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An Investigation of Physics Laboratory and its Effects on Students Learning at Secondary Level in Mardan

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Abstract

The quantitative study aimed to investigate Physics Laboratory and its effects on students learning at Secondary Level in Mardan. The objectives of the study were, to investigate the physical resources in physics laboratory at secondary level in Mardan; and to inquire the effects of physical resources on students learning at secondary level in Mardan. This study was delimited to male public sector secondary schools in district Mardan. All the (23059) secondary school students in district Mardan were the population for this study (EMIS, 2019). A sample of (400) Secondary School Students of class 9th and 10th were selected randomly in this research work. A closed ended Questioner was used as a research instrument in this study with the options of 'Yes', 'No', and 'Undecided" collected and data were analysed by using simple percentages. Graphs and data were interpreted. Major findings of the study showed that physical resources help Students in their learning activities. Majority of students responded that physics laboratory having fully equipped with physical recourses. It was concluded that Physics laboratory is fully equipped& facilitated. It was recommended that laboratories should be upgraded & teachers should be properly trained.

Keywords: Physics Laboratory, Physical Recourses, Learning Activities etc.

Introduction

Experiments in physics are conducted in a physics laboratory. As is well known, experimentation is an essential component of the fundamental subject in the field of physics. These physics laboratories can be found in almost every educational facility. The majority of colleges purchase physics equipment in accordance with the curriculum. As per Oxford Advance Learners dictionary definition Physics is "the scientific study of matter and energy and the relationships between them, including the study of forces, heat, light, sound, electricity and the structure of atoms". It is clear that Physics is a huge subject that encompasses many different disciplines, and students are taught the principles of each of these areas at the school level. Numerous school-level experiments might be carried out in each of them. A variety of physics laboratory tools are available, ranging from basic ones like magnets, pulleys, pendulums, inclined planes, heat lamps, beakers, lenses, glasses, tuning forks, item scales, etc. to more advanced ones like spectroscopes, microscopes, electromagnets, voltammeters, and potentiometers, etc. (Gooday, 1990). Physics is a branch of natural science that examines matter, its building blocks, motion and behavior in space and time, as well as the associated concepts of energy and force. (Valle, 1989).Understanding how the cosmos acts is the core objective of one of science's most fundamental fields, physics. A physicist is a scientist who focuses on the discipline of physics. Due to the involvement of astronomy, physics is not only one of the oldest academic fields, but also quite possibly the oldest. Physics, chemistry, biology, and some disciplines of mathematics have been a part of natural philosophy for a large portion of the previous two millennia, but during the Scientific Revolution in the 17th century, these natural sciences became independent research fields. The borders of physics are not well defined because it interacts with numerous interdisciplinary fields of study, such as quantum chemistry and biophysics (Brody, 2012). The underlying mechanisms investigated by other sciences are frequently explained by new concepts in physics, and this opens up new directions for investigation in these and other academic fields like mathematics and philosophy.

New technologies are frequently made possible by improvements in physics. For instance, improvements in the knowledge of electromagnetism, solid-state physics, and nuclear physics directly influenced the creation of new items that significantly altered modern society, such as television, computers, home appliances, and nuclear weapons; improvements in thermodynamics influenced the growth of industrialization; and improvements in mechanics provided the inspiration for the invention of calculus. Early modern Europeans utilized experimental and quantitative techniques to uncover what are now thought to be the laws of physics, establishing physics as a distinct science. The heliocentric Copernican model of the solar system replaced the geocentric one. Kepler determined the laws governing planetary body motion between 1609 and 1619. Galileo pioneered the use of telescopes and observational astronomy in the 16th and 17th centuries. Isaac Newton discovered and combined the laws of motion and universal gravitation (that would come to bear his name). Newton also created calculus, the study of continuous change in mathematics, which offered fresh approaches to the solution of physical problems. (Linn, 1987).

Science describes the natural objects and phenomena relatively. It means that to define or describe a single natural happening, one has to depend on the concepts about other related objects. The relative nature of knowledge requires you to have know-how about the related fields of your study. The conceptual study for science students is necessary to the extent that without it you cannot understand even a single topic of science. Physics is mathematical, not because we understand the physical world so well, but rather because we do not, and we can only understand it mathematically. (American Association for the Advancement of Science. 1994). The conceptual knowledge of yours will allow you to think with greater clarity about the things. Moreover, concepts give birth to concepts. Many renowned scientists, whom you study theories of, were once just learners. What exalted them to the level of being a scientist was their understanding of concepts. They understood the concepts given by previous scientists. This understanding guided their interest in proposing new concepts. Likewise, as a student of FSc, if you are doing the conceptual study, you will most likely to propose even better ideas than those given before. Therefore, the conceptual study in any branch of science is the first step to become a great scientist. (Darling Hammond & Bransford, (Eds.) 2007). Apart from its intellectual benefits, the conceptual study of science is also very helpful in attempting the exams. Most of the students in FSc fail because they just try to memorize the topics and give no attention to the understanding of concepts. I have written a separate post on why FSc students fail in exams. All educational boards of Pakistan, particularly the Federal Board of Intermediate and Secondary Education (FBISE), designs question papers in a way that your concepts are to be checked. Most of the time, an examiner tries to check how well you have understood the concepts. It is for this reason that papers include conceptual questions besides just definitions. We are writing down some of the conceptual questions that can be asked in your final exams of physics XI: (Mullins, & Kiley, 2002).

Statement of the Problem

Physics is the backbone of science subjects at secondary level. Learning physics helps learners to understand about Universe and all the natural process of this universe or universes. Practical work in the physics helps students in their practical learning. It helps the learners to solve their day-to-day issues and problems. This study will help the students, teacher, heads & society to understand about physics lab in detail, and also its effects on their learning at the secondary level in district Mardan.

Objective of the Study

The objectives of the study were:

1. To investigate the physical resources in physics laboratory at secondary level in Mardan
2. To inquire the effects of physical resources on students learning at secondary level in Mardan.

Research Questions

The following Research Questions were developed:

1. What are the physical resources in physics laboratory at secondary level in Mardan?
2. What are the effects of physical resources on students learning at secondary level in Mardan?

Research Methodology

Population

All the (23059) secondary school students in district Mardan were the population for this study (EMIS, 2019).

Sample

A sample of (400) Secondary School Students of class 9th and 10th were selected randomly in this research work (Krejcie & Morgan, 1970) Online Raosoft Calculator were used for the purpose of sampling with margin error of 5%. .

Research Instrument

A closed ended Questioner was used as a research instrument in this study with the options of 'Yes', 'No', and 'Undecided'.

Data Analysis

Data was tabulated and analyzed by using simple percentages. Graphs and data were interpreted. Findings and conclusions were drawn and recommendations were made.

Review of Literature

Secondary Education

High school diplomas are referred to as secondary education. Typically comprises classes 9 through 12. Students pursue essential subjects like science, math, and English in addition to elective classes at the secondary education level. Secondary schools come in a variety of forms and provide dynamic learning opportunities in welcoming settings. The secondary level of education is typically comprised of grades 9 through 12, but some school districts in the United States also include grades 6 through 8 in this category. Public high schools are the most typical sort of secondary education. In the secondary education system, students typically attend various classes in various classrooms throughout their school hours. Each period lasts somewhere between 30 and 90 minutes. Importantly, students have the chance to study from many instructors. The best environment for preparing young people, especially adolescents, for healthy and fruitful adult life, including involvement in social, political, and economic realms, is commonly considered to be secondary education. A major portion of a country's population also needs a secondary education in order to develop the specialized skills and aptitudes required for a market that is becoming more and more technologically oriented if it is to compete in the global economy. (Minicucci,1992).Secondary education gives young people the education and training they so desperately need and helps lay the groundwork for restoring peace and unity at home in nations that are recovering from conflict or other crises. The challenge for developing nations, as well as nations that are experiencing conflict or crisis, is to ensure that the secondary education sub-sector can accommodate enough students to meet these needs, ensure stability through equitable access, and provide a curriculum that is long enough, of high enough quality, and relevant enough to ensure that all school-leavers have the skills and aptitudes necessary for a successful and healthy life. There is no quick trick to accomplishing this goal. In most nations, secondary education is the stage of the educational continuum that is in charge of a child's growth during adolescence, which is the most rapid stage of their physical, mental, and emotional development. The beliefs and attitudes that were created in primary school are more deeply ingrained along with the acquisition of knowledge and abilities at this exact educational level, especially in its first cycle. Seven levels are described in the 1997 International Standard Classification of Education (ISCED), which can be used to compare educational systems around the world. These can be applied in various ways, at various age levels, and by local denominations within a nation. (Kochhar, 1984). The seven levels are:

1. Level 0 represents pre-kindergarten education.
2. Level 1 represents primary education or the first stage of basic education.
3. Level 2 represents lower secondary education or the second stage of basic education.
4. Level 3 represents upper secondary education.
5. Level 4 represents post-secondary non-tertiary education.
6. Level 6 represents the second stage of tertiary education.

Physics Laboratory at Secondary Level

According to the findings of certain studies, the purpose of doing labs should be to teach experimental methodologies rather than to reinforce the material covered in the classroom (Holmes & Wieman, 2018). The laboratory work is the most essential component of the physics curriculum. Integral Sacred The laboratory serves as much more than a simple area at the rear of the classroom for students to use as a place to hone their abilities in physics. In the laboratory, students are taught how to ask questions, carry out procedures, acquire data, analyses data, answer questions, and develop new subjects to explore. In the context of the instruction of natural sciences, the term "laboratory" refers to activities that are based on the observations, assessments, and experiments conducted by the students.

(Roth& Roychoudhury, 1993). It is impossible to imagine studying science or learning about science without taking part in some kind of laboratory or fieldwork experience. As a result, it is now feasible for students to have the same amount of influence as their teachers. A young person may conduct an experiment that would perplex his or her more experienced peers if that young person is familiar with the appropriate techniques. (Adams and Shrum 1990). Newton's program of "experimental philosophy" is mostly credited for firmly establishing the fundamental methodologies of physics. This method bases its hypotheses on experience-based reasoning, and experimentation is used to verify their predictions. Students participate in laboratory exercises to gain familiarity with phenomena in high school physics. These exercises also provide as a springboard for the students' systematic idea development and a platform for evaluating the soundness of their justifications.(Bernard, Sidney& Baylor, 1985)

Students Learning

High school students have the opportunity to study physics as one of the three scientific fields. The subject of physics is presented using a variety of mediums, including multimedia lectures, instructional videos, quizzes, evaluations, and offline and online projects. The purpose of the physics class is to get pupils ready for the level of science they would encounter in college.(Daineko, Dmitriyev & Ipalakova, 2017). However, depending on a student's overall academic performance, some students may be allowed to study physics in the 12th grade or even as early as the 10th grade. Physics is often taught in the 11th grade. Students will be taught the fundamental principles that govern the physical universe. Physics education helps students understand the workings of the cosmos, from its structure to how its diverse components interact. In order to understand the significance of difficult scientific topics in everyday life, students examine them and make real-world connections. The objective of a physics education is to provide students with a firm understanding of motion, energy, electricity, magnetism, and the basic principles that govern the universe. Students gain the ability to think abstractly and critically about scientific ideas and procedures as they practice asking questions, formulating hypotheses, conducting experiments, and finding solutions to problems. (PosNER, Strike, Hewson, & Gertzog, 1982).

Conditions for Learning through Laboratory

According to theory and research, laboratory activities can provide meaningful learning opportunities for all students if the students have the chance to work with tools and materials while collaborating with classmates in a setting where they are free to look for answers to challenges that interest them. In other words, students must be given the opportunity to engage in meaningful learning. The following instructional circumstances make this feasible. (Roth & Roychoudhury, 1993).

- To acquire the motor and cognitive abilities required to excel in physics, students must actively engage in laboratory activities. The only method to accomplish this is in this manner. (Etkina and Van Heuvelen, 2007).
- The number of lab stations and the size of the class must be kept to a minimum in order for the instructor to actively work with each lab group while also keeping an eye on student activity. For lab groups with just two or three students, this necessitates the use of the proper tools and stations. All students should have equal access to laboratory activities with the proper level of supervision, according to schools and instructors, and they should make accommodations for students with disabilities.
- Wherever feasible, integrate toys, sports equipment, tools, household products, and other objects that are relevant to the students' world in laboratory activities.
- For laboratory activities to be integrated into classroom work, students must be able to move freely between their desks and the laboratory area, as well as have enough room to set up equipment. It is desirable to have desks, laptops, and adequate room for lab stations and equipment in the classroom. At the high school level, it is extremely beneficial for the lab to be connected to the classroom.
- The effectiveness of students' learning of physics should include evaluation of skills acquired during laboratory activities as well as of the material gained during these activities. To evaluate laboratory learning and emphasize the significance of laboratory work to students, test questions that are directly related to laboratory work are employed.
- Good laboratory operations call for enough and convenient equipment storage, a workstation with tools for repairing, maintaining, or manufacturing equipment, as well as enough planning

time in their calendar to maintain, set up, and test laboratory equipment before to courses. These are all requirements for effective laboratory operations.

- For safe laboratory work for both teachers and students, it is essential to have access to safety information and resources, such as the AAPT publication Teaching Physics Safely, as well as adequate, up-to-date safety equipment.(Kwan & Texley,2009).

To keep up with emerging trends in physics teaching and to retain their professional abilities, teachers need the time, resources, encouragement, and support to travel to important professional meetings. These activities include attending workshops and professional conferences, perusing new laboratory equipment, curricula, textbooks, and reference materials, working with colleagues in schools and colleges, and interacting with others in the physics and engineering research community. (Tobin, 1990).

Data Analysis and Interpretation

Table No. 1 Physical Facilities

Item No	Statement	Yes	No	Undecided	%	%	%
1	Physics laboratory is fully equipped.	**323**	45	32	**80.75**	11.25	8
2	Physics laboratory has enough experimental tables.	**311**	40	49	**77.75**	10	12.25
3	Physics laboratory has safety kits.	**299**	55	46	**74.75**	13.75	11.5
4	Physics laboratory has well lighted.	**301**	44	55	**75.25**	11	13.75
5	Physics laboratory has Vernier Calipers.	**255**	95	50	**63.75**	23.75	12.5
6	Physics laboratory has Screw Gauges.	**246**	85	69	**61.5**	21.25	17.25
7	Physics laboratory has Stop Watches.	**302**	48	50	**75.5**	12	12.5
8	Physics laboratory has free fall apparatus.	**358**	29	13	**89.5**	7.25	3.25

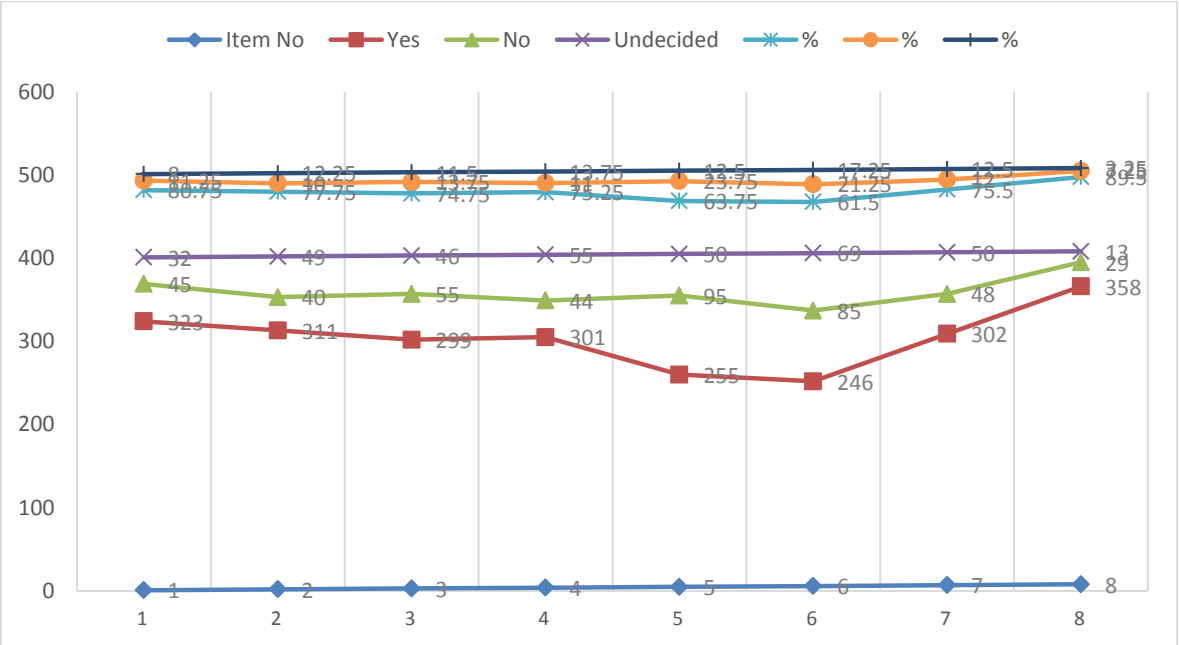

Table No. 1, item no.1, shows that 400 secondary school students were asked that physics laboratory is fully equipped. As a result to this statement 323 with percentage of 80.75 opted 'Yes', 45 students with percentage of 11.25 opted 'No' and 32 students with the percentage of 8 were opted 'Undecided'. Results show that the physics laboratories are fully equipped. Item no.2 shows that 400 secondary school students were asked that physics laboratory has enough experimental tables. As a result to this statement 311 with percentage of 77.75 opted 'Yes', 40 students with percentage of 10 opted 'No' and 49 students with the percentage of 12.25 were opted 'Undecided'. Results show that the physics laboratories have enough experimental tables. Item no.3 shows that 400 secondary school students were asked that physics laboratory has safety kits. As a result to this statement 299 with percentage of 74.75 opted 'Yes', 55 students with percentage of 13.75 opted 'No' and 46 students

with the percentage of 11.5 were opted 'Undecided'. Results show that the physics laboratories have safety kits.Item no.4 shows that 400 secondary school students were asked that physics laboratory has well lighted. As a result to this statement 301 with percentage of 75.25 opted 'Yes', 44 students with percentage of 11 opted 'No' and 55 students with the percentage of 13.75 were opted 'Undecided'. Results show that the physics laboratories have well lighted. Item no.5 shows that 400 secondary school students were asked that physics laboratory has Vernier Calipers. As a result to this statement 255 with percentage of 63.75 opted 'Yes', 95 students with percentage of 23.75 opted 'No' and 50 students with the percentage of 12.5 were opted 'Undecided'. Results show that the physics laboratories have Vernier Calipers.Item no.6 shows that 400 secondary school students were asked that physics laboratory has Screw Gauges. As a result to this statement 246 with percentage of 61.5 opted 'Yes', 85 students with percentage of 21.25 opted 'No' and 69 students with the percentage of 17.25 were opted 'Undecided'. Results show that the physics laboratories have Screw Gauges. Item no.7 shows that 400 secondary school students were asked that physics laboratory has Stop Watches. As a result to this statement 302 with percentage of 75.5 opted 'Yes', 48 students with percentage of 12 opted 'No' and 50 students with the percentage of 12.5 were opted 'Undecided'. Results show that the physics laboratories have Stop Watches. Item no.8 shows that 400 secondary school students were asked that physics laboratory has free fall apparatus. As a result to this statement 358 with percentage of 89.5 opted 'Yes', 29 students with percentage of 7.25 opted 'No' and 13 students with the percentage of 3.25 were opted 'Undecided'. Results show that the physics laboratories have free fall apparatus.

Table No. 2 Physical Resources on Students Learning

Item No	Statement	Yes	No	Undecided	%	%	%
9	Physical Resources helps in Students Concepts.	**300**	42	58	**75**	10.5	14.5
10	Physical Resources supports Students Understanding.	**302**	38	60	**75.5**	9.5	15
11	Physical Resources sustenance Students Demonstration.	**322**	56	22	**80.5**	14	5.5
12	Physical Resources benefits Students Skills.	**313**	49	38	**78.25**	12.25	9.5
13	Physical Resources advantages Students Observation.	**268**	94	38	**67**	23.5	9.5
14	Physical Resources deals with the students' Abilities.	**250**	91	59	**62.5**	22.75	14.75
15	Physical Resources helps Students in their assignments.	**336**	56	08	**84**	14	2
16	Physical Resources helps in Students experiments.	**375**	20	05	**93.75**	5	1.25

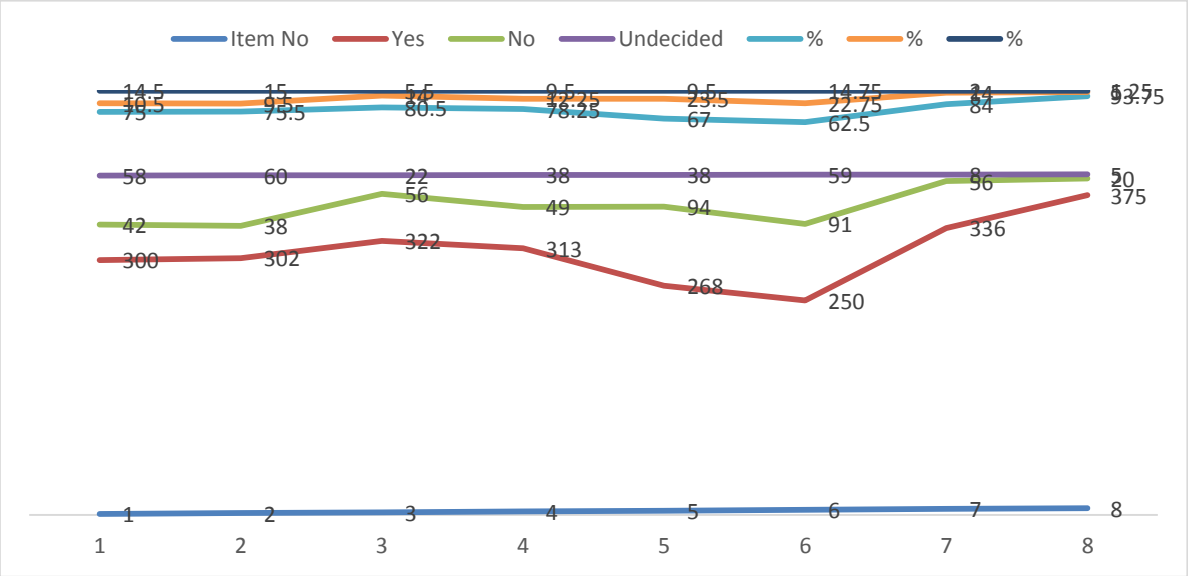

Table No. 2, item no.9, shows that 400 secondary school students were asked that physical resources help is Students concepts. As a result to this statement 300 with percentage of 75 opted 'Yes', 42 students with percentage of 10.5 opted 'No' and 58 students with the percentage of 14.5 were opted 'Undecided'. Results show that the physical resources help is student's concepts. Item no.10 shows that 400 secondary school students were asked that physical resources support students understanding. As a result to this statement 302 with percentage of 75.5 opted 'Yes', 38 students with percentage of 9.5 opted 'No' and 60 students with the percentage of 15 were opted 'Undecided'. Results show that the physical resources support students understanding. Item no.11 shows that 400 secondary school students were asked that Physical Resources sustenance students demonstration. As a result to this statement 322 with percentage of 80.5 opted 'Yes', 56 students with percentage of 14 opted 'No' and 22 students with the percentage of 5.5 were opted 'Undecided'. Results show that the physical resources sustenance students' demonstration. Item no.12 shows that 400 secondary school students were asked that physical resources benefits student's skills. As a result to this statement 313 with percentage of 78.25 opted 'Yes', 49 students with percentage of 12.25 opted 'No' and 38 students with the percentage of 9.5 were opted 'Undecided'. Results show that the physical resources benefits student's skills. Item no.13 shows that 400 secondary school students were asked that physical resources advantages student's observation. As a result to this statement 268 with percentage of 67 opted 'Yes', 94 students with percentage of 23.5 opted 'No' and 38 students with the percentage of 9.5 were opted 'Undecided'. Results show that the physical resources advantages student's observation. Item no.14 shows that 400 secondary school students were asked that physical resources deal with the students' abilities. As a result to this statement 250 with percentage of 62.5 opted 'Yes', 91 students with percentage of 22.75 opted 'No' and 59 students with the percentage of 14.75 were opted 'Undecided'. Results show that the physical resources deal with the students' abilities. Item no.15 shows that 400 secondary school students were asked that physical resources help students in their assignments. As a result to this statement 336 with percentage of 84 opted 'Yes', 56 students with percentage of 14 opted 'No' and 8 students with the percentage of 2 were opted 'Undecided'. Results show that the physical resources help students in their assignments. Item no.16 shows that 400 secondary school students were asked that physical resources help in student's experiments. As a result to this statement 375 with percentage of 93.75 opted 'Yes', 20 students with percentage of 5 opted 'No' and 5 students with the percentage of 1.25 were opted 'Undecided'. Results show that the physical resources help in student's experiments.

Findings

On the basis of the analysis the following findings were made:

1. 80.75 respondents were of the view that Physics laboratory is fully equipped.
2. 77.75 respondents were of the view that Physics laboratory has enough experimental tables.
3. 74.75 respondents were of the view that Physics laboratory has safety kits.
4. 75.25 respondents were of the view that Physics laboratory has well lighted.
5. 63.75 respondents were of the view that Physics laboratory has Vernier Calipers.
6. 61.5 respondents were of the view that Physics laboratory has Screw gauge.
7. 75.5 respondents were of the view that Physics laboratory has Stop watch.
8. 89.5 respondents were of the view that Physics laboratory has Free fall apparatus.
9. 75respondents were of the view that Physical Resources helps in Students Concepts.
10. 75.5respondents were of the view that physical resources support students understanding.
11. 80.5 respondents were of the view that physical resources sustenance student's demonstration.
12. 78.25respondents were of the view that physical resources benefits student's skills.
13. 67 respondents were of the view that physical resources advantages student's observation.
14. 62.5 respondents were of the view that physical resources deals with the students' Abilities.
15. 84 respondents were of the view that physical resources help Students in their assignments.
16. 93.75 respondents were of the view that physical resources help in student's experiments.

Conclusions

On the basis of the findings, it was concluded that:

Physics laboratory is fully equipped, enough experimental tables, has safety kits, has well lighted, has Vernier Calipers, has Screw Gauges, has Stop Watches, has free fall apparatus, Physical Resources helps in Students Concepts, supports Students Understanding, sustenance Students Demonstration,

benefits Students Skills, advantages Students Observation, deals with the students' Abilities, helps Students in their assignments and helps in Students experiments.

Recommendations

On the basis of conclusions, it was recommended that:

1. The Secondary School Physics laboratories should be upgraded according to the requirements of the learners.
2. It is also recommended that the teachers should be properly trained for the use of laboratories, this improves the overall learning of the students.

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