to investigate the profile of students' critical thinking skill on overall score. To obtain the result, all data is collected from one hundred and ten respondents without any consideration towards any independent variables.

At the first, the minimum score of overall students' critical thinking in science virtual test on living things and sustainability theme is 26.90 with the highest score reached is 92.30. The average score is 56.54 which can be categorized as moderate level. The mode of the score is 57.00 which indicate that most of students gain that score. The largest number of students is seen to be distributed in the range of 40.00 to 60.00. The percentage of students who is in moderate level reached 69% while the percentage of students who categorized into have high level and low level critical thinking skill are 14% and 17%. Hence, the distribution of overall critical thinking score is not too wide compare to other elements ( $SD = 13.21$ ).

The next description is the analysis of students' attainments on eight critical thinking elements. As noted

**Table 2** Students' Attainments Based on Gender

Critical Thinking Element	Male (n = 47)		Female (n = 63)		p value
	Mean	SD	Mean	SD	
1. Purpose	71.28	20.84	73.81	23.94	0.563
2. Question at Issue	33.51	23.47	29.37	25.22	0.382
3. Assumption	31.56	30.14	28.84	30.41	0.642
4. Point of View	70.04	26.50	63.22	28.23	0.202
5. Information	62.41	24.69	54.23	25.13	0.092
6. Concepts	53.90	31.51	54.50	29.51	0.919
7. Interpretation an Inference	60.99	26.30	63.49	22.97	0.597
8. Implication and Consequences	78.01	26.26	63.49	30.94	0.011*
<b>Overall Score</b>	<b>59.00</b>	<b>13.83</b>	<b>54.70</b>	<b>12.54</b>	<b>0.091</b>

on Table 1, only students' attainments on generating purpose is identified as high level. On the other side, embodying point of view, using information, utilizing concept, and making interpretation and inference, as well as generating implication and consequences are on the same level as the overall critical thinking score which is at moderate level. The data show that there are two elements which categorized as low level, raising question at issue and making assumption element.

Compared the mean that students attained, generating purpose arose to have the highest score of 72.72 among all elements. Meanwhile making assumption appeared as the lowest which only got 30.00. In line with the mean scores, the distribution of students' critical thinking on each element be represented through the standard deviation.

As shown on Table 1, students' scores has high standard deviation on most of critical thinking element. It represents the widely distributed scores of the students on define score range and average scores. The highest standard deviation lies on utilizing concept ( $M = 55.24$ ,  $SD = 30.24$ ), the second place is on making assumption ( $M = 30.00$ ,  $SD = 30.19$ ).

All attainments on science virtual critical thinking test on living things and sustainability theme test is analyzed. Middle school students at least are expected to be practicing thinker (Paul & Elder, 2010). As practicing thinker students are expected to have an awareness of how the thinking tends to be flawed, the understanding of basic elements of reasoning and the standards to assess it, the awareness of the need to monitor and correct the thinking, and understand that people basically egocentric. Practicing thinker are ready to analyze their thinking across many areas, but only the beginning to think in systematic way and also attempt to assess and critique their own conclusions, beliefs, and opinions. However, they still have limited insight into deeper levels of thought, and thus into deeper levels of the problems embedded in thinking.

Results of this study that students' critical thinking level on living things and sustainability theme is in moderate category. The overall critical thinking score fell between 43.33 and 69.75 as the cut off points. Moderate critical

thinking category is characterized as beginning skill to think critically. Students start to become knowledgeable to monitor and improve their systematically thinking such as on students' thinking about assumption, concepts, point of view, implication, information, inference, and etc.

Moderate level of critical thinking on middle school students is not by chance. For instance, this moderate overall critical thinking in science have to support students by at least moderate critical thinking ability of constructing eight element of critical thinking; generates purpose, raises question, embodies point of view, using information, utilize concept, makes inference, makes assumption, and generates implication. In general, this condition is described by 69% of student that have moderate critical thinking level. Despite, on raising question at issue (31.14) and making assumption (30.00), students still have low critical thinking level which mean students still have difficulty to identify and address some question to an issue or problem. Also still hard to take presupposition or viewpoints for granted for a thought.

### 3.2 Students' Critical Thinking Based on Gender

The next objective of the study is to examine the difference between male and female students on critical thinking skill. From 110 respondents, male students is 43% and female students is 57%. Descriptive statistics of both group are generated. For answering the research question, difference inferential statistics are conducted. The first step is checking the normality of the data by see the skewness value of each variable. The data is approximately normal, then independent t-test is selected. The statistical result is summarized on Table 2.

The highest score which attained by male group is in generating implication and consequences skill (78.01) and the lowest is in making assumption skill (31.56). In other side, generating purpose skill arose to be the highest score in female group (73.81), while as same as male group, making assumption skill have the lowest score (28.84). Both male and female students considered to have high level of critical thinking skill on generating purpose while on raising question at issue and making assumption skill both group



are on low level of critical thinking skill. On embodying point of view and generating implication and consequences skill, male and female group have different skill level of critical thinking, male is on high level skill and female group is on moderate level skill. On using information, utilizing concepts, and making interpretation and inference, both groups are on moderate level as well as the overall critical thinking skill.

At significant level 0.05, most of elements and overall critical thinking score show there are no significant differences ( $p > 0.05$ ). Different with other data, generating implication and consequences skill shows there is significant difference between male and female group ( $p = 0.011$ ).

In general can be concluded that there is no significant difference between male and female group on critical thinking skill on living things and sustainability theme. However, the data show while male group has slightly higher overall critical thinking attainments rather than female group.

The data show that both male and female groups have moderate level of critical thinking. Most of elements also

present the fair ability on both group. This condition indicates that the teaching and learning activities in science class are triggering the students to think critically.

The result of this study revealed that there is no significantly differences between male and female students in term of critical thinking. This finding also in line with some empirical studies. The non-significant role of gender also concurs with the findings of some researches. In summary researchers argue that the result of their study indicates that male and female learners do not differ in critical thinking or testing performance (Thompson et al., 2002; Oguz et al., 2016) Gender does not play role in enhancing and declining the critical thinking skill which in line with a statement regarding critical thinking whether it can be learned through gaining life experiences and teaching it to others. Thus, it is the evident that gender is not a matter in critical thinking (Halpern, 2003).

Differently generating implication and inference element show there is significant difference between male and female group. Male show up to have high mean score on this critical thinking elements. It is in line with the research conducted by Gok (2014). It was reported that the

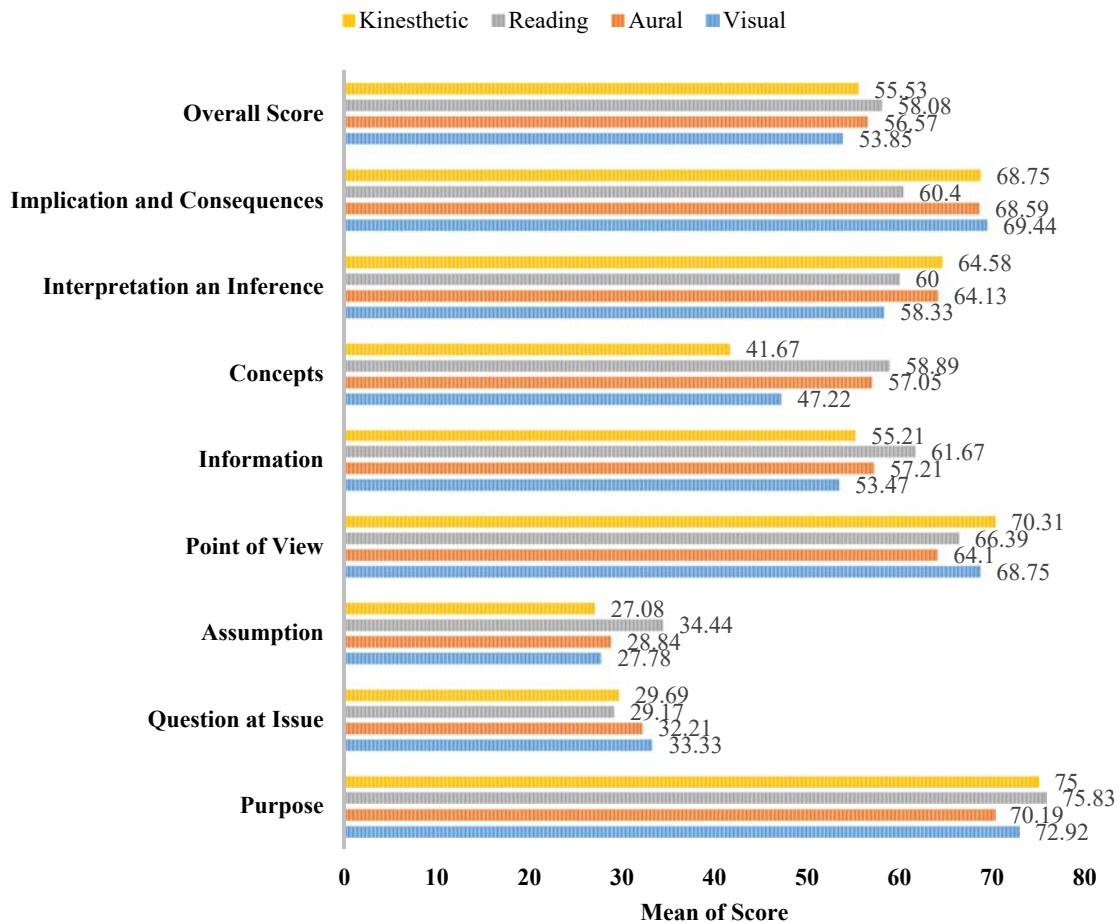


Figure 1. Visualization of Students' Critical Thinking Based on VARK Learning Style

**Table 3** Students' Attainments' Based on Science Motivation

Critical Thinking Element	High Motivation (n = 23)		Moderate Motivation (n = 70)		Low Motivation (n = 17)		p value
	Mean	SD	Mean	SD	Mean	SD	
1. Purpose	77.17	19.81	72.50	23.37	67.65	22.99	0.419
2. Question at Issue	32.61	23.15	30.31	25.24	30.88	24.25	0.949
3. Assumption	34.05	34.98	29.52	28.54	26.47	31.21	0.721
4. Point of View	75.00	23.70	67.38	28.12	49.02	23.91	0.010*
5. Information	64.13	21.09	54.64	26.49	61.76	23.58	0.227
6. Concepts	56.52	27.40	56.19	32.37	43.14	22.86	0.260
7. Interpretation and Inference	65.22	27.48	64.76	21.89	49.02	26.66	0.046*
8. Implication and Consequences	79.71	19.43	70.00	31.16	54.90	31.05	0.032*
<b>Overall Score</b>	61.36	13.29	56.52	13.37	49.33	9.34	0.016*

difference between male and female was found on the problem solving. Male has better ability in solving problem than female. As a result, there are various research results related to the gender difference and its contribution to the variables of learning achievement and problem solving, such as the research which conducted by Ricketts & Rudd (2004), Mahanal, (2012) and Crawford, et al. (2005).

### 3.3 Students' Critical Thinking Based on Learning Style

The next focus of the study is to examine the critical thinking difference based on visual, aural, read/write, and kinesthetic learning style group. From one hundred and ten respondents, the percentage of students who had visual learning style was 11%, aural was 47%, read/write was 27%, and kinesthetic was 15%. The statistical analysis is conducted which summarized on Table 4.3. To see the differences between each category, the normality check is done by see the skewness value. All data is normally distributed, then one-way ANOVA is used.

Visual group has the highest score in generating purpose skill (72.92) and lowest score in making assumption skill (27.78) as same as aural and kinesthetic group. Differently, read/write group shows the lowest score in raising question at issue skill (29.17).

For the level of students' critical thinking in generating purpose skill, all learning style indicated to have high critical thinking level while raising question at issue and making assumption skill showed as the elements which have low critical thinking level. On embodying point of view skill, three learning style groups (visual, aural, read/write) are on moderate critical thinking level while kinesthetic is on high critical thinking level. Different on utilizing concepts skill, the three groups appear in moderate critical thinking level while kinesthetic group is on low critical thinking level. Using information, making interpretation and inference, generating implication and consequences skill are in moderate critical thinking level as well as the overall critical

thinking attainments for all groups on science virtual test on living things and sustainability theme. The visualization of students' attainments is showed on Figure 1.

To check whether there is significant differences among the groups, inferential statistical analysis is conducted. One way ANOVA is conducted, because the independent variable has more than two groups and the data are normally distributed. At significant level 0.05, all data show there is no significant differences among visual, aural, read/write, and kinesthetic group ( $p > 0.05$ )

All elements show fair ability among all groups' score. It indicates that the teaching and learning activities fulfil the need of all learning preferences. All groups is forced to think critically in science class.

Fleming (1992) stated that student's modality preferences can be understood and motivate teacher to use the learning strategies that are aligned with a modality preferences which will lead to persistence learning tasks, a deeper approach to learning, active and effective metacognition. Then, the knowledge of, and acting on, one's modal preferences is an important condition for improving one's learning. Learning style is a useful step towards understanding, and hence improving learning. Modal preferences influence individuals' behaviors, including learning, but they are not fixed. Modal preferences are stable in the medium term. Learning style can support students' in learning but it may not affect the students' achievement. Which can be support the findings of the study, there is no differences on testing result of critical thinking among the groups ( $p > 0.05$ ).

### 3.4 Students' Critical Thinking Based on Motivation to Learn Science

The next focus of the study is to examine the difference of critical thinking among students who has high, moderate, and low level of Motivation to learn Science. The

statistical analysis is conducted which summarized on Table 3.

For the description of students' attainments on critical thinking skill, the data show that students' attainments on generating purpose on high and moderate motivation group are categorized to have high critical thinking level, meanwhile low motivation group has moderate critical thinking skill level. On raising question at issue and making assumption elements, all group has low critical thinking skill level. On embodying point of view, high motivation group is in high critical thinking skill level. Moderate and low motivation group appear to have moderate level critical thinking level. On using information, two groups have moderate level of critical thinking whether moderate motivation group categorized to have low critical thinking level. On utilizing concept skill, high and moderate motivation group have moderate level of critical thinking while, low motivation group has low critical thinking level. The rest elements such as interpretation and inference, implication and consequences, and overall critical thinking show up to have moderate critical thinking level.

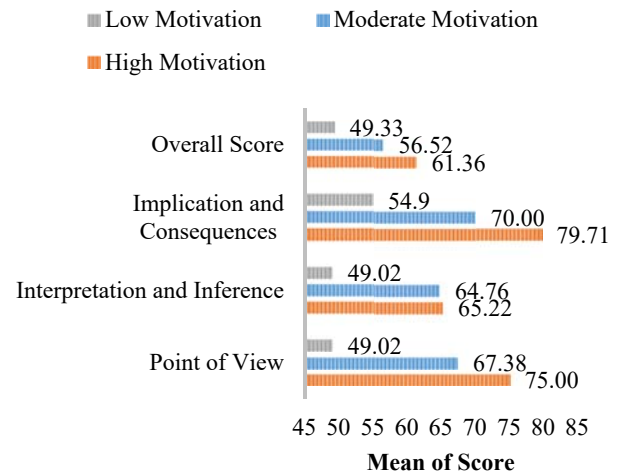
One way ANOVA is conducted. At significant level 0.05, five elements show whether there is no significant difference. In contrast, embodying point of view, making interpretation and inference, generating implication and consequences, as well as overall critical thinking score show there is significant difference among the groups ( $p < 0.05$ ).

Post hoc analysis is conducted since there are four critical thinking elements which have p value that greater than 0.05. The analysis is conducted for embodying point of view, making interpretation and inference, generating implication and consequences, and overall critical thinking skill to see the comparison between high, moderate, and low motivation group.

On embodying point of view the significant difference appear between high and low motivation group and also between moderate and low motivation group ( $p < 0.05$ ). Meanwhile, between high and moderate motivation group there is no significant difference ( $p = .232$ ). Similar with this critical thinking element, interpretation and inference as well as overall critical thinking skill present the significant differences also appear between high and low motivation group and moderate and low motivation group. Moreover, in generating implication and consequences the significant difference only appear between high and low motivation group. Researchers indicates that motivational condition had significant effect on testing performance (Hawthorne et al., 2015).

### 3.5 The Correlation between Students' Critical Thinking Skill and Students' Motivation

The next focus of this study is to investigate the correlation between students' critical thinking on science virtual test on living thing and sustainability theme and students' motivation to learn science. Researcher



**Figure 2.** Visualization of Students Critical Thinking Comparison between High, Moderate and Low Motivation Group

investigated the correlation between students' critical thinking level group which divided into low, moderate, and high with the students' motivation level group. It was conducted to see whether students with low critical thinking level is proportional with their motivation or not and so on. After the Kendall-Tau b correlation test, at significant level 0.05, this present study show that there is no correlation between students' critical thinking and students' motivation ( $p = 0.081$ ). It means whether students who have high critical thinking level in science is not influenced by their science motivation which in line with the findings of Nikou and Economides (2016) that science motivation has no effect to the test and also supported by Chua (2012). Even the result is in contrast with the research finding by Fahim and Hajimaghsoodi (2014) that motivation has a positive relationship with critical thinking. Different findings is caused by the different method in the research. Fahim and Hajimaghsoodi (2014) research involved treatment while this study only focus on how is the students' motivation level to science.

## 4. CONCLUSION

Based on research question and findings revealed on this study that conclude as follow as:

1. In general overall students' critical thinking profile on science virtual test on living things and sustainability theme is on moderate category. Despite, on raising question at issue and making assumption, students still have low critical thinking level which mean students still have difficulty to identify and address some question to an issue or problem. Also still hard to take presupposition or viewpoints for granted for a thought. Embodying eight elements of critical thinking ability



- make the student get used in thinking critically. Teacher also has important role to improve the critical thinking.
- In general, there was no significant difference between male and female group on their critical thinking skill. Gender does not play role in enhancing and declining the critical thinking skill. Gender is not a matter in critical thinking.
  - There was no significant difference among visual, aural, read/write, and kinesthetic group on their critical thinking skill. Learning style is a useful step towards understanding, and hence improving learning. Modal preferences influence individuals' behaviors, including learning, but they are not fixed. Modal preferences are stable in the medium term. Learning style can support students' in learning but it may not affect the students' achievement.
  - There was significant differences among low, moderate, and high motivation level group in overall critical thinking skill which indicated that motivational condition had significant effect on testing performance.
  - There was no correlation between students' critical thinking and students' motivation. Because motivational prompts were not found to affect students' critical thinking subscores or self-reported effort and importance scores which support the result of the study. Meant, whether students who have high critical thinking level in science is not influenced by their motivation to learn science in class.

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