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Perception of School and University Students in Learning Physics in National Capital Region, India

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Abstract This study investigates and correlates the perception of school and university students in learning Physics at senior secondary, graduation and post graduation levels. The pedagogical experiments is conducted on learners' of 10+2 class of school level and B.Sc.& M.Sc. class of University level. Authors will use the questionnaire's method and will identify five types of research questions focused on concepts, understandings, relationship and applications, which reflects the commitment of the learners for learning physics. Each learner's undergoes the questionnaire's test. To analyze the results of experiment, linear regression statistical analysis technique is used to justify and correlate the significance of performance level of students at 10+2, graduate and post-graduate course. The study reveals that, on the average, the percentage of students in learning physics with strong positive commitment at 10+2, B.Sc. and M.Sc. level is almost same (46.1 – 46.3%) but it varies with positive commitment and poor or negative commitment. The study establishes that on the average, the students with negative commitment are less than 14%. The results of regression analysis tell that there is positive correlation among the learners at all levels and for all categories but their degree of correlation significantly varies. It can be seen that the coefficient of performance (r^2) decreases for transition from B.Sc. to M.Sc. level for learners having strong positive, positive and negative commitments in physics learning.

Keywords: *physics, learner, questionnaires, regression, school, university*

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1. Introduction

Physics is a natural science, which is a basis of scientific and technical progress. It inculcate the basic knowledge and technology acquisition among the learners that is essential in era of advanced transformation, information and technology [1,2,3,4]. It plays a significant role in exploring the universe and helps to develop the observational skill, accuracy, analysis ability and creative thinking of the students [5,6]. Its concepts and techniques underpin the progress of all other branches of science. It is also a cross-cutting discipline that has applications in many sectors of economic development, including health, agriculture, water, energy and information technology [7]. The application of science through technology is crucial for providing the infrastructure that all modern countries need. The role of science in sustainable development was recognized at the United Nations Millennium Summit in 2000. A careful analysis of the Millennium Development Goals that came out of the summit shows the importance of science and technology in meeting those goals and as a tool for economic growth. In October 2005, politicians, educators and physicists from all over the globe met in Durban, South Africa, to consider the role of physics in creating a sustainable future for developing countries [8].

In India, only few studies are available in literature regarding Physics learning. Research in physics education conclusively shows that the lecture paradigm is no longer the only possibility [9]. Credible alternative paths replace the lecture format with learning environments and the proverbial lecture hall with a learning workshop or a studio. These completely redesign the course structure to take into account both the research on student learning and the social theories of learning. The study reveals that, new generation has a high capacity to take charge of its own learning and is often far ahead on the learning curve than the instructors, in abilities for collaborating, social networking and leveraging technology. The success of these programs suggests that the not too distant future certainly belongs to the new paradigm of comprehensive unified learning environments. Then this is the quantum leap required as we move on the knowledge network and scale up education for greater access to our masses [9,10]. In an another study, the authors, conclude that there is a strong need to pay attention to learners' beliefs, attitudes, and expectations when they come into the classroom, and effort should be made to transfer their novice like view to expert like view by employing certain strategies, like

concept tests and Peer Instruction [11], just-in time teaching [12], interactive lecture demonstrations [13], etc. Research has provided strong evidence that such strategies can increase conceptual as well as expectation gains [14,15,16].

However, decreasing number of learners to study physics at schools and colleges in India is a serious concern. This affects the choice of professions by learners and on the prestige of professions of technical directions. Learners do not like to study physics because of the complexity of the materials. It is teacher's responsibilities to make learning physics more accessible, understandable, and interesting. The challenges are training teachers, providing infrastructure for a ballooning population of students, and attracting a higher fraction of those students to physics and other sciences [17,18].

In an educational system, senior secondary education is important as acts as a feeder for graduation and post graduation courses. The quality of higher education, which is expected to produce high quality professionals in the different fields, depends upon the quality of secondary education [19]. With this view, in the present study, an attempt has been made to evaluate the understanding of the students in physics learning at 10+2, B.Sc. and M.Sc. levels. Linear regression analysis is done to correlate the performance of the learners at 10+2 and B.Sc. level & B.Sc. and M.Sc. levels.

2. Methods and Materials

The research design in this study is aimed to diagnose the learner's interest in Physics, their understanding and degree of commitment in physics learning, physics in relationship, conceptual knowledge and applications of physics in growth of individual and society for sustainable development. This study addressed the following questions:

(i).What are the perceptions of students about the contribution of physics in development of other sciences, technology and society as a whole?

(ii). How the students learning outcome in physics contribute in energy consideration and sustainability?

(iii). How the performances of experiments in Physics change the conception of students towards physics learning and shaping the career?

(iv). How the students are accurate in identifying the concepts in physics, and contribution of Physics in real life in relation to technology, research and knowledge?

(v). How the commitment of students in physics learning varies as they move from 10+2 to B.Sc. level and B.Sc. to M.Sc. level ? Is there any correlation among the students in perception of learning physics at 10+2, B.Sc. and M.Sc. levels?

The pedagogical experiment was conducted in M.Sc. (Physics) and B.Sc. (Non-medical) classes of SGT University Gurugram, 12th class students of Central Colonel Academy, Senior Secondary School Gurugram, Kendriya Vidalya Sector 12, Dwarka, New Delhi, Kendriya Vidyalaya Sector 05 Dwarka, New Delhi and Government Sarvodaya Vidyalya Jafferpur, Delhi, in April 2018. The questionnaires' method has been used. In all 218 learners participated in the experiment and each learner filled in the questionnaire.

The perception measuring scale was divided in to two parts. The first measuring scale contain twenty items with three likes – type option. A three point scale used was ranged from, SA-strongly agree, A-agree and D- disagree. The second measuring scale contain 9 items with four likes - type option and one correct option. The research questionnaires have positive polarization with physics and were based on five different understandings given in research questions. The items of the questionnaire are presented in Table 1 – Table 3.

3. Results

3.1. Research Question 1

What are the perceptions of students about the contribution of physics in development of other sciences, technology and society as a whole?

The answer to the research question 1 is illustrated in percentage in Table 1 while Figure 1 shows the illustration in chart form.

Table 1.

		M.Sc.			B.Sc.			10+2.		
S. No.	Statement/Items	SA (%)	A(%)	D (%)	SA (%)	A(%)	D(%)	SA (%)	A(%)	D (%)
1	A quantitative study of whatever we observe in nature tells that these observations can be explained and understand in terms of a few laws of Physics.	62.5	37.5	0	38.9	47.2	13.9	47.3	41.2	11.5
2	Physics is the most basic of all the sciences and it had played a very important role in the development of other sciences.	62.5	37.5	0	66.7	33.3	0	46.6	39.9	13.5
3	The study of structure of atom, radioactivity, x-ray diffraction etc. solved a number of problems in understanding of complex chemical structure in chemistry.	62.5	37.5	0	41.7	52.8	5.5	42.6	42.6	14.8
4	Advancement in physics, in developing, optical microscope, electron microscope etc. is found to be of immense use in the study of Biology.	87.5	12.5	0	63.9	33.3	2.8	55.4	31.1	13.5
5	The use of Radio Telescope has leads to the discovery of astronomical bodies.	0	62.5	37.5	36.1	52.8	11.1	31.1	54.1	14.8
6	The mechanical, nuclear, gravimetric and acoustic techniques developed in physics are widely used in sciences such as geology, meteorology, oceanography and seismology.	50	12.5	37.5	30.6	58.3	11.1	36.5	52.7	10.8
7	Physics is a quantitative science and so it has strong relationship with mathematical concepts.	100	0	0	75	25	0	60.8	29.7	9.5
8	The discoveries in Physics have brought revolution in Technological advancement.	62.5	37.5	0	61.1	38.9	0	58.8	33.8	7.4
9	Weather forecasting becomes very accurate with the use of satellites.	25	50	25	47.2	44.4	8.4	52	37.8	10.2

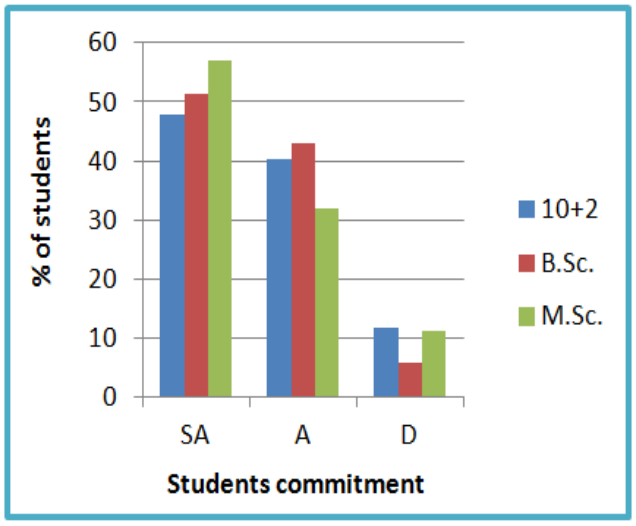

Figure 1. Perceptions of students about the contribution of physics in development of other sciences, technology and society

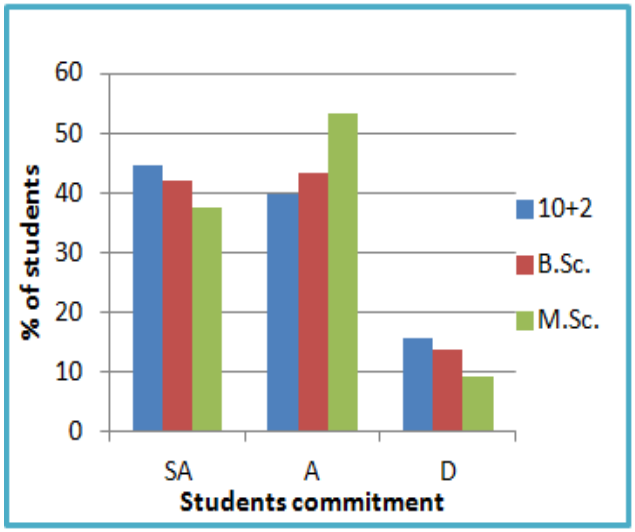

Figure 2. Students learning outcome: physics contribution in energy consideration, sustainability and experimental study

3.2. Research Question 2 & 3

2. How the students learning outcome in physics contribute in energy consideration and sustainability?

3. How the performances of experiments in Physics change the conception of students towards physics learning?

The answer to the research questions 2 & 3 are illustrated in percentage in Table 2 while Figure 2 shows the illustration in chart form.

3.3. Research Question 4

How the students are accurate in identifying the concepts in physics, and contribution of physics in real life in relation to technology, research and knowledge?

The answer to the research question 4 is illustrated in percentage in Table 3 while Figure 3 shows the illustration in chart form.

Table 2.

		M.Sc.			B.Sc.			10+2.		
S. No.	Statement / Items	SA (%)	A(%)	DA (%)	SA (%)	A(%)	DA (%)	SA (%)	A(%)	DA (%)
10	The discovery of Nuclear fission in physics has proved to be a tremendous source of energy.	12.5	87.5	0	38.9	55.6	5.5	48.6	41.9	9.5
11	Discovery and development of Lasers, microelectronics, computers, superconductivity, Nano-materials and mobile communication in physics have brought about a profound change in the thinking and living style of the human beings.	50	50	0	55.6	38.9	5.5	45.3	39.2	15.5
12	Development of Light Emitting diode has considerably reduced the electricity consumption and benefited the society a lot.	37.5	62.5	0	44.4	41.7	13.9	34.5	52	13.5
13	Energy is the basic requirement to improve the quality of life of peoples. Concepts of physics are the main driving force for generation and conversion of energy.	25	62.5	12.5	77.8	0.11	11.1	52.7	31.8	15.5
14	Sun is an inexhaustible source of energy, the concept of physics involved is the Nuclear Fusion.	37.5	62.5	0	44.4	44.4	11.1	49.3	35.8	14.9
15	According to the Einstein relativistic concept of Physics, the life of fundamental particles moving with very high speed increases.	37.5	25	37.5	25	41.7	33.3	33.8	43.2	23
16	Physics education can contribute in introducing sustainability by showing how investigation of the physical world is a necessary step in finding sustainable solutions.	0	100	0	27.8	63.9	8.3	36.5	49.3	14.2
17	Can sustainability be a relevant issue in motivating student in learning process in physics?	37.5	25	37.5	19.4	66.7	13.9	26.4	48.6	25
18	Making experiments in physics class increases my interest to the subject.	75	25	0	19.4	55.6	25	59.5	29.1	11.4
19	Laboratory experiment teaches how to work with discipline.	50	50	0	47.2	41.7	11.1	50	35.1	14.9
20	Laboratory works in Physics makes me more practical in my daily life	50	37.5	12.5	63.9	25	11.1	54	31.1	14.9

Table 3. Percentage of students, who gives correct response

			% of Students with correct response		
Sr. No.	**Items**	**Please tick the correct answer**	**10+2**	**B.Sc**	**M.Sc.**
21	Identify the physics concept	A. Momentum B. Einstein theory C. F=ma D. Newton	35.9	22.2	12.5
22	An example of physics in nature	A. Energy and force B. Chemical reaction C. Differential equation D. All of above	75	75	75
23	An example of physics concept in real life.	A. Newton's Laws B. Particle accelerator C. National physical Laboratory D. Balloon that sticks to the wall	31.3	41.7	25
24	An example of physics in technology	A. Magnetic Resonance Imaging B. Laws of gravitation C. Quantum Mechanics D. Scattering of light	32	58.3	62.5
25	An example of research of 21st century in physics	A. Dark energy that derive cosmic acceleration B. Laws of motion C. Gravitation D. Discovery of Nucleus	54.6	97.2	62.5
26	Identify the physicist whose saying is," Quantum Physics, thus reveals a basic oneness of the universe"	A. Isaac Newton B. John Bardeen C. Erwin Schrodinger D. Max. Planck	28.4	52.8	62.5
27	Name of a physicist, who is a winner of the Nobel Prize in physics	A. S.N.Bose B. A.P.Mitra C. Homi Jahangir Bhambha D. C.V.Raman	29.8	77.8	75
28	Which one is the top Journal in Physics?	A. Nature Physics B. Indian Journal of physics C. American Journal of Physics D. Indian Journal of Radio and Space Physics	29.7	19.4	25
29	An example of contribution of physics for an advanced word	A. Global Positioning System B. Navigation C. Railways D. Roadways	47.7	58.3	25

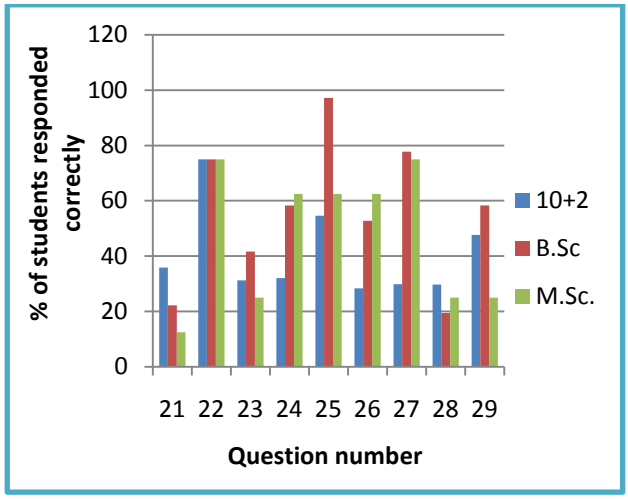

Figure 3. Students concepts in physics, and contribution of physics in real life

3.4. Research question 5

How the commitment of students in physics learning varies as they move from 10+2 to B.Sc. level and B.Sc. to M.Sc. level? Is there any correlation among the students in perception of learning physics at 10+2, B.Sc. and M.Sc. levels?

The answer to the research question 4 is llustrated in Table 4 -Table 8.

Table 4. Performance Level of students in 10+2, B.Sc. and M.Sc. course

Class	Performance Level in %		
	Strong Positive (Average)	Positive (Average)	Weak/Negative (Average)
10+2	46.1	40	13.9
B.Sc.	46.3	43.1	10.1
M.Sc.	46.3	43.8	10.0

Table 5. Correlation coefficient and the regression equation (Strong Positive Confidence Level)

Class	**% variation in confidence level**	**Multiple r**	**r^2**	**Regression Equation**
10+2	31.1 – 60.8			
B.Sc.	19.4 – 77.8	0.6104	0.3726	B.Sc. = 0.3479 (10+2) +29.9926
M.Sc.	0 - 100	0.3705	0.1372	M.Sc. = 0.2479 (B.Sc.)+ 34.7853

Table 6. Correlation coefficient and the regression equation (Positive Confidence Level)

Class	% variation in confidence level	Multiple r	r^2	Regression Equation
10+2	29.7 – 54.1			
B.Sc.	0.11 – 66.7	0.6148	0.3780	B.Sc. = 0.3213 (10+2) +26.1636
M.Sc.	0 - 100	0.1589	0.0252	M.Sc. = 0.0982 (B.Sc.)+ 38.7691

Table 7. Correlation coefficient and the regression equation (Negative Confidence Level)

Class	% variation in confidence level	Multiple r	r^2	Regression Equation
10+2	7.4 – 15.5			
B.Sc.	0.0 – 33.3	0.5287	0.2795	B.Sc. = 0.2739 (10+2) +11.1394
M.Sc.	0 – 37.5	0.4746	0.2252	M.Sc. = 0.2499 (B.Sc.)+ 7.4577

Table 8. Correlation coefficient and the regression equation (Conceptual learning)

Class	% variation in confidence level	Multiple r	r^2	Regression Equation
10+2	28.4 – 54.6			
B.Sc.	19.4 – 97.2	0.5491	0.3015	B.Sc. = 0.8621 (10+2) +20.945
M.Sc.	12.5 - 75	0.78741	0.6200	M.Sc. = 0.7637 (B.Sc.) + 4.5628

4. Discussion of Results

In the present study, the perspective of Physics learning for sustainable development has been tested by questionnaire's method for 10+2, B.Sc., and M.Sc. students. Regression analysis has been done to find out correlation of physics learning at 10+2 & B.Sc. levels and B.Sc. & M.Sc. levels. The question wise discussion of results as follow:

It can be seen from Table 1 and Figure 1, the perceptions of students about the contribution of physics in development of other sciences, technology and society as a whole, there is positive trends at all levels. The percentage of students which have strong commitment at 10+2 level is 47.9, at B.Sc. level is 51.4 and at M.Sc. level is 56.94 while having positive commitment varies as 40.32, 42.89 and 31.94 respectively. The number of students having negative commitment are found to be less than 12 % at all levels.

Table 2 & Figure 2 answers the students learning outcome about physics contribution in energy consideration, sustainability and experimentation. It has been found that the percentage of students having strong positive commitment are 44.6, 42.16 and 37.5, having positive commitment are 39.74, 43.21 and 13.62 & having negative commitment are 15.66, 13.62 & 9.09 at 10+2, B.Sc. and M.Sc. level respectively.

In conceptual understanding and contribution of Physics in real life in relation to technology, research and knowledge, it can be seen from Table 3 and Figure 3, the percentage of students with correct response is 40.49, 55.86 & 47.22 at 10+2, B.Sc. and M.Sc. levels respectively. 10+2 is the right stage for conceptual understanding of physics while B.Sc. is the right stage for understanding research concepts, latest developments in science and contribution of Physics in an advanced world.

From Table 4, it can be seen that, on the average, the number of students with negative commitment are less than 14%. It means, majority of the students understand the relevance of the physics for sustainable development. To find out correlation among the students in perception of learning physics at 10+2, B.Sc. and M.Sc. levels, regression analysis has been done (Table 5 – Table 8). The analysis reveals that there is positive correlation among the learners at all levels and for all categories but their degree of correlation significantly varies. It can be seen that the coefficient of performance (r^2) decreases for transition from B.Sc. to M.Sc. level in comparison to transition from 10+2 to B.Sc. level, for learners having strong positive, positive and negative commitments in physics learning. It may be due to the experience of the learners in different environments, quality of teaching learning process and motivational & social factors. Similar results has been observed in studies [20,21,22]. In logical thinking, creative thinking and conceptual understanding of Physics, on the average, there is positive correlation among the students of 10+2 and B.Sc. (r^2=0.2831) & among the students of B.Sc. and M.Sc. (r^2=0.6200).

5. Conclusion

In the present study, the perspectives of physics learning in Educational Institutions have been investigated using questionnaires' method. The regression analysis has been carried out to correlate the performance level of learners at 10+2, B.Sc. and M.Sc. levels. The concrete findings of the study are;

(i). the percentage of students heaving strong commitment in physics learning are observed to be almost same at all levels.

(ii). the learners having positive commitment (average students) improve their performance at higher stages.

(iii) the average number of students having negative commitment in physics learning are less than 14% and it decreases with the increase of level.

(iii) Experience of the learners in different environments, quality of teaching learning process and motivational & social factors plays significant role in their performance.

(iv) 10+2 is the right stage for conceptual understanding of physics while B.Sc. is the right stage for understanding research concepts, latest developments in science and contribution of Physics in an advanced world.

(v). Regression analysis reveals that there is positive correlation among the learners at all levels and for all categories but their degree of correlation significantly varies. Also in logical thinking, creative thinking and conceptual understanding of Physics, on the average, there is positive correlation among the students of 10+2 and B.Sc. (r^2=0.3015) & among the students of B.Sc. and M.Sc. (r^2=0.5965).

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