

Effect on Student's Critical Thinking in Physics Classroom Using Virtual Laboratory

Jipsy Malhotra

Abstract--- *A congenial environment in classroom always have innovation in form of creativity which leads to construction of content. Creativity is one of the vital goal of education. Right mix of creativity with curriculum will transform the way students acquire knowledge and apply in life. In this research paper researcher has discussed the effect on students critical thinking in physics classrooms using Virtual laboratory. Researcher has done Quasi experimental study to see the effect of Virtual laboratory using pre-test post-test design. Statistical technique used is paired sample t-test. Results showed improvement in critical thinking level of students.*

Keywords--- *Critical thinking, Virtual Laboratory*

I. INTRODUCTION

We live in the world of developing technologies. Technology has enhanced the educational process and created lots of platform to innovate the teaching learning strategies. The use of informational communication technology has already existed in methodological skills. But implementation of virtual classrooms has not reached to all classrooms. Globalization, new technology, and knowledge growth in today's societies call for creative and purposeful citizens who can combine excellence with ethics. Gifted students and professionals in science create new ideas and products that can be used in the benefit of our society. A congenial environment in classroom always have innovation in form of critical thinking which leads to construction of content. Critical thinking is one of the vital goals of education. Right mix of creativity with curriculum will transform the way students acquire, critical thinking, and knowledge and apply in life.

Science education especially in physics learning requires active involvement of thinking process for having clarity of subject matter. All scientific questions cannot be answered by books and discussion thoughts only. The scientist believes only those concepts in which results of carefully collected data and analysis of measurement done in evidence. We cannot separate physics from technology in this world. IT based physics learning helps in motivating and encouraging students in active participation in concept clarity of subject matter as it leads to innovation or other higher order thinking skills. Through technology, of course some 21st century skills will be achieved. One of the abilities demanded is the ability to think critically. Efforts to improve critical thinking skills are carried out through the application of appropriate and consistent learning models.

In physics class laboratory is vital and central part of teaching learning process. Traditional laboratory needs sufficient landscape. Many of the schools don't have sufficient space or limited well-equipped laboratory. Good physics learning is purely work on practical's as it leads to reconstruction of concepts and develops higher order thinking as critical thinking. There is sometimes lack of material due to cost or area. There for it became necessary to find all the alternative solution of cost and space that should be efficient, practical and cheaper. For

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covering all these gaps virtual laboratory was used as methodology. Virtual laboratory utilization helps to increase the concept clarity and also increases the critical thinking of the students.

Critical thinking permits students to

- Evaluate their own thinking and issues related to physical, mental and surrounding.
- Developing decision taking efficiency for finding solution of existing issues.
- Make reasonable and defensible decisions about issues related to individual and community well-being.
- Design different steps to solve social, political and economic issues.
- Understanding the community and innovating different ideas to make it more civilized.

For developing critical thinking teacher should

- Be their subject expert so that while interacting they can move into depth analysis of the topic.
- Be open to become a continuous learner, so that all challenges that came from student's mind can be cleared.
- Motivate students to think out of box by engaging them in critical thinking while discussions in classrooms.
- Respect to the ideas and personal experience of the students in the classrooms.
- To inquire through questions, challenge the principles and mould the theories as per their concept clarity.
- Work not only to their cognitive domain but affective domain by facilitating them for peer interaction
- Providing congenial environment by ensuring safety, making them work cooperatively and sharing their responsibilities.
- Child centric approach in classroom.

Advantages of using Virtual Labs

- Virtual labs are useful for the topics where frequent experiments are needed with safety measures.
- Actual experiment process is time consuming
- Health risk involved experiment can be done virtually.

This study integrates virtual lab (PhET simulation) usage in physics classrooms. The material taught was force and motion as shown in below figure. The following are the animated images of force chapter taught in class using virtual labs with three phases.

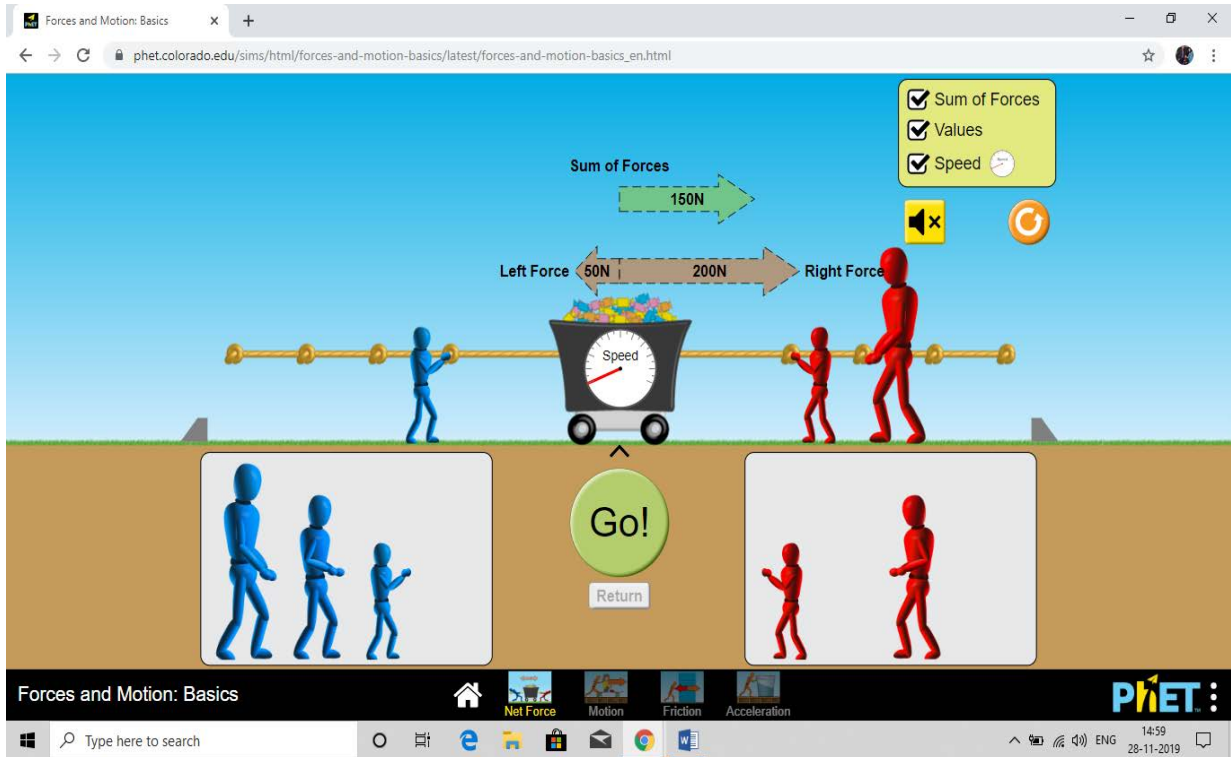
Phase 1: Initial stage

Sum of Force = 0N



Phase 2

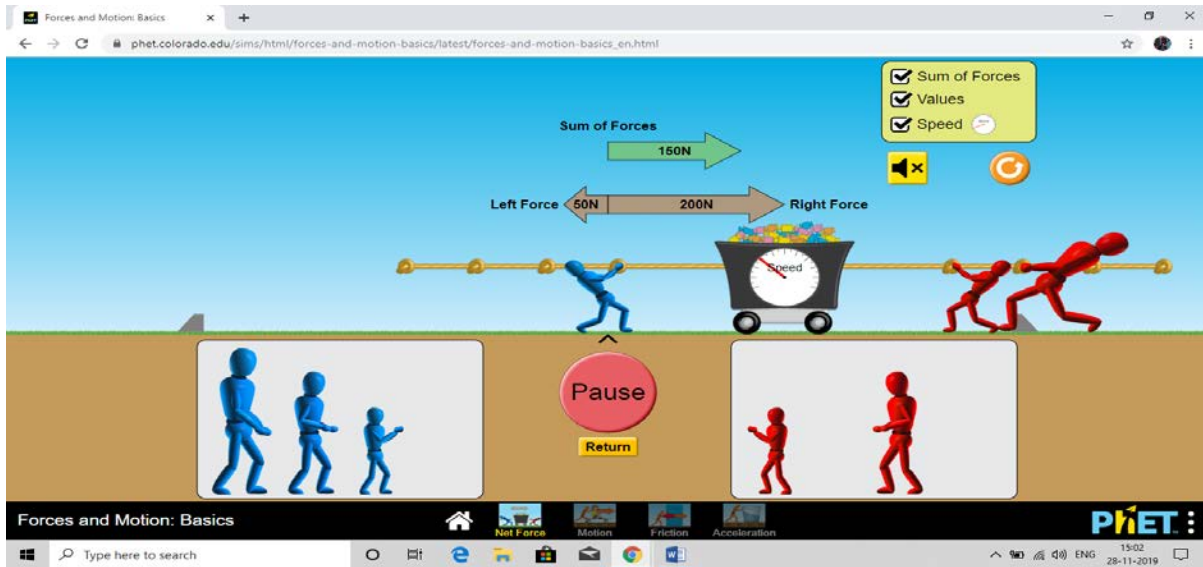
When net force =150N



Phase 3

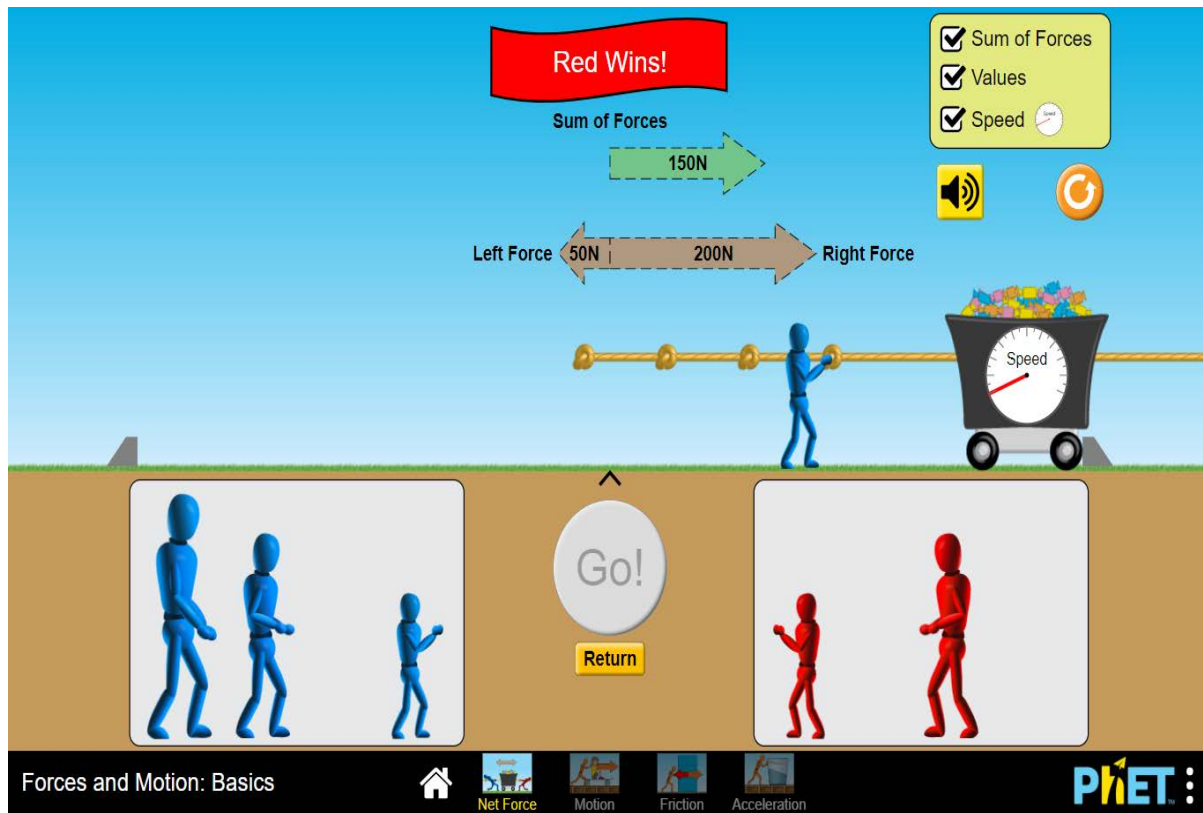
When net force =150N

Weight has been displaced from its initial position .



Phase 4

Red wins as force towards right side was exceeding.



The above animated images show how with increase in value of Force effects the speed. The clarity of the concept leads to rise in critical thinking.

II. RESEARCH METHOD

Quasi experimental methodology is employed. Research students were chosen using purposive sampling technique. 98 students of one school with 49 students in each section was considered. Two intact sections were taken. One section called control group was taught through traditional approach in physics classroom. Other section as an experimental group taught using virtual lab (PhET Simulation Technology) on Physics concepts. The treatment was given for continuous one week; one lecture daily of 60 minutes was arranged. Data on student's critical thinking was collected by using self-made questionnaire by researcher. The questionnaire contains questions having components as Inferences, explanation, evaluation, self-regulation and analysis as discussed by Facione's. Pre-Post-test was done to find out the effect on critical thinking. Increased level of critical thinking was determined by comparing the pre and post-test scores.

Research questions

1. To find out effect of virtual laboratory usage on critical thinking of students.
2. To find out student's perception about virtual lab usage.

III. DATA ANALYSIS

Data was analysed descriptively and statistically too. The results of critical thinking scores were analysed using paired sample t-test with normality test data.

IV. RESULTS

Results showed that usage of virtual labs in physics classroom has led to increase in critical thinking. Previously students were given pre-test to know their initial ability. After the experiment post-test was given. The result of normality test for pre-test and post-test data is as given below in figure

Table 1: Pre-test critical thinking scores of Experimental and control groups

Initial mean scores of students critical thinking ability for experimental group is 7.31 and for control group 6.10. It shows initially both groups were at same level .

Group	N	Mean	SD
Experimental	49	7.31	2.31
Control	49	6.10	2.12

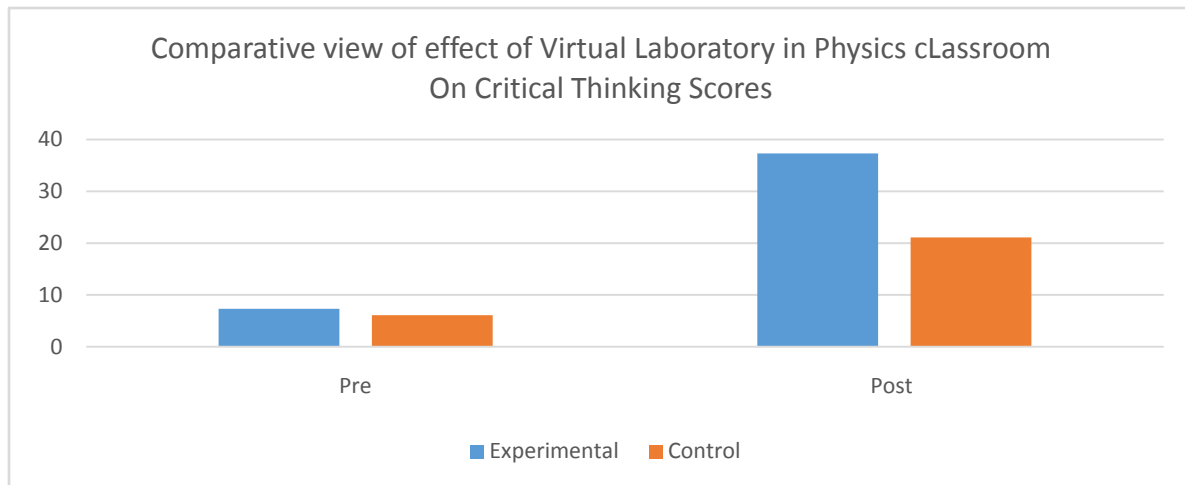
Table 2: Post-test critical thinking scores of Experimental and control groups

Final mean scores of students critical thinking ability for experimental group is 37.31 and for control group 21.10. It shows rise in critical thinking level when taught through virtual lab usage.

Group	N	Mean	SD
Experimental	49	37.31	3.17
Control	49	21.10	4.28

It has been noticed that creative thinking skill of control and experimental group has increased but there is more rise in experimental group as shown in below figure

Figure: Comparative view of effect of Virtual Laboratory in Physics Classroom On Critical Thinking Scores



V. DISCUSSION

After performing the experiment, it has been cleared that virtual laboratory helps in encouraging students in active participation. It not only leads to get correct inference and strengthen their skills. but also full time security. This lead to engagement, increase in interest and raise in concept clarity. This in accordance with Oidoy (2012) research that “Virtual laboratories are useful to provide learners with the opportunity to learn by doing, exciting, motivating activities to discover, ensuring classroom interaction through discussion and debate, develop higher order thinking skills. In virtual labs learning, most student activities are performed on a computer. Students are given problems, some information, and software hat they can use to test ideas. The next step is left entirely to the students. Each student should be able to identify the needs and develop the appropriate design, test the experimental design, and analyse the suitability of the original plan with the results already obtained, then revise and experiment if necessary.”Gunawan also showed that virtual Laboratory usage leads to improve in critical thinking disposition. Yusuf and Subaer (2013) also agree to virtual laboratory usage lead to active participation of learner. Students believe that virtual laboratory usage is one of the best supporting aid for concept clarity which leads to increase in critical thinking of students. Nance (2009) and co-authors supported usage of virtual laboratory and also added the usage of this for research process.

VI. CONCLUSION

Research on effect on student’s critical thinking in Physics classroom using Virtual Laboratory in force and motion concept assisted by PhET simulation has positive effect. Both experimental and control group has shown rise. But there is comparatively more increase in critical thinking scores in experimental group students. Only thing to be kept in mind is students should be familiar with the features of virtual laboratory, to achieve the goals faster. Therefore, teachers of present century should need to effectively utilize virtual laboratories to increase the learning outcomes designed.

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