CHAPTER IV

RESEARCH RESULT AND DISCUSSION

A. Concept Mastery

Conceptual mastery data is obtained by using objective test multiple choices which is given to the students before learning (pretest) and after learning (posttest) with virtual laboratory. Pretest is given to students in order to know prior knowledge of students about optic material before learning. While for posttest is given to students in order to know final knowledge of students after given a treatment of virtual laboratory in optic material learning.

Based on analysis pretest data from conceptual mastery items, it shows the result that both classes means boys class and girls class pretest result obtain not too significant differences (H_0 Accepted). Average of pretest score also include in lower standard category. That means all the average of both classes has bad marks. That case happens because both of class, boys class and girls class have not received optic material especially in refraction subtopics yet. Moreover, the test that is given to the students also using English language and there are several terms which the students has not already understand yet. But, it has possibility that prior knowledge of students in optic topics are obtained from several learning sources outside schools or learning at the classroom. For instance, internet, magazine, books, newspaper, and etc. The explanation above is based on recapitulation of students conceptual mastery result that has been provided in the table 4.1. below:

Table 4.1.

Recapitulation of Conceptual mastery Score in Boys Class and Girls Class List

Component	Pretest		Posttest	
	Boys Class	Girls Class	Boys Calss	Girls Class
N	17	23	17	23
Average	41,58824	40	75,35294	65,21739
SD	8,124491	5,510321	10,46387	8,665273
Max score	57	50	97	77
Min Score	30	30	63	53
Normality test				
Sig.	0,200	0,114	0,161	0,182
Summary	Normal	Normal	Normal	Normal
Homogenity test				
Levene statistic	0,571		0,293	
Sig.	0,454		0,592	
Summary	Homogen		Homogen	
Hypothesis Test Independent T-Test (*2-tailed*)				
t	1,964		3,348	
Summary	H_0 Accepted		H_0 Denied	

Prior knowledge are very important and it can influence to the next process of learning. The importance of learning is students can relate they learning with their prior knowledge. It is one of the importance in constructivism theory that learning has already had prior knowledge (Dahar, 2006). There is no learning with empty heads. Prior knowledge has relationship with what students learn now. That statement in a line with Piaget cited (Dahar, 2006) that from assimilation process, someone use a structure or their ability that has already exist to respond to the problem in their environment.

Because average pretest score of boys class and girls class has no significant differences, so to investigate conceptual mastery improvement result, it is discussed in average of posttest score and it is obtained after the treatment given to the students. It means that, students in both of class has already learn optic topics using virtual laboratory media. So, posttest score can figure the differences of conceptual mastery improvement of students because of pretest score are not too different. The result of average posttest score in boys class and girls class has significant differences. Boys class has higher value of average posttest score than girls class as shown in table 4.1. Actually there is an improvement of conceptual mastery for both of class. Because virtual laboratory also can improve conceptual mastery of students. It is strengthen by previous research result that said virtual laboratory can improve students achievement (Tuysuz, 2010).

The differences of conceptual mastery improvement in girls class and boys class because of gender differences between them. Where class with specific gender domination will have specific perception and attitude to learning process of physics lesson using virtual laboratory media.

Physics are the lesson that consist of logical, analytical, logical thinking, abstract things, and etc. That is why physics can be called as "Boys lesson" (Wood, 2009). Actually both boys and girls use their lobus of their brain but in different composition. Boys tends to use his left hemisphere of brain. Left hemisphere of brain in boys developed more than girls. Left hemisphere of brain here controlled the logical thinking, abstract things, numerical arrangement, analytical thinking (Wood, 2009). So that, boys students in the class can receive a lot of information of physics lesson easier than girls.

The other reason that makes average result of improvement in conceptual mastery of physics lesson using virtual laboratory is the media that is used. virtual laboratory is include in computer media. Using computer in education for learning, in this cases girls students consider that computer is used to do something useful for them. Girls in multimedia interface or computer tends to visual design of multimedia itself, while boys is tends to navigation and control the multimedia or computer itself (Passig and Levin, 2000).

There are several differences of boys class and girls class in conceptual mastery, here there are the level cognitive of students in each classes. Level cognitive itself based on Bloom taxonomy revised from C1 (Remembering), C2 (Understanding), C3 (Applying), C4 (Analyzing), and C5 (Evaluating). The level cognitive of students are obtained from *N-gain* score of each level cognitive. This is the following table of level cognitive in boys class and girls class:

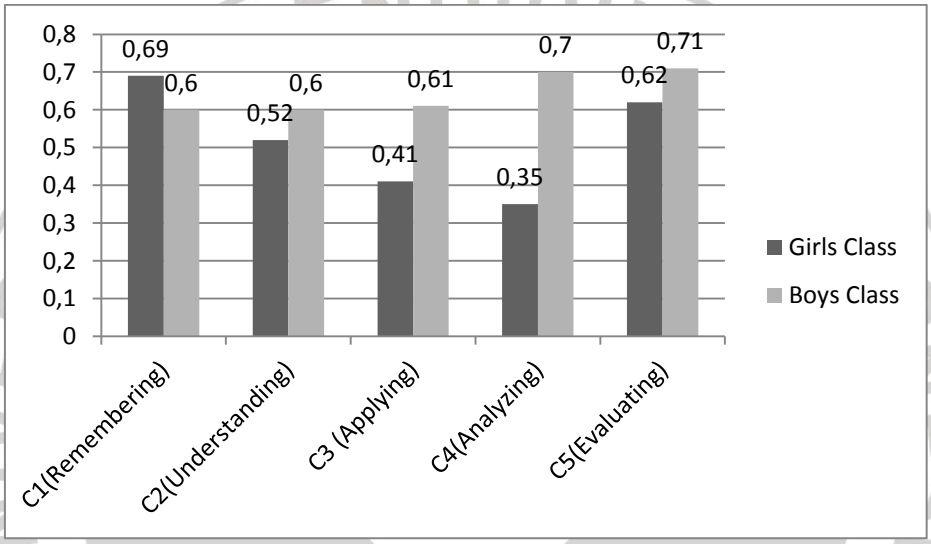

Figure 4.1

***N-Gain* Value of Boys Class and Girls Class Level Cognitive**

Diagram 4.4 above shown that, average *N-gain* score of boys class is the highest one. Every class, either boys class or girls class has the improvement of conceptual mastery in each level cognitive. Based on the result of cognitive level or level of thinking from each conceptual mastery items is found that girls class has outperformed in C1 (Remembering) level, and got lower value in C4 (Analytical). While boys class has outperformed in C5 (Evaluation) and got lower value in C1 (Remembering).

C5 (Evaluation) in level of cognitive include in higher order thinking means that students can construct their cognitive ability in complex thinking. This also include in analytical level of thinking or we can said that C4. Boys has

outperformed than girls in this level because the characteristic of brain that develop in each boys and girls students. While girls in analytical level of thinking has lower value. It is because boys students more developed in left hemisphere of brain. Left hemisphere of brain in boys developed more than girls. Left hemisphere of brain here controlled the logical thinking, abstract things, numerical arrangement, analytical thinking. While women has better develops in her right hemisphere of brain. Right hemisphere of brain that control the intuitive, artistic, imaginative, holistic, and others task and visual include in remember (Wood, 2009). That is why girls has higher value in C1 (remembering) rather than boys class. Also girls has lower value in applying level of thinking in conceptual mastery item test. In that test, applying level of thinking is represent by calculation question and it is need formula. It is in a line with the level of approval result from interest in physics questionnaire, girls students agree that they have difficulties in using formula during physics lesson. It is inversely proportional with the result of boys students. They got high value for applying level of thinking and disagree with the statement about difficulties in using formula during physics lesson. Boys can assemble a range of three-dimensional objects and solve problems requiring mathematical reasoning (Pease and Pease, 2008).

From whole result, conceptual mastery in physics lesson using virtual laboratory both boys class and girls class has an improvement significantly. For level of thinking also both of classes has improvement in higher order thinking. So, it can be said that virtual laboratory is very good media to improve higher order thinking of students during a lesson. According to Chaeruman cited (Warsita, 2008) virtual laboratory media can train and develop higher order thinking means that train them to think in higher order thinking level.

B. Students Interest in Physics

Students interest in physics data is obtained by distributes questionnaire that consist of 20 statements, 5 others inside the question include in negative statement to control students answer. This questionnaire consists of four indicators that consider to the students interest in physics lessons. Each indicator has 5 statements. Those four indicators are Indicate interested in physics learning through virtual laboratory learning media, Indicate interested toward layout and facilities in virtual laboratory in physics learning, Indicate interested and optimistic in learning physics, and Indicate not interested and pessimistic in learning physics. This questionnaire is distributed to know whether students are interested in physics or not. This is the following overall result of interest in physics between boys class and girls class:

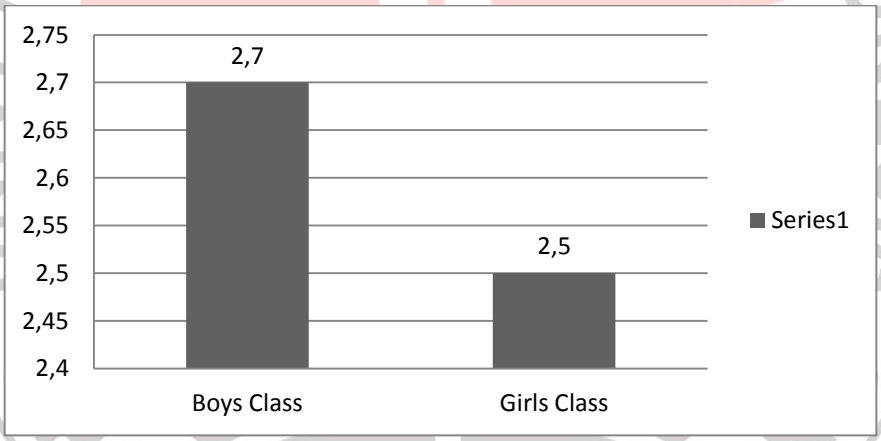

Figure 4.2

Percentage Result Interest in Physics Questionnaire

From diagram above, it is shown that boys has higher value of approval level or agreement than girls. Boys class got 2,7 and girls class got 2,5. It can be said that boys class has more interest in physics lesson than girls. Either it uses virtual laboratory in learning physics or general opinion about physics learning in everyday lesson. To make it clear, Here there are the results of interest in physics based on indicator.

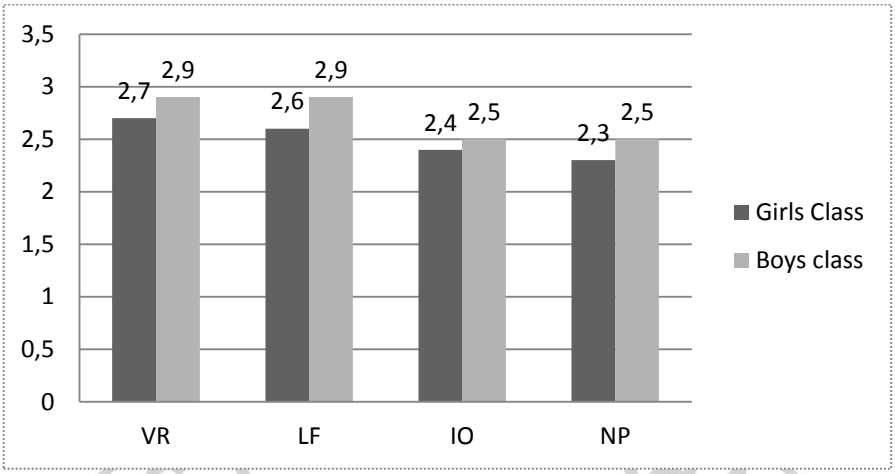

Figure 4.3

Percentage Results of Interest in Physics Based on Indicator

VR : Indicate interest in physics learning through virtual laboratory learning media.

LF : Indicate students interest toward layout and facilities of virtual laboratory in physics learning.

IO : Indicate students interest and optimistic in learning physics.

NP : Indicate students are not interested and pessimist in learning physics.

From diagram above, it is shown that boys class is higher than girls class in first indicator of students interest in physics. In this indicator also consist of five statements that has already computed and supported for this result. So, it can be said that most of students in both of class has interest in physics learning through virtual laboratory media. But, for boys class has higher value than girls class. The result also the same with second indicator of interest in physics questionnaire is about interested toward layout and facilities in virtual laboratory on physics learning. So this indicators means that whether the students has positive approval in learning physics from layout and facilities that is consisted in virtual laboratory learning media or not.

Also in third indicators that explain about indicate interested and optimistic in learning physics. This indicator is made to know what differences of pure interest and optimistic of students from girls class and boys class in physics lesson. This indicators only to know the students opinion about physics generally. The result also the same with fourth indicators that indicate girls class is not interested and pessimistic in learning physics. This indicator to show whether the students is not interested and pessimistic in physics learning or not in generally.

Interest in physics generally result from the questionnaire, it is obtained that boys class has more interest than girls class. Because physics consist of mathematical reasoning, logical, analytical, logical thinking, abstract things, and etc. So, the value of approval level in statement physics is a difficult and boring lesson, boys class has lower for approval value while girls class has higher approval level value. It is caused by boys tends to use his left hemisphere of brain. Left hemisphere of brain in boys developed more than girls. Left hemisphere of brain here controlled the logical thinking, abstract things, numerical arrangement, analytical thinking (Wood, 2009). These ancient hunting skills are the reason men dominate areas like architecture, chemistry, physics, building, and statistics (Pease and Pease, 2008). So that the boys class has more interest in physics lesson than girls class. Because girls tends to use her right hemisphere of brain that consist of intuitive, visually, emotional, and etc. This result also the same and linked with level of thinking in C3 (Applying) that tends more formula problems and C4 (Analyzing), that is stated girls class got lower value in both of cognitive level than boys class.

Interest in physics through virtual laboratory result also has the result, boys class has more interest than girls class. It is because they learn physics using virtual laboratory media. Media as communication process (Warsita, 2008) can relate with the interested of students during learning. Actually, both of class has high value of level approval in this category than in interest in physics generally. Boys has more interest in physics through virtual laboratory because using computer in education for learning, in this cases girls students consider that computer is used to do something useful for them.

Girls in multimedia interface or computer tends to visual design of multimedia itself, while boys is tends to navigation and control the multimedia or computer itself (Passig and Levin, 2000). This statement is in a line with Turkle *et. Al* cited (Johnson, 2006) that boys consider the computer is something that has to be comprehended, while girls use a computer as tools to reach a goal or doing their task, and expected that computer can make them comfort. Besides that, the research said 84% of girls consider computer as a tools to reach their goals or tools to give them a freedom in creativity, while boys that agree with that, only 33% (pease adn Pease, 2008). So that, virtual laboratory media can also improve interest in students learning (Warsita, 2008) especially in this research is an optic topic.

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C. Discussion

This research has goals to compare conceptual mastery between boys class and girls class, where the conceptual mastery is learning outcomes after Junior High School students has already learned optic topic using virtual laboratory learning media. This research is done in different class, but each class receives the same treatment, means that each class learns using virtual laboratory in optic topics. Model and method that is used in learning also the same. Learning process is done in small class compare with regular class.

The improvement of students conceptual mastery differences in this learning because of several factor. One of the main factor that support the result of students conceptual mastery students improvement is they learn physics lesson using virtual laboratory learning media as learning sources and communication process.

Virtual laboratory is included in learning media as communication process in learning. Based on Warsita (2008) in other terms, learning media is communication media that is used in learning contextual to reach the learning goals. This learning media also can improve conceptual mastery of students.

Based on research Sovocom Company from America, found that there is relationship between type of media with human memory to absorb and save a

message, type of media with brains' ability in memorize of message. For instance ability of memorize in audio media 10%, visual (visual text) 40%, and audiovisual 50%. While, the ability to save the message based on audio media less than 3 days is 70%, more than 3 days is 10%, media visual (visual text) less than 3 days is 72%,more than 3 days is 20%,and audiovisual media less than 3 days is 85%, more than 3 days is 65% (Warsita, 2008).

Virtual laboratory media also include in multimedia interactive (audiovisual) media which can facilitated the students to improve their conceptual mastery about one of phenomena or abstract concept. This is in a line with statement (Warsita, 2008) Virtual laboratory can make abstract concept become concrete. Based on learning process that has already done in this research, virtual laboratory fiture can support to make abstract concept becomes concrete. So, that the conceptual mastery of students are improves. For instance, this is the relation between light rays concept and the images that is formed in different medium.This concept include in abstract concept. So, they can make it clearly through virtual laboratory media in this pages:

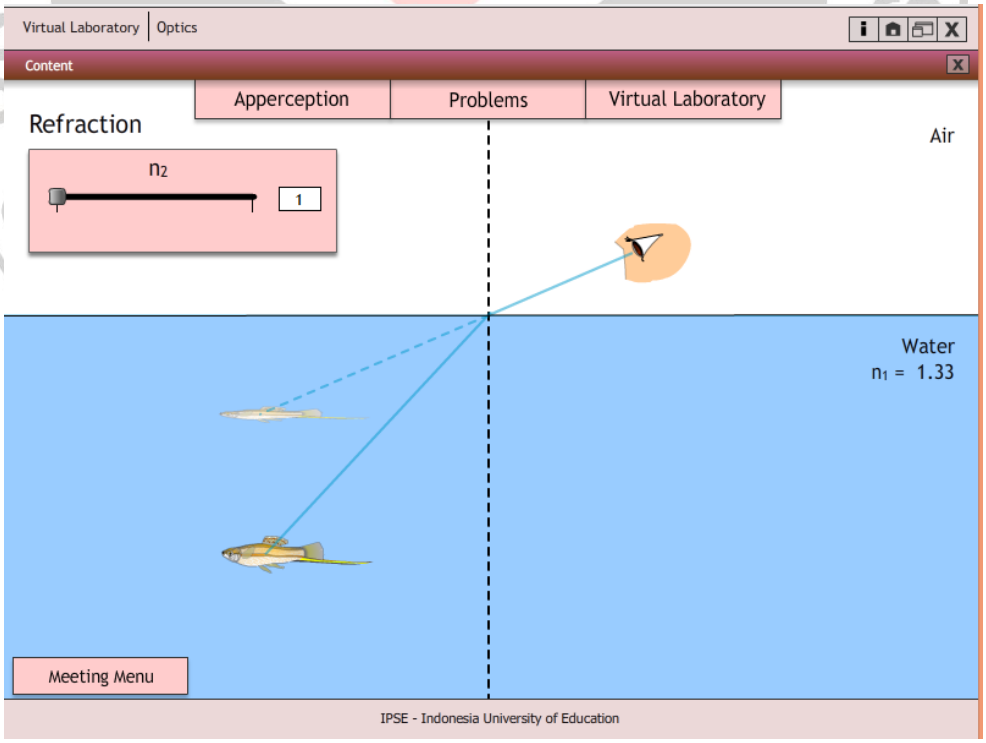

Figure 4.4. Light Rays in Different Medium Simulation

From this simulation, students can figure out how light rays travels from optical less dense medium to the optical denser medium or vice versa. So that abstract concept that consist in optic topic can be understood by the students because they have already had an experiences using virtual laboratory media. Because learning actually is a process which is the individual change their behaivour because of experiences, Gagne cited (Dahar, 2006).

Virtual laboratory media also as multimedia can display dynamic fiture, so the students can do it interactively. Interactive means that get students involved, simulation can capture students attention by placing them in charge of things and asking. It also allows users to interact with the program instead users seeing its output (Roblyer, 2006). While dynamic fiture means that in virtual laboratory as multimedia interactive is one of learning media based computer technology that combine and integrate all the media which consist of text, graph, photo, video, animation, narration, and interactivity that programed by usig principal and theory of learning (Warsita, 2008). This learning media also has a function multisensory learning that can be delivered by using of 5 senses there are audio, visual, or kinesthetic. There are several more advantages of virtual laboratory compare with others learning media. The advantages that is brings by virtual laboratory appropriate with the condition in this research are: 1) make abstract concept become concrete; 2) Shows the object that has big or small size that cannot be seen by naked eyes; 3) shows the fast motion into slow motion or vise versa; 4) Provide consistent information that can be repeated and saved; 5) Overcome the obstacle about time and rooms (Warsita, 2008). So, virtual laboratory is appropriate with physics subject that its scope comes from macroscopic until microscopic, something that cannot be seen by naked eyes. Especially in optics topics that has microscopic scope is about light rays and particle of things. Here there are the layout of virtual laboratory that shown light rays in converging lens experiment:

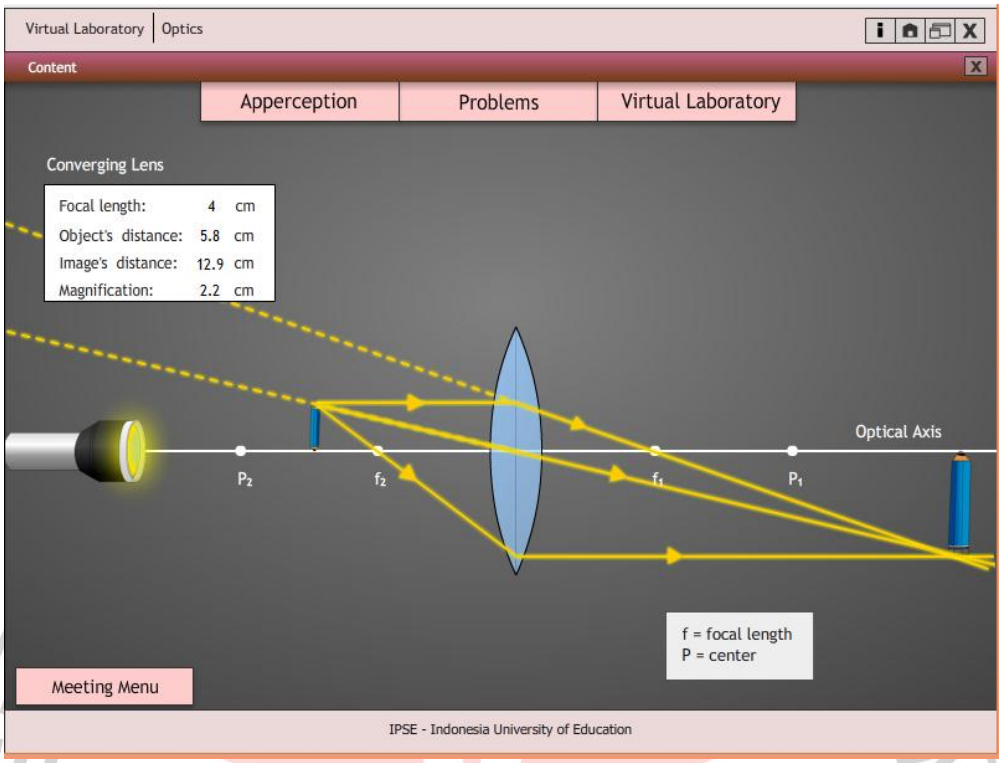

Figure 4.5. Light Rays in Thin Lens Simulation

Beside those things, using virtual laboratory media in learning process especially in optic topics from this research that virtual laboratory can make students enthusiastic to reach standard competence that has already appointed. In science learning, using of virtual laboratory can improve the students motivation twice rather than in traditional method (Munir, 2011). It means that virtual laboratory can increase students motivation. Because motivation is very important to get a good learning outcomes in learning process. Because students are easier to get a concept and has an effort to learn by themselves, so that learning outcomes or conceptual mastery can be improved. This is in a line with research that has already done by Yuliansyah (2010) that virtual laboratory is effective media to improve students conceptual mastery in dynamic electricity topics.

The differences of improvement of conceptual mastery of girls class and boys class is significant. Boys class also got higher value than girls class. The differences of conceptual mastery result because of gender differences between

them, where class with specific gender domination will have spesific perception and attitude to learning process of physics lesson using virtual laboratory media.

Physics are the lesson that consist of logical, analytical, logical thinking, abstract things, and etc. That is why physics can be called as "Boys lesson" (Wood, 2009). Actually both boys and girls use their lobus of their brain but in different composition. Boys tends to use his left hemisphere of brain. Left hemisphere of brain in boys developed more then girls. Left hemisphere of brain here controlled the logical thinking, abstract things, numerical arrangement, analytical thinking (Wood, 2009). Based on research dr Camilla Benbow and colleague dr Julian Stanley tested a group of gifted children and found that boys good at math outnumbered girls by 13 to 1. Boys can construct a block building from two-dimensional plans easier and quicker than girls, they can estimate angles accurately and can see whether a flat surface is level. These ancient hunting skills are the reason men dominate areas like architecture, chemistry, physics, building, and statistics (Pease and Pease, 2008). So that, boys students in the class can receives a lot of information of physics lesson easier than girls.

The other reason that makes average result of improvement in conceptual mastery of physics lesson is different, virtual laboratory as the media that is used. Virtual laboratory is include in computer media. Using computer in education for learning, in this cases girls students consider that computer is used to do something useful for them. Girls in multimedia interface or computer tends to visual design of multimedia itself, while boys is tends to navigation and control the multimedia or computer itself (Passig and Levin, 2000). This statement is in a line with Turkle *et. Al* cited (Johnson, 2006) that boys consider the computer is something that has to be comprehended, while girls use a computer as tools to reach a goal or doing their task, and expected that computer can make them comfort. Beside that, The research said 84% of girls consider computer as a tools to reach their goals or tools to give them a freedom in creativity, while boys that agree with that, only 33% (Pease and Pease, 2008). This is in a line with observation during learning physics in this research between girls class and boys class. Boys class tends to obey the rules in the computer laboratory, always

concentration to the media and has fast movement when they use virtual laboratory media. While in girls class, they tends to break te rule in computer laboratory class during a physics lesson. Most of them open the other tabs beside virtual laboratory application media, for example tumbler, twitter, etc.

During physics learning using virtual laboratory in this research also less boys students always asks how to use virtual laboratory media and contents itself. But they are very confidence when they use virtual laboratory media by themselves. While girls students always asks during the lesson until the end how to use virtual laboratory media and also the content itself. This observational result also in a line with Johnson cited (Passig and Levin, 2000) found that girls more than boys displayed computer anxiety and more worried about working with computer without instruction.

Spatial ability also has significant influences to boys students in outperformed of physics conceptual mastery using virtual laboratory media. It is caused by testosterone hormone that can trigger the development of lobus in the brain to develop spatial development in boys (Pease and Pease, 2008). Computer media needs high spatial ability or three dimensional ability. Iowa State University professor of psychology Dr Camilla Benbow scanned the brains of more than a million boys and girls to study their spatial ability and reported that differ ences between the sexes were already striking by the age of four. She found that while girls were excellent at seeing two dimensions in the brain, boys had the ability to see a third dimension (Pease and Pease, 2008).

Beside boys class and girls class has differences in average of posttest score and improvement of conceptual mastery, based on the result of cognitive level or level of thinking from each conceptual mastery items is found that girls class has outperformed in C1 (Remembering) level, and got lower value in C4 (Analytical). While boys class has outperformed in C5 (Evaluation) and got lower value in C1 (Remembering).

C5 (Evaluation) in level of cognitive include in higher order thinking means that students can construct their cognitive ability in complex thinking. This also include in analytical level of thinking or we can said that C4. Boys has

outperformed than girls in this level because the characteristic of brain that develop in each boys and girls students. While girls in analytical level of thinking has lower value. It is because boys students more develop in left hemisphere of brain. Left hemisphere of brain in boys develop more than girls. Left hemisphere of brain here controlled the logical thinking, abstract things, numerical arrangement, analytical thinking. While women has better develops in her right hemisphere of brain. Right hemisphere of brain that control the intuitive, artistic, imaginative, holistic, and others task and visual include in remember (Wood, 2009). Also girls has lower value in applying level of thinking in conceptual mastery item test. In that test, applying level of thinking is represent by calculation question and it is need formula. It is in a line with the level of approval result from interest in physics questionnaire, girls students agree that they have difficulties in using formula during physics lesson. It is inversely proportional with the boys students results. They got high value for applying level of thinking and disagree with the statement about difficulties in using formula during physics lesson. Boys can assemble a range of three-dimensional objects and solve problems requiring mathematical reasoning (Pease and Pease, 2008). The statement also in a line with the process during learning. In steps Generalization, analytical ability are treated to the students and girls got lower value for that.

From whole result, that conceptual mastery in physics lesson using virtual laboratory both boys class and girls class has an improvement significantly. For level of thinking also both of classes has improvement in higher order thinking. So, it can be said that virtual laboratory is very good media to improve higher order thinking of students during a lesson. According to Chaeruman cited (Warsita, 2008) virtual laboratory media can train and develop higher order thinking means that train them to think in higher order thinking level.

Different gender, also different motivation in physics lesson. Gagne (Dahar, 2006) said that students has to be given a motivation to learn, it is expected that all the concept which is obtained can be useful for them. Motivation also make the concept in learning process are easier absorbed by the students. In this cases, there are differences motivation between boys class and girls class in

learning physics. Higgins cited (Putri, 2010) James, a physiologist in education found the basic differences factor to motivate boys students and girls students. Where girls students has motivation to make their parents and teacher happy with learning, while boys students has less motivation on it except the subject of learning is the most preferred by them. That research is in a line with the result in questionnaire interest in physics that boys students is more interest than girls in physics learning. So, that motivation is proportional with learning outcomes in learning process.

Interest in physics generally result from the questionnaire, it is obtained that boys class has more interest than girls class. Also conceptual mastery result that is obtained, boys has outperformed than girls class. The result of conceptual mastery is caused by interest in physics. Actually interest is one of motivation that comes from inside the students itself (Dimyati and Mudjiono, 2009). Motivation is very important in learning process to improve learning outcomes of students during learning process especially in conceptual mastery.

This statement is in a line with conceptual mastery result which is stated that there is a difference of conceptual mastery improvement between boys class and girls class with boys class has greater result than girls class. It is also proven by the correlational result between interest in physics and conceptual mastery. The results said that there is a significant relationship between both variables because the results is less than 0.005, it is 0.001. And they have strong correlation within them with the value 0.648. for coefficient determination is about 42% means that conceptual mastery of students can be explained by interest in physics, but the rest of it 58% can be explained by other factor there are genders, process of learning, multimedia interfaces, and body anatomy of their brain development. Conceptual mastery has relationship with interest in physics also proven by the result of (Lai, 2011) said that motivation is related to achievement and intrinsic motivation can predict math achievement.

Because physics consist of mathematical reasoning, logical, analytical, logical thinking, abstract things, and etc. So, the value of approval level in statement physics is a difficult and boring lesson, boys class has lower for

approval value while girls class has higher approval level value. It is caused by boys tends to use his left hemisphere of brain. Left hemisphere of brain in boys developed more then girls. Left hemisphere of brain here controlled the logical thinking, abstract things, numerical arrangement, analytical thinking (Wood, 2009). These ancient hunting skills are the reason men dominate areas like architecture, chemistry, physics, building, and statistics (Pease and Pease, 2008). So that the boys class has more interest in physics lesson than girls class. Because girls tends to use her right hemisphere of brain that consist of intuitive, visually, emotional, and etc. This result also the same and linked with level of thinking in C3 (Applying) that tends more formula problems and C4 (Analyzing) , that is stated girls class got lower value in both of cognitive level than boys class.

So, to make interest in physics of girls class improves, teacher can do some appropriate treatments. Based on McBride (2006), to enhance learning physics of girls class as like provide opportunities for girls to study together and expect girls to ask for help and want to affiliate with a teacher. It is in a line with the approval level of questionnaire statement that girls students most choose agree for they can't do physics homework by themselves. In the process of learning also figure that statement, girls class always asks in every level of steps how to conduct the experiment and always need teacher helps. Then based on Haussler and Hoffmann (2002), they said to stimulate interest in Physics among girls as like connect physics with the application clearly, encourages discussions and reflections on the social importance of physics ,shows physics in relation to the human body. Physics is include in science that has a link with other subject in science such as biology. From TIMSS result shown that girls tends to have high score in biology rather than boys (Mullis *et al*, 2000). So that, if there is something girls like, it will increase their interest and motivation to learn something.