COLLEGE RESEARCH PROJECT

FINAL REPORT

Project Title:

Students' Attitude towards Physics Practical at the Undergraduate (College) Level: A Study of the Colleges in Meghalaya

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Project Title:

Students' Attitude towards Physics Practical at the Undergraduate (College) Level: A Study of the Colleges in Meghalaya

Abstract:

The Laboratory is the one place in the college or an institution where the students spent a large fraction of his/her time, trying to establish what is there to be done as prescribed by the curriculum and also to perform the experiments on a wide range of phenomena. Physics practical for that matter includes a large range of experiments from all the different subjects of Physics. The time spent in the laboratory is the time during which the students are (supposedly) expected to learn through hands-on interaction with the different instruments, through mutual student interactions and also to not only learn but also thoroughly understand the various concepts related to a particular experiment, to be able to apply the same kind of scientific approach later when they are doing their research work(s). It is therefore of utmost importance that the students should have and develop a positive attitude towards the laboratory works so as to enable them to not only learn and understand but also to be able to incorporate new ideas (which is the very essence of any research) into a particular experiment that would in turn greatly benefit them when they enter the realms of research. The aim of this study is to investigate if, whether, there are any such negative attitudes amongst the students in the state of Meghalaya regarding the Physics laboratory work(s).

Introduction:

Science is different from other subjects. It is not just the subject of science that is different; in fact the entire process of doing science is different. The means by which knowledge is acquired is different in science than it is in history or mathematics or poetry or etc... Science is different because the answers/solutions to scientific questions/problems are not found in a textbook or through pondering high and lofty thoughts. Indeed, scientists do ponder and think high and lofty thoughts; and indeed students in science class will find answers in a textbook. But the basis of what scientists believe and why they believe is not the result of mere thinking or reading in a textbook. The basis of what scientists believe is the result of the careful collection and analysis of laboratory evidence. In any physics class, the "differentness" of science will be most evident when the time for the laboratory comes.

In any physics curriculum, lab is central, integral, and sacred. More than a mere place in the back of the classroom, the laboratory is the place where physics students do physics. It is in the laboratory that physics students learn to practice the activities of scientists — asking questions, performing procedures, collecting data, analyzing data, answering questions, and thinking of new questions to explore. According to the results of thorough research done by science educators in many developed countries, practical work plays a very important role in teaching and learning science efficiently. Over the last thirty-five years, laboratory work has been gaining a central and distinctive place in science education, and science educators have suggested that there are rich

benefits in learning science with the help of laboratory activities (Hofstein and Lunetta, 2003; Tiberghen, Veilard, Marechal, Buty and Millar, 2001). In particular, in developed countries the laboratory is used as an important medium of instruction in introductory physics courses.

In the current era, the laboratory is especially important as student-centered inquiry has re-emerged as a modern teaching style in science. However, according to Tobin (1990) meaningful learning is possible in the laboratory only if the students are given opportunities to manipulate real equipment and materials in an environment suitable for them to construct their knowledge of phenomena and related scientific concepts. However, laboratory work demands a significant amount of time and many times rather expensive equipments. Although laboratory experiments and activities are acknowledged as being fundamental to the teaching-learning process in physics, however, it is a huge challenge to organize them efficiently.

An experiment is a controlled quantitative investigation—controlled in the sense that the various quantities entering into the experiment are under the control of the experimenter and quantitative in the sense that numerical data are obtained. There is nothing mysterious about an experiment: the investigator ordinarily proceeds according to the scientific method. There are several ways in which the students may expect to benefit from the laboratory work. It helps them to understand and remember the physics they have studied and learned; it gives them practice in the application of physical laws and logic to real cases and in that way helps them to think clearly; and it gives them some skill in the use of scientific instruments and techniques.

A whole year's course adds up to less than six weeks of actual laboratory time (the Ph.D. candidate ordinarily spends about two years of full-time laboratory work on a single problem) so that they cannot expect to get any very thorough mastery of specialized laboratory techniques; however, they usually learn about less specialized techniques. Most of the principles of physics were discovered by men using equipments no better than the simple laboratory equipments. Most of the equipments, in fact, were not as good. It is a general observation that the students and teachers have to spend large amount of time in physics laboratory performing experiments. Practical work is expected to bring in behavior changes in the students. The scientific temperament, curiosity, interest and creativity form the bases of this change. Practical work attempts to provide a body of knowledge through procedures that are demonstrated objective but today they are often done in a subjective context.

The laboratory work in physics can be an exciting part of the course or it can be drudgery depending upon the attitude of the students towards it. If they regard it merely as an impediment to getting through the course, probably they will not enjoy it and, furthermore, they will derive very little benefit from it. On the other hand, if their approach towards laboratory work is with the thought that it is an opportunity to learn and with the desire to make the most out of it, then it is almost certain that they will find the time spent on it both profitable and interesting.

Nowadays, unfortunately, it appears as if the students perform experiments just for the sake of marks. This is evident from the fact that they come to the lab unprepared and are completely unaware of the various experiments that they are going to perform or have to perform. They are completely dependent on the teacher for any particular experiment and care very little for the outcomes of the experiment. They do not seem to have the scientific temper or the inclination towards learning anything, at all, in the laboratory which in-turn makes them to be unable to use their time and their resources efficiently.

The significance of the proposed research work is to establish if there are any negative attitudes of the students towards Physics practical work in the laboratory as is evident from their lackadaisical attitude towards lab experiments and their utter lack of enthusiasm and scientific temper; and if so to find out proper ways and means or to suggest remedial measures to help motivate and develop the students' interests in the laboratory. As pointed out earlier, the laboratory is the core component of the study of Physics which helps to prove the various phenomena understood and accepted to be true by the scientists and the scientific community as a whole. In the words of *Richard Feynman – "to guess at the wonderful, simple, but very strange patterns beneath them all, and then to experiment to check again whether we made the right guess"*. It is very important to inculcate a positive attitude towards practical lab work in the minds of the young students who are the budding future scientists of the nation and the whole scientific community.

Objective:

The objective of this study is to find out the attitudes of the students, of the different colleges of Meghalaya offering B.Sc at the undergraduate level, towards Physics practical and to assess if there are any negative attitudes, as such, amongst the students towards laboratory experimental works. Due to the nature of the problem and certain constraints, a Purposive Sampling Technique was adopted for this study for which all the students of nine colleges of Meghalaya offering Science Education at the undergraduate level having Physics as one of their subjects (both Honours & Pass) were selected for the sample. Thus, a sample of 320 B.Sc. students were selected and these are assumed as a complete representative of the entire student community in the state with Physics as one of their subjects. To determine the objective of the study, evidence will be established based on the data collected from the sample surveyed and these will be reported through percentages and graphical representations.

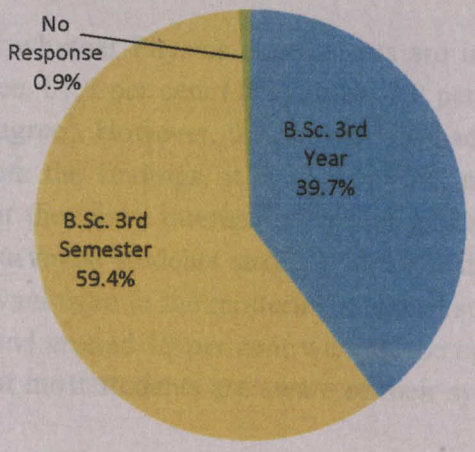
Results Obtained:

For the sample surveyed, 39.7 per cent (127)[1] of the students are studying in their 3rd Year, while 59.4 per cent (190) are in their 3rd Semester. This reflects that most of the respondents are the B.Sc. 3rd Semester students. However, it was found that about 0.9 per cent

[1] Number in bracket indicates the number of students under study.

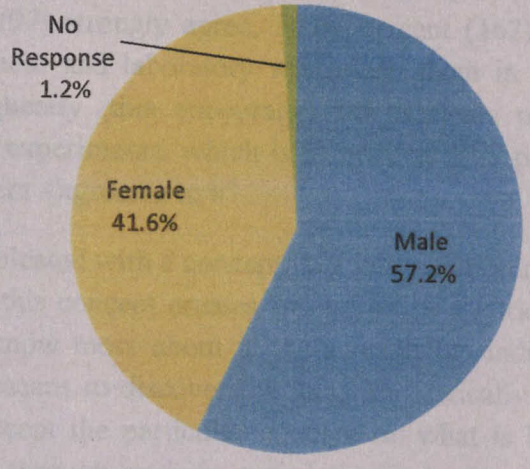
(3) of the sample surveyed did not respond to which class they belong to. These findings are also evident from Figure (i) as shown below.

Figure (i): Class-wise Distribution of Students



The distribution of the students surveyed by gender is presented in Figure (ii).

Figure (ii): Distribution of Students by Gender



From the above figure, it is evident that out of all the students surveyed, 41.6 per cent (133) are female while 57.2 per cent (183) are male and 1.2 per cent (4) did not respond to which gender they belong to. While a generalisation cannot be made, however, this clearly reflects a gender differential in the number of female students opting for Physics as one of the subjects at their under-graduate level. Male students outnumber female students by around 15 percent.

According to the questionnaire, the students had to point out their opinions in four categories – Strongly Agree, Agree, Disagree and Neither Agree nor Disagree; based on a set of questions given to them in-order to find out their attitude towards Physics practical and to assess if there are any negative attitudes, as such, amongst them towards the laboratory experimental works. However, due to no responses and ineligibility of the responses of the students, two more

categories were incorporated for a clear-cut analysis and reporting i.e. No Response and Wrong Response. The analysis was carried out according to the questions given in the questionnaire and these are presented in tabular form (ANNEXURE: I) and graphical representation (ANNEXURE: II) and accordingly reported.

When students were enquired whether Physics experiments are interesting, 27.8 per cent (89) have replied they strongly agree, 61.9 per cent (198) agree, 1.9 per cent (6) disagree and 6.9 per cent (22) neither agree nor disagree[2]. However, 0.9 per cent (3) had no response and 0.6 per cent (2) gave wrong response. From the findings, it is evident that more than 80 per cent of the students are of the opinion that they have interest in Physics experiments. It may be mentioned that 9.1 per cent (29) of the surveyed students strongly agree that the experiments in the B.Sc Syllabus (NEHU) are still relevant even in the modern context of science, while more than half - 56.6 per cent - of them agree and around 19 per cent were of the opinion that they neither agree nor disagree[3]; which shows that most students are aware of their syllabus and can relate it to the modern context of science.

Furthermore, when asked to whether the students believe that the current Physics laboratory work will enable them to apply or facilitate in their research work in the future[4]; 27.8 per cent (89) responded that they strongly agree and 55.6 per cent (178) agree. Out of all the students surveyed, 30.3 per cent (97) strongly agree, 50.6 per cent (162) agree and 6.6 per cent (21) disagree that the experiment and laboratory work help them in understanding the theoretical concepts better[5]. Consequently, this encourages the students to like spending time in the laboratory to perform the experiments; which is evident by 12.2 per cent (39) strongly agreeing and exactly half - 50per cent - agreeing to it[6].

When an individual is inculcated with a concept, this will either encourage or discourage him/her to learn more about it. If this concept creates an interest or a curiosity in the individual, he/she will try to find out and know more about it. As a result the individual may be innovative in experimenting ways and means to discover the facts, theoretically as well as practically, where he/she will not merely accept the particular concept on what is being told or taught but will perform and apply them through various experiments. Again, this in-turn will create more interest in that concept or the subject as in case of this study. Also, in this process, the individual enjoy performing these experiments. Therefore, this is evident in this study where 7.8 per cent (25) of the students strongly agree and 42.8 per cent (137) agree that they usually question the results of a particular experiment and do not simply accept them[7]. 4.4 per cent (14) strongly agree and 22.5 per cent (72) agree that they also try to perform the experiments in other ways

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[2] ANNEXURE: I Table 1 and ANNEXURE:II Figure 1
[3] ANNEXURE: I Table 2 and ANNEXURE:II Figure 2
[4] ANNEXURE: I Table 3 and ANNEXURE:II Figure 3
[5] ANNEXURE: I Table 4 and ANNEXURE:II Figure 4
[6] ANNEXURE: I Table 5 and ANNEXURE:II Figure 5
[7] ANNEXURE: I Table 6 and ANNEXURE:II Figure 6

other than such ways as prescribed in the textbooks[8].It was seen that some students were also innovative in performing their Physics experiments as8.8 per cent (28) responded strongly agree and 39.7 per cent (127) agree that they try to incorporate their own ideas while performing an experiment[9]. However, 32.8 per cent (105) disagree in trying to incorporate their own ideas in performing Physics experiments.35.3 per cent (113) strongly agree and 43.8 per cent (140) agree that performance of experiments in physics increases my interest in the subject[10]. In addition, more than half of the students usually enjoy performing the experiments and do not feel any pressure at all to complete the experiments[11].

In today's education state of affairs the mindset of most students as seen by many are much more interested in the marks than in understanding the experiments. However, this is contradictory in this study where only 5.3 per cent (17) of the students strongly agree and 18.8 per cent (60) agree[12] to this saying. An enormous of 60 per cent (192) of the students surveyed disagrees that their interest is in marks only rather than the experiments, while 13.4 per cent (43) were indifferent. Furthermore, 69.7 per cent (223) of the students disagree that they just want to complete the experiments even if they do not understand the experiments whereas only 3.1 per cent (10) strongly agree and 18.1 per cent (58) agree[13].

When students were asked whether they wish the experimental laboratory work is not part of the curriculum, it was found that 65.3 per cent (209) disagree while 3.4 per cent (11) strongly agree and13.4 per cent (43) agree[14]. Also, 69.1 per cent (221) of the students disagree that they think the laboratory work is just an extra burden on their existing heavy syllabi[15]. The reason for these findings may be that laboratory work not only enables the students to understand more on theoretical aspects of the subject but they also have the opportunity to attain more marks in the subject through performing of experiments in Practical Examination; which is also part of their syllabus. Thus, it is evident that students are fond of laboratory work and 75 per cent (240) of the students think that laboratory work is not tedious and boring[16].

Physics is a subject where students not only read physics but they also do physics – in the laboratory, which is fundamental and integral in any physics curriculum. The entire process of doing physics, as any other science, is different. The process involves asking questions, performing procedures preferably by high precision and expensive instruments, collecting data, analysing data, interpreting the results, etc. and these demand a significant amount of time. Some technical and scientific understanding on instruments, methods, procedures, etc. is required in

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[8]ANNEXURE: I Table 7 and ANNEXURE:II Figure 7
[9]ANNEXURE: I Table 8 and ANNEXURE:II Figure 8
[10]ANNEXURE: I Table 9 and ANNEXURE:II Figure 9
[11]ANNEXURE: I Table 0 and ANNEXURE:II Figure 10
[12]ANNEXURE: I Table 11 and ANNEXURE:II Figure 11
[13] ANNEXURE: I Table 12 and ANNEXURE:II Figure 12
[14] ANNEXURE: I Table 13 and ANNEXURE:II Figure 13
[15] ANNEXURE: I Table 14 and ANNEXURE:II Figure 14
[16] ANNEXURE: I Table 15 and ANNEXURE:II Figure 15

performing experiments. Thus, in this study students were asked a set of questions in the questionnaire to find out their attitude towards Physics laboratory work, as mentioned in the objective of the study, in these aspects.

From the sample surveyed, 5.3 per cent (17) of the students strongly agree, 25 per cent (80) agree and 46.6 per cent (149) disagree that the methods of measurement in physics are tiresome[17]. Students claim that they understand the significance of high precision instruments in making measurement of physical quantity and this is evident by13.4 per cent (43) strongly agree, 49.4 per cent (158) agree, 13.8 per cent (44) disagree and 20.3 per cent (65) neither agree nor disagree[18]. It is interesting to mention that the percentage of the students strongly agreeing and disagreeing to this point respectively is somewhat the same i.e. about 13 per cent. Thus, we may infer that the very same number of students who understand the significance of high precision instruments is the same as those who do not understand at all. In addition, it was found that more than half of the students claim that they understand why a particular quantity is measured many times[19] and this is apparent by 45 per cent (144) of the students said that they disagree when asked that they do not know how to use the uncertainties and error analysis while reporting experimental data[20].Nearly half (around 42 per cent) of the students disagree that that experimental uncertainties are never discussed in laboratory papers and reports[21]and 46.9 per cent (150) agree that they believe there is an absolute true value in any measurement of a physical quantity[22]. This shows that students are aware of the concepts and procedures related to their laboratory work and consequently these findings reflect that students have good attitude towards laboratory work.

When enquired in regard to understanding procedures, results attained and interpretation of the result of Physics Laboratory work, it was found that students lack to comprehend them. As it was found that over 46 per cent disagree to totally understand whatever that are given in the Laboratory Manuals or prescribed books[23]; 42.5 per cent (136) agree that they followed the procedure stepwise even without having knowledge why they have to do that because they know that they will get the correct result(s) while 35.6 per cent (114) disagree[24]. Also, 10.3 per cent (33) of the students strongly agree and 36.2 per cent (116) agree that they are more concern about the result(s) than the theory behind the experiment,while37.8 per cent (121) disagree[25].Most students find experimental results difficult to interpret and hence they never try to interpret the result of experiment on their own with almost41 per cent agreeing to

[17] ANNEXURE: I Table 16 and ANNEXURE:II Figure 16
[18] ANNEXURE: I Table 17 and ANNEXURE:II Figure 17
[19] ANNEXURE: I Table 18 and ANNEXURE:II Figure 18
[20] ANNEXURE: I Table 19 and ANNEXURE:II Figure 19
[21] ANNEXURE: I Table 20 and ANNEXURE:II Figure 20
[22] ANNEXURE: I Table 21 and ANNEXURE:II Figure 21
[23] ANNEXURE: I Table 22 and ANNEXURE:II Figure 22
[24] ANNEXURE: I Table 23 and ANNEXURE:II Figure 23
[25] ANNEXURE: I Table 24 and ANNEXURE:II Figure 24

this[26].Procedures according to scientific methods in laboratory work enable students to practice the application of physical laws and logic to real cases and it also gives them some skill in the use of scientific instruments and techniques, but unpleasantly the students under this survey simply commit to memory the procedures, recording and tabulation of the experimental data during their preparations for practical examinations with 5.6 per cent (18) strongly agree, 22.2 per cent (71) agree, 59.4 per cent (190) disagree and10.6 per cent (34) neither agree nor disagree[27]. The reason for these findings may also be that the methods of measuring a physical quantity in physics are different from those in daily uses as evident by 12.2 per cent (39) strongly agree and 42.8 per cent (137) agree[28].

It may be mentioned here that students do get the assistance of their teachers and lab attendant which is evident by 45 per cent (144) strongly agree and 40.3 per cent (129) agree while only 3.1 per cent disagree that their teacher is very helpful when it comes to doing the practical works[29]; and 46.9 per cent agree that their lab attendant is proficient in all the experiments[30], this helps the students in performing the experiments. More than half of the student surveyed – 55.3 per cent disagree that there is pressure from teacher to complete the experiment whereas 5.3 per cent strongly agree, 19.7 per cent agree and 16.2 per cent neither agree nor disagree[31]. These finding are to some extent ambiguous for the fact that not only students but also the teachers do get the pressure of completing their syllabus be it theory or practical due to the time constrains especially with the semester system. Furthermore, again more than half - 51.6 percent (165) - of the students disagree that during Practical classes, it is very difficult for the teacher(s) to attend all the students because there are so many students and groups in the class[32]; this reflects that in most of the colleges under study, the student strength and the division of groups in the practical classes is in proportion to the faculty strength of the concern Department i.e. the student-teacher ratio is very appropriate.

Conclusion:

From the study undertaken, we may conclude that the findings seem to reflect a positive attitude of the students towards Physics practical and consequently no negative attitudes towards laboratory experimental works. The results obtained are encouraging as far as the students of Meghalaya are concerned. It is however imperative on the part of the teacher to constantly observe and motivate the students so as to help them overcome any difficulties or doubts, whatsoever, and thus eradicate even an iota of negative attitude from their tender minds before it even start budding. Students should be encouraged to not only understand any particular

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[26] ANNEXURE: I Table 25 and ANNEXURE:II Figure 25
[27] ANNEXURE: I Table 26 and ANNEXURE:II Figure 26
[28] ANNEXURE: I Table 27 and ANNEXURE:II Figure 27
[29] ANNEXURE: I Table 28 and ANNEXURE:II Figure 28
[30] ANNEXURE: I Table 29 and ANNEXURE:II Figure 29
[31] ANNEXURE: I Table 30 and ANNEXURE:II Figure 30
[32] ANNEXURE: I Table 31 and ANNEXURE:II Figure 31

experiment but also to incorporate their own ideas to any experiment and find out what research works are related to that experiment. However, a more thorough study may be undertaken to find out the low rate of enrolment at the research and higher levels and the quality of research works that come up from the higher echelon of learning in the state.

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ANNEXURE: I

Table 1: Frequency Distribution of Responses to Query -

"Physics experiments are interesting"

Response	Frequency	Percentage (%)
Strongly Agree	89	27.8
Agree	198	61.9
Disagree	6	1.9
Neither Agree nor Disagree	22	6.9
No Response	3	0.9
Wrong Response	2	0.6
Total	320	100

Table 2: Frequency Distribution of Responses to Query – "The experiments in B.Sc.syllabus are still relevant even in the modern context of science"

Response	Frequency	Percentage (%)
Strongly Agree	29	9.1
Agree	181	56.6
Disagree	33	10.3
Neither Agree nor Disagree	63	19.7
No Response	12	3.8
Wrong Response	2	0.6
Total	320	100

Table 3: Frequency Distribution of Responses to Query – "Physics laboratory work is going to help me later, I believe, when I am doing my research"

Response	Frequency	Percentage (%)
Strongly Agree	89	27.8
Agree	178	55.6
Disagree	11	3.4
Neither Agree nor Disagree	32	10
No Response	2	0.6
Wrong Response	8	2.5
Total	320	100

Table 4: Frequency Distribution of Responses to Query - "The experiment and laboratory work help me in understanding the theoretical concepts better"

Response	Frequency	Percentage (%)
Strongly Agree	97	30.3
Agree	162	50.6
Disagree	21	6.6
Neither Agree nor Disagree	36	11.2
No Response	3	0.9
Wrong Response	1	0.3
Total	320	100

Table 5: Frequency Distribution of Responses to Query - "I like spending time in the laboratory to perform the experiments"

Response	Frequency	Percentage (%)
Strongly Agree	39	12.2
Agree	160	50
Disagree	64	20
Neither Agree nor Disagree	52	16.2
No Response	2	0.6
Wrong Response	3	0.9
Total	320	100

Table 6: Frequency Distribution of Responses to Query - "I usually question theresults of a particular experiment and do not simply accept them"

A6.		
Response	**Frequency**	**Percentage (%)**
Strongly Agree	25	7.8
Agree	137	42.8
Disagree	82	25.6
Neither Agree nor Disagree	65	20.3
No Response	6	1.9
Wrong Response	5	1.6
Total	320	100

Table 7: Frequency Distribution of Responses to Query – "I also try to perform the experiments in other ways other than such ways as prescribed in the textbooks"

A7.		
Response	**Frequency**	**Percentage (%)**
Strongly Agree	14	4.4
Agree	72	22.5
Disagree	181	56.6
Neither Agree nor Disagree	45	14.1
No Response	3	0.9
Wrong Response	5	1.5
Total	320	100

Table 8: Frequency Distribution of Responses to Query - "I also try to incorporate my own ideas while performing an experiment"

Response	**Frequency**	**Percentage (%)**
Strongly Agree	28	8.8
Agree	127	39.7
Disagree	105	32.8
Neither Agree nor Disagree	50	15.6
No Response	5	1.6
Wrong Response	5	1.6
Total	320	100

Table 9: Frequency Distribution of Responses to Query – "Performance of experimentsin physics increases my interest in the subject"

Response	Frequency	Percentage (%)
Strongly Agree	113	35.3
Agree	140	43.8
Disagree	16	5
Neither Agree nor Disagree	45	14.1
No Response	1	0.3
Wrong Response	5	1.6
Total	320	100

Table 10: Frequency Distribution of Responses to Query – ". I usually enjoy performingthe experiments and do not feel any pressure at all to complete the experiments"

Response	Frequency	Percentage (%)
Strongly Agree	36	11.2
Agree	151	47.2
Disagree	69	21.6
Neither Agree nor Disagree	52	16.2
No Response	3	0.9
Wrong Response	9	2.8
Total	320	100

Table 11: Frequency Distribution of Responses to Query – "I am much more interestedin the marks than in understanding the experiments"

Response	Frequency	Percentage (%)
Strongly Agree	17	5.3
Agree	60	18.8
Disagree	192	60
Neither Agree nor Disagree	43	13.4
No Response	4	1.2
Wrong Response	4	1.2
Total	320	100

Table 12: Frequency Distribution of Responses to Query – "I just want to complete the experiments even if I don't understand them"

Response	Frequency	Percentage (%)
Strongly Agree	10	3.1
Agree	58	18.1
Disagree	223	69.7
Neither Agree nor Disagree	15	4.7
No Response	2	0.6
Wrong Response	12	3.8
Total	320	100

Table 13: Frequency Distribution of Responses to Query – "I wish the experimental laboratory work is not part of the curriculum"

Response	Frequency	Percentage (%)
Strongly Agree	11	3.4
Agree	43	13.4
Disagree	209	65.3
Neither Agree nor Disagree	49	15.3
No Response	5	1.6
Wrong Response	3	0.9
Total	320	100

Table 14: Frequency Distribution of Responses to Query - "I think the laboratorywork is just an extra burden on my already heavy syllabi"

A13.		
Response	**Frequency**	**Percentage (%)**
Strongly Agree	3	0.9
Agree	38	11.9
Disagree	221	69.1
Neither Agree nor Disagree	51	15.9
No Response	4	1.2
Wrong Response	3	0.9
Total	320	100

Table 15: Frequency Distribution of Responses to Query – "I think the laboratorywork is tedious and boring"

Response	Frequency	Percentage (%)
Strongly Agree	9	2.8
Agree	15	4.7
Disagree	240	75
Neither Agree nor Disagree	48	15
No Response	5	1.6
Wrong Response	3	0.9
Total	320	100

Table 16: Frequency Distribution of Responses to Query – "The methods ofmeasurement in Physics are tiresome"

Response	Frequency	Percentage (%)
Strongly Agree	17	5.3
Agree	80	25
Disagree	149	46.6
Neither Agree nor Disagree	70	21.9
No Response	3	0.9
Wrong Response	1	0.3
Total	320	100

Table 17: Frequency Distribution of Responses to Query – "I understand the significanceof high precision instruments in making measurement of physical quantity"

Response	Frequency	Percentage (%)
Strongly Agree	43	13.4
Agree	158	49.4
Disagree	44	13.8
Neither Agree nor Disagree	65	20.3
No Response	8	2.5
Wrong Response	2	0.6
Total	320	100

Table 18: Frequency Distribution of Responses to Query – "I understand why a particular quantity is measured many times"

Response	Frequency	Percentage (%)
Strongly Agree	58	18.1
Agree	189	59.1
Disagree	28	8.8
Neither Agree nor Disagree	38	11.9
No Response	4	1.2
Wrong Response	3	0.9
Total	320	100

Table 19: Frequency Distribution of Responses to Query - "I do not know how touse the uncertainties and error analysis while reporting experimental data"

Response	Frequency	Percentage (%)
Strongly Agree	20	6.2
Agree	93	29.1
Disagree	144	45
Neither Agree nor Disagree	48	15
No Response	8	2.5
Wrong Response	7	2.2
Total	320	100

Table 20: Frequency Distribution of Responses to Query - "Experimental uncertainties are never discussed in laboratory papers and reports"

Response	Frequency	Percentage (%)
Strongly Agree	16	5
Agree	77	24.1
Disagree	134	41.9
Neither Agree nor Disagree	74	23.1
No Response	17	5.3
Wrong Response	2	0.6
Total	320	100

Table 21: Frequency Distribution of Responses to Query – "I believe there is anabsolute true value in any measurement of a physical quantity"

Response	Frequency	Percentage (%)
Strongly Agree	30	9.4
Agree	150	46.9
Disagree	63	19.7
Neither Agree nor Disagree	71	22.2
No Response	4	1.2
Wrong Response	2	0.6
Total	320	100

Table 22: Frequency Distribution of Responses to Query – "I totally understood whatever that are given in the Laboratory manuals or prescribed books"

Response	Frequency	Percentage (%)
Strongly Agree	8	2.5
Agree	72	22.5
Disagree	150	46.9
Neither Agree nor Disagree	79	24.7
No Response	7	2.2
Wrong Response	4	1.2
Total	320	100

Table 23: Frequency Distribution of Responses to Query – "I followed the procedure stepwise even without having knowledge why I have to do that because I know I will get the correct result(s)".

Response	Frequency	Percentage (%)
Strongly Agree	31	9.7
Agree	136	42.5
Disagree	114	35.6
Neither Agree nor Disagree	33	10.3
No Response	2	0.6
Wrong Response	4	1.2
Total	320	100

Table 24: Frequency Distribution of Responses to Query – "In the laboratoryI am more concern about the result(s) than the theory behind the experiment"

Response	Frequency	Percentage (%)
Strongly Agree	33	10.3
Agree	116	36.2
Disagree	121	37.8
Neither Agree nor Disagree	44	13.8
No Response	3	0.9
Wrong Response	3	0.9
Total	320	100

Table 25: Frequency Distribution of Responses to Query – "Experimental results are difficult to interpret hence I never try to interpret the result of experiment on my own"

Response	Frequency	Percentage (%)
Strongly Agree	26	8
Agree	133	41.6
Disagree	78	24.4
Neither Agree nor Disagree	69	21.6
No Response	9	2.8
Wrong Response	5	1.6
Total	320	100

Table 26: Frequency Distribution of Responses to Query - . During my preparations for practical examinations I simply commit to memory the procedures, recording and tabulation of the experimental data"

Response	Frequency	Percentage (%)
Strongly Agree	18	5.6
Agree	71	22.2
Disagree	190	59.4
Neither Agree nor Disagree	34	10.6
No Response	3	0.9
Wrong Response	4	1.2
Total	320	100

Table 27: Frequency Distribution of Responses to Query – "The methods of measuringa physical quantity in physics are different from those in daily uses"

Response	Frequency	Percentage (%)
Strongly Agree	39	12.2
Agree	137	42.8
Disagree	72	22.5
Neither Agree nor Disagree	64	20
No Response	4	1.2
Wrong Response	4	1.2
Total	320	100

Table 28: Frequency Distribution of Responses to Query – "My teacher is very helpful when itcomes to doing the practical works"

Response	Frequency	Percentage (%)
Strongly Agree	144	45
Agree	129	40.3
Disagree	10	3.1
Neither Agree nor Disagree	25	7.8
No Response	4	1.2
Wrong Response	8	2.5
Total	320	100

Table 29: Frequency Distribution of Responses to Query – "Our lab attendant isproficient in all the experiments"

Response	Frequency	Percentage (%)
Strongly Agree	67	20.9
Agree	150	46.9
Disagree	36	11.2
Neither Agree nor Disagree	55	17.2
No Response	7	2.2
Wrong Response	5	1.6
Total	320	100

Table 30: Frequency Distribution of Responses to Query – "There is pressure from teacher to complete the experiment"

Response	Frequency	Percentage (%)
Strongly Agree	17	5.3
Agree	63	19.7
Disagree	177	55.3
Neither Agree nor Disagree	52	16.2
No Response	4	1.2
Wrong Response	7	2.2
Total	320	100

Table 31: Frequency Distribution of Responses to Query – "During Practical there is so many students and groups and it is very difficult for our teacher(s) to attend to all of us"

Response	Frequency	Percentage (%)
Strongly Agree	44	13.8
Agree	77	24.1
Disagree	165	51.6
Neither Agree nor Disagree	29	9.1
No Response	3	0.9
Wrong Response	2	0.6
Total	320	100

ANNEXURE: II

Figure 1: Bar Diagram Showing Responses to Query - "Physics experiments are interesting"

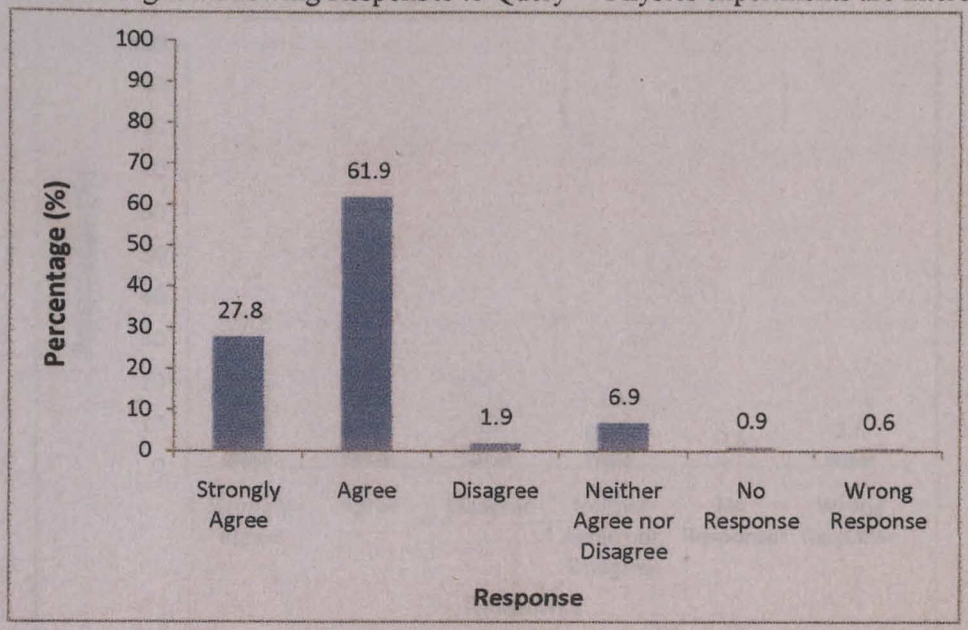


Figure 2: Bar Diagram Showing Responses to Query – "The experiments in B.Sc. syllabus is still relevant even in the modern context of science"

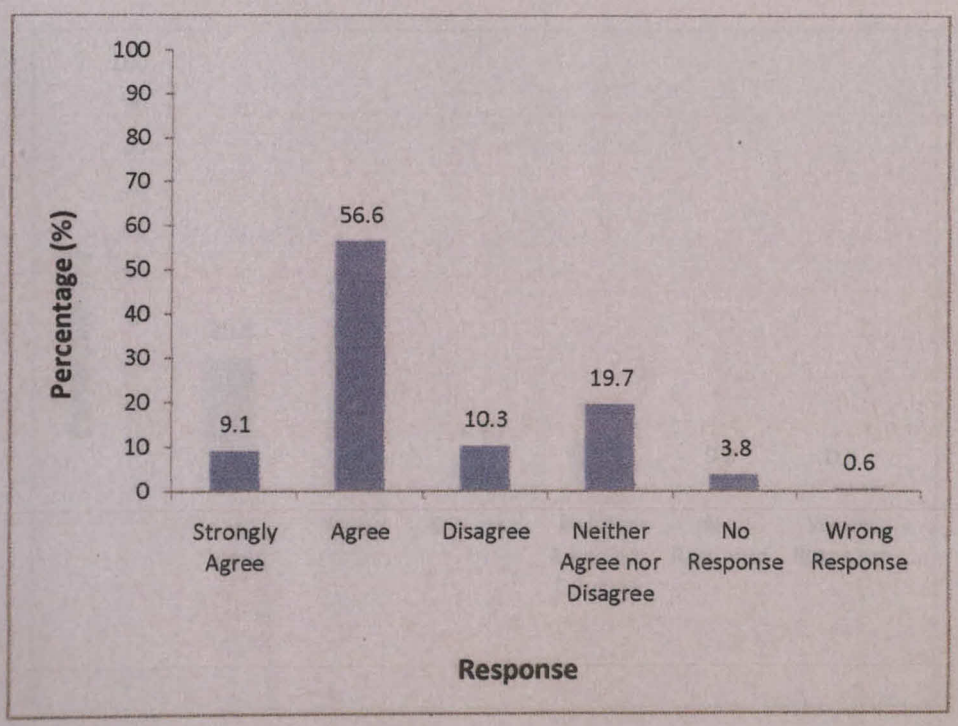


Figure 3: Bar Diagram Showing Responses to Query – "Physics laboratory work is going to help me later, i believe, when I am doing my research"

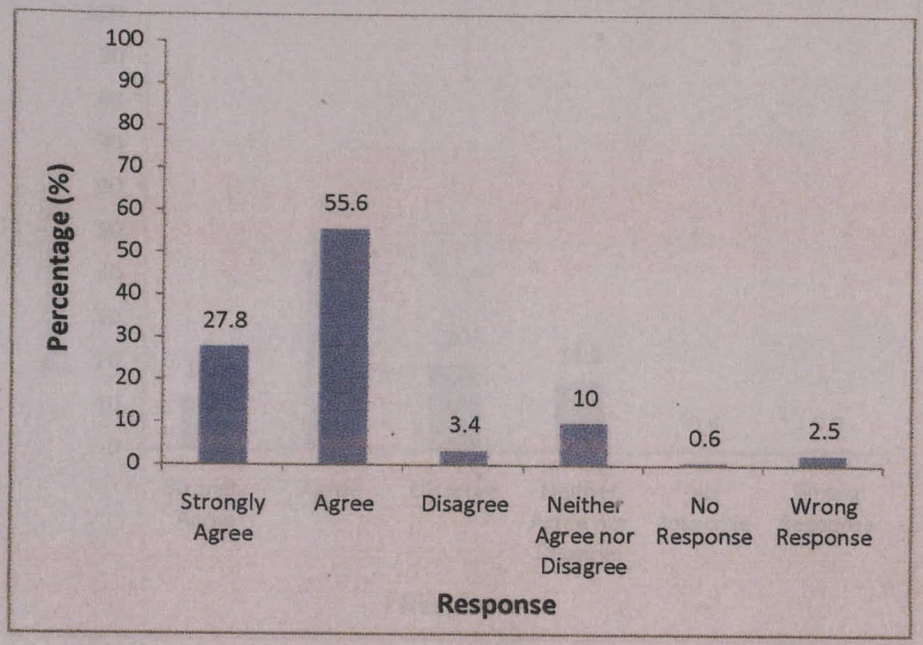


Figure 4: Bar Diagram Showing Responses to Query - "The experiment and laboratory work help me in understanding the theoretical concepts better"

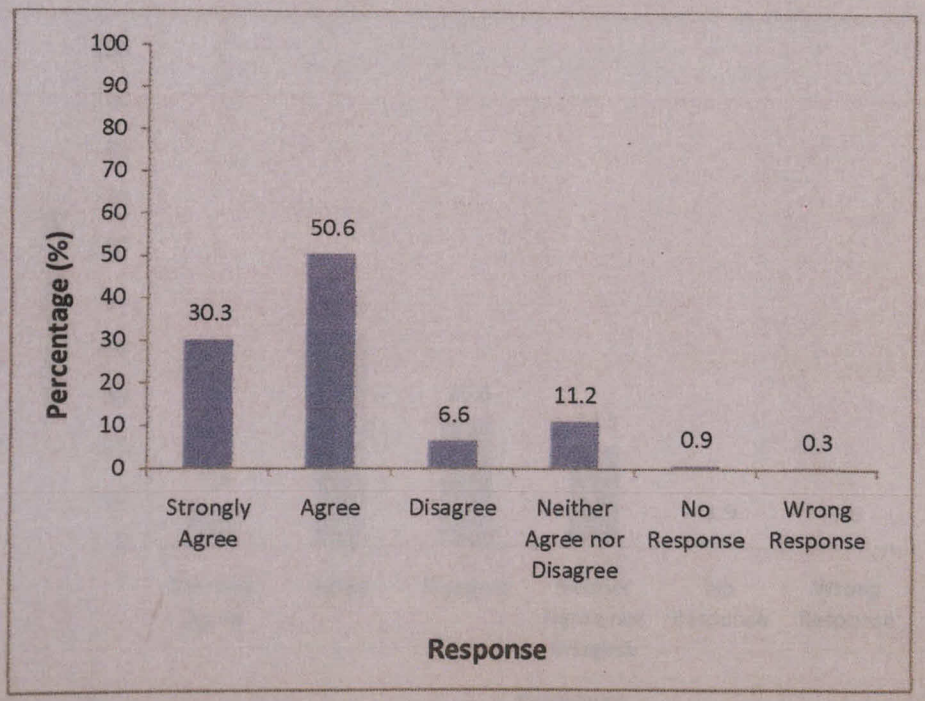


Figure 5: Bar Diagram Showing Responses to Query - "I like spending time in the laboratory to perform the experiments"

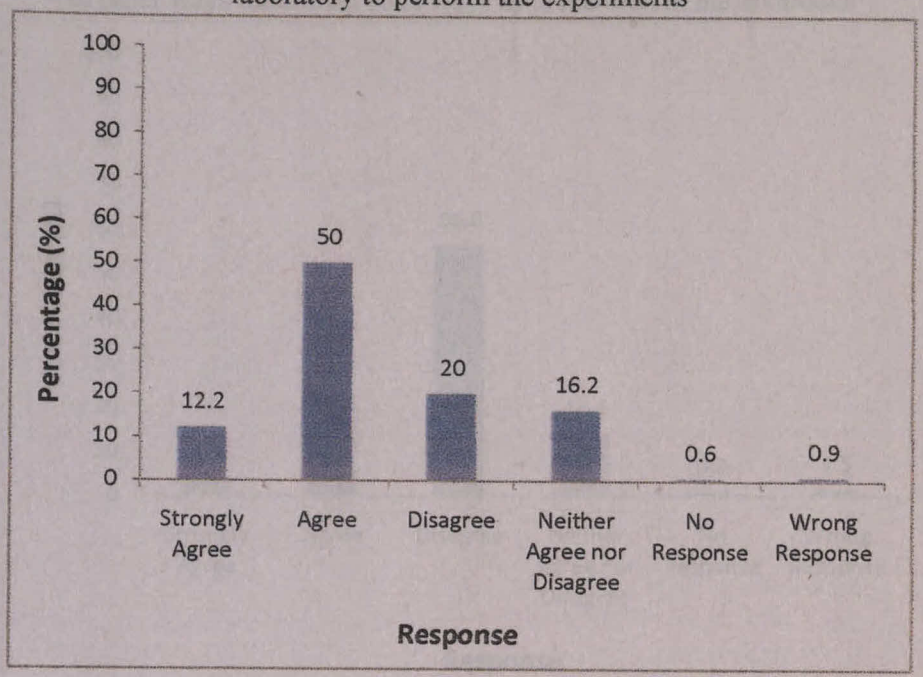


Figure 6: Bar Diagram Showing Responses to Query - "I usually question the results of a particular experiment and do not simply accept them"

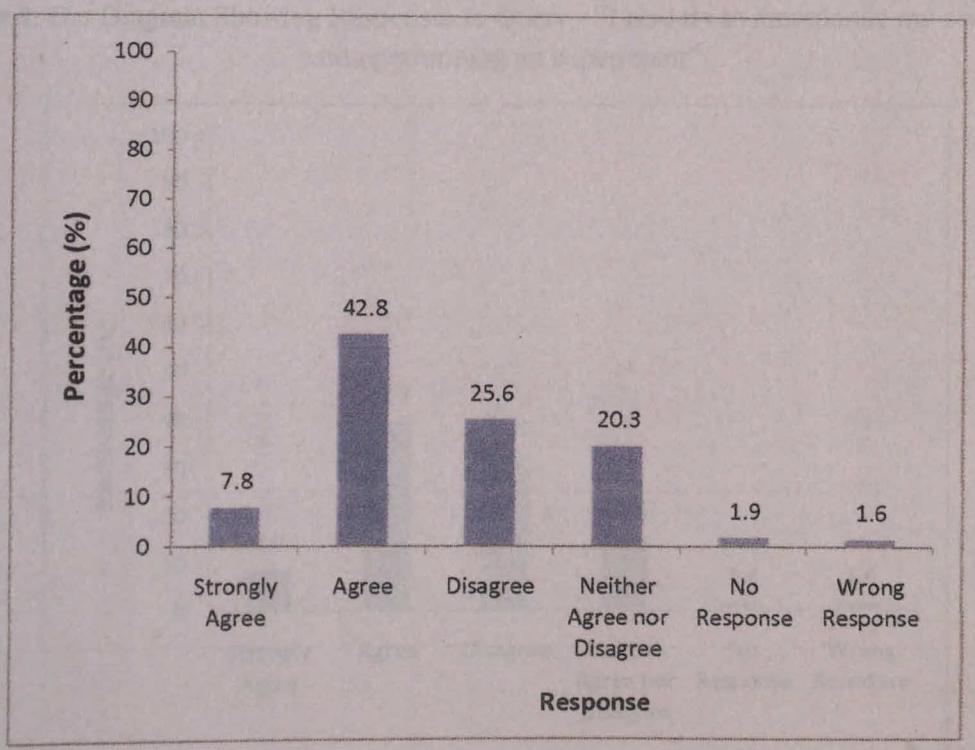


Figure 7: Bar Diagram Showing Responses to Query – "I also try to perform the experiments in other ways other than such ways as prescribed in the textbooks"

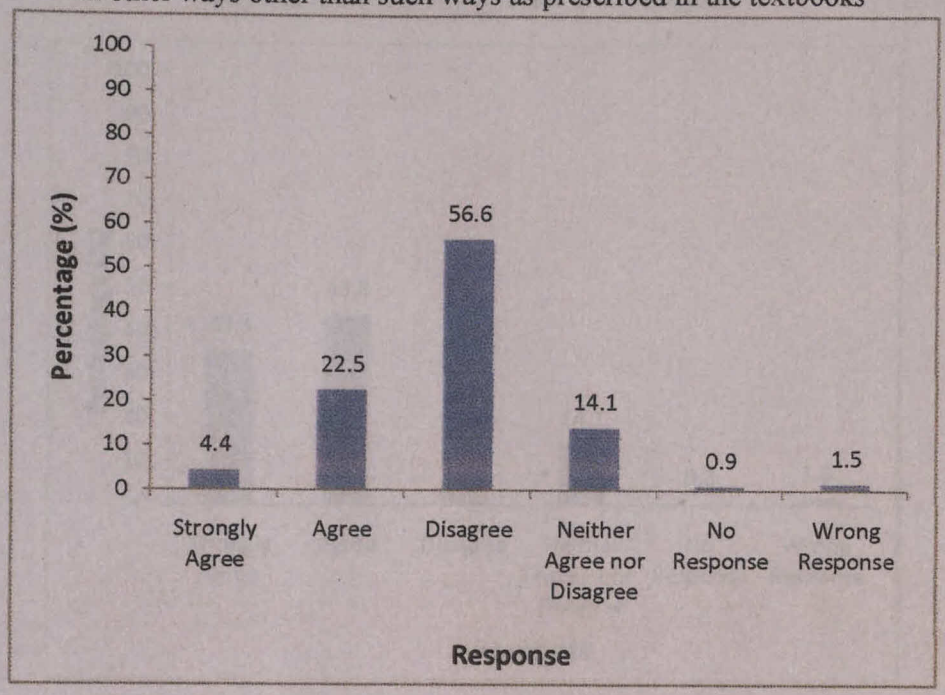


Figure 8: Bar Diagram Showing Responses to Query - "I also try to incorporate my own ideas while performing an experiment"

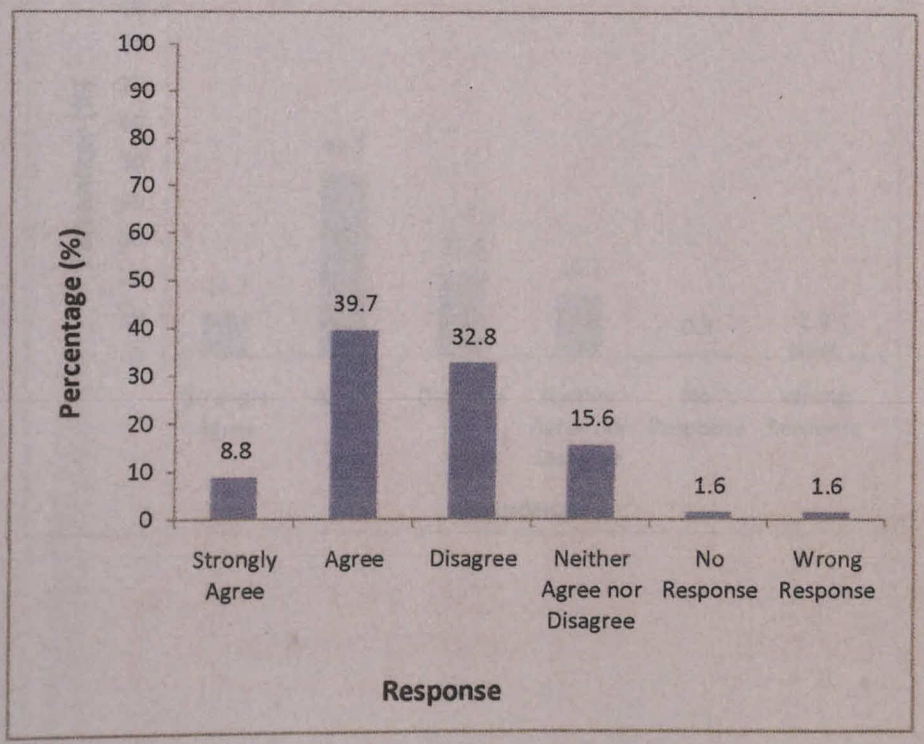


Figure 9: Bar Diagram Showing Responses to Query – "Performance of experiments in physics increases my interest in the subject"

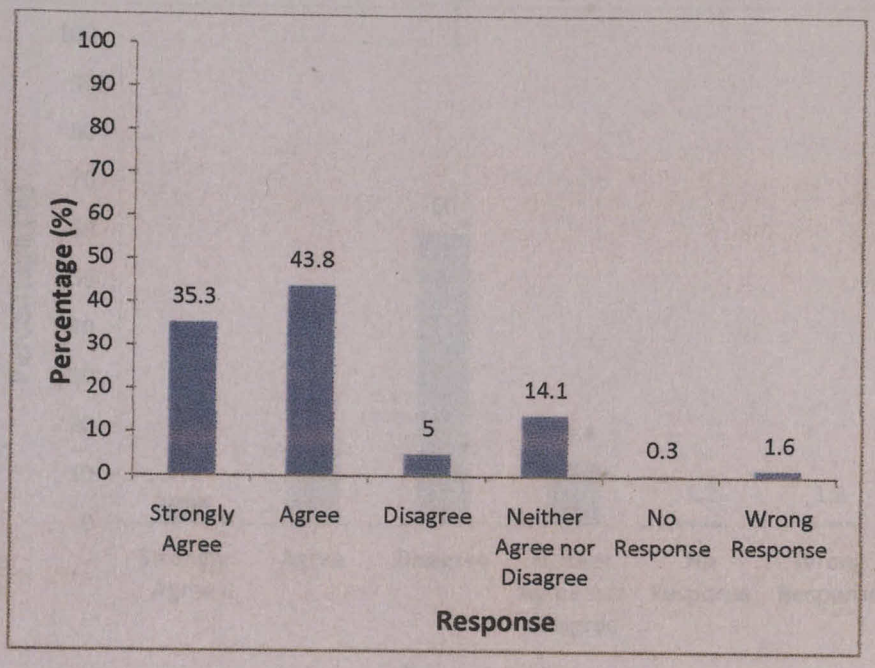


Figure 10: Bar Diagram Showing Responses to Query – "I usually enjoy performing the experiments and do not feel any pressure at all to complete the experiments"

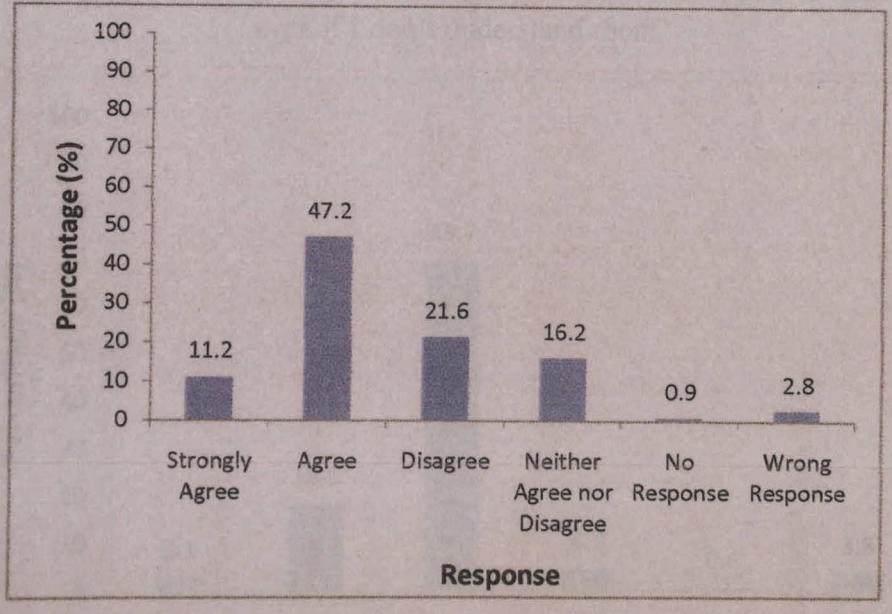


Figure 11: Bar Diagram Showing Responses to Query – "I am much more interested in the marks than in understanding the experiments"

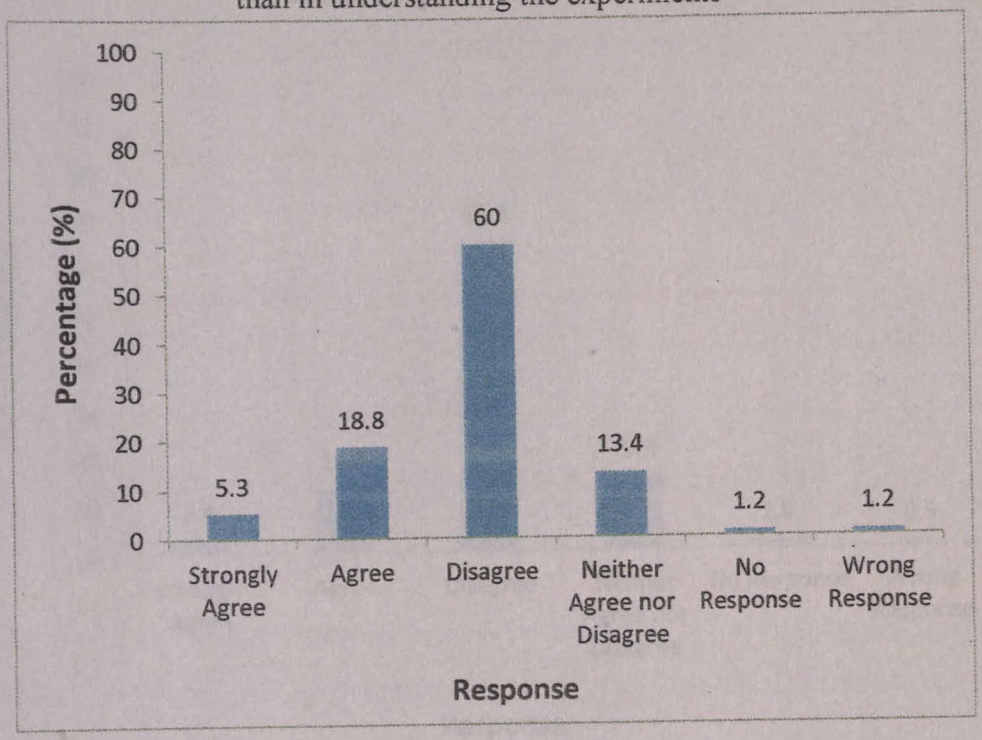


Figure 12: Bar Diagram Showing Responses to Query – "I just want to complete the experiments even if I don't understand them"

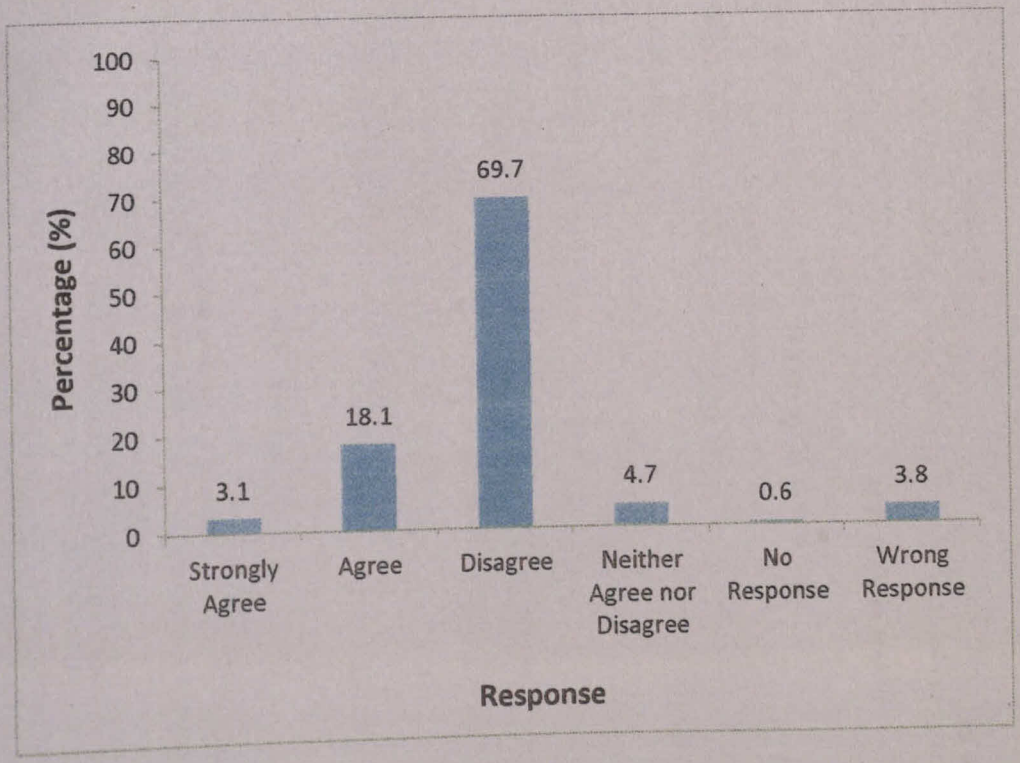


Figure 13: Bar Diagram Showing Responses to Query – "I wish the experimental laboratory work is not part of the curriculum"

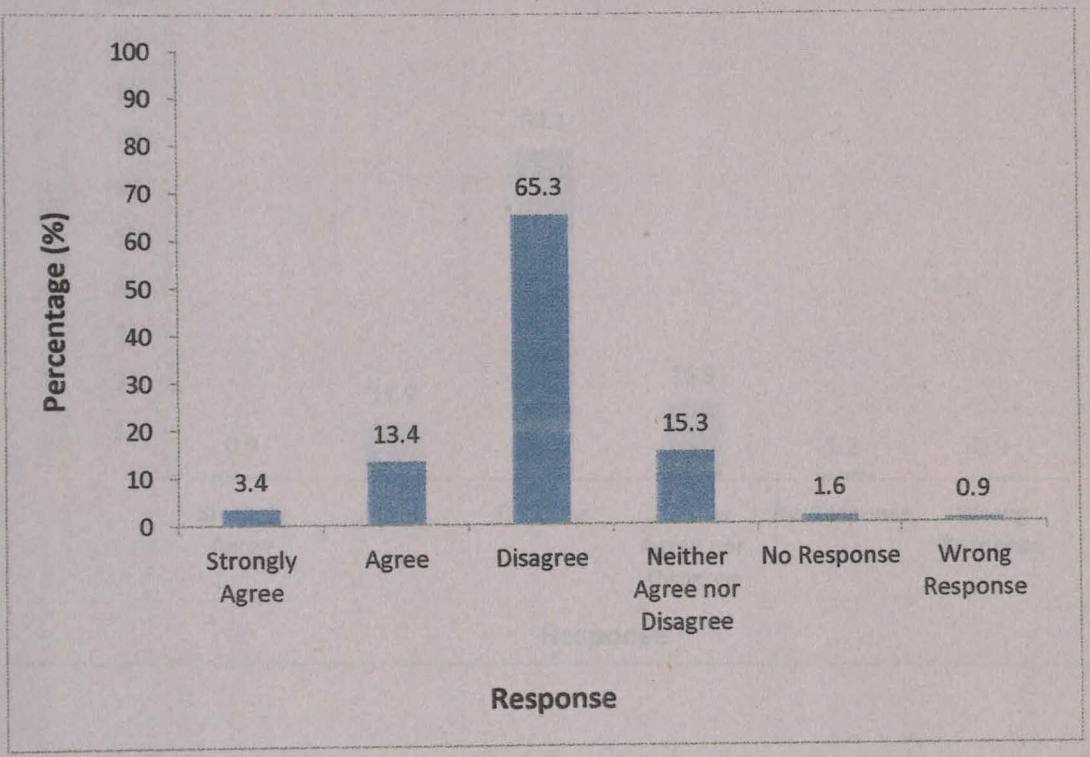


Figure 14: Bar Diagram Showing Responses to Query - "I think the laboratory work is just an extra burden on my already heavy syllabi"

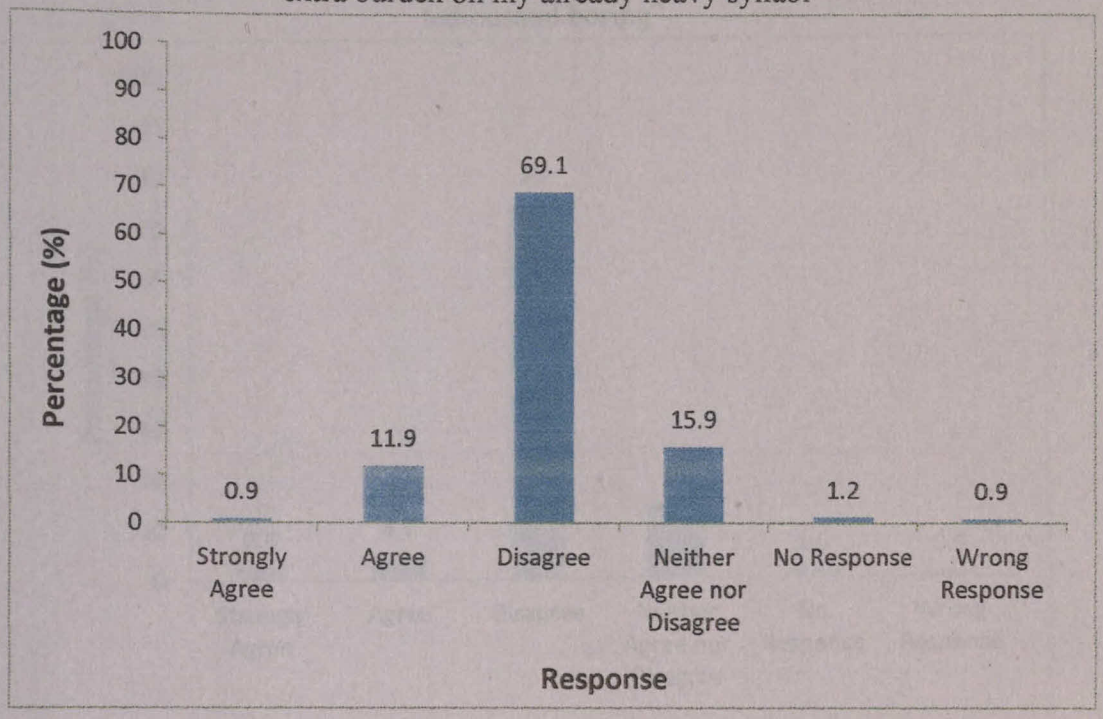
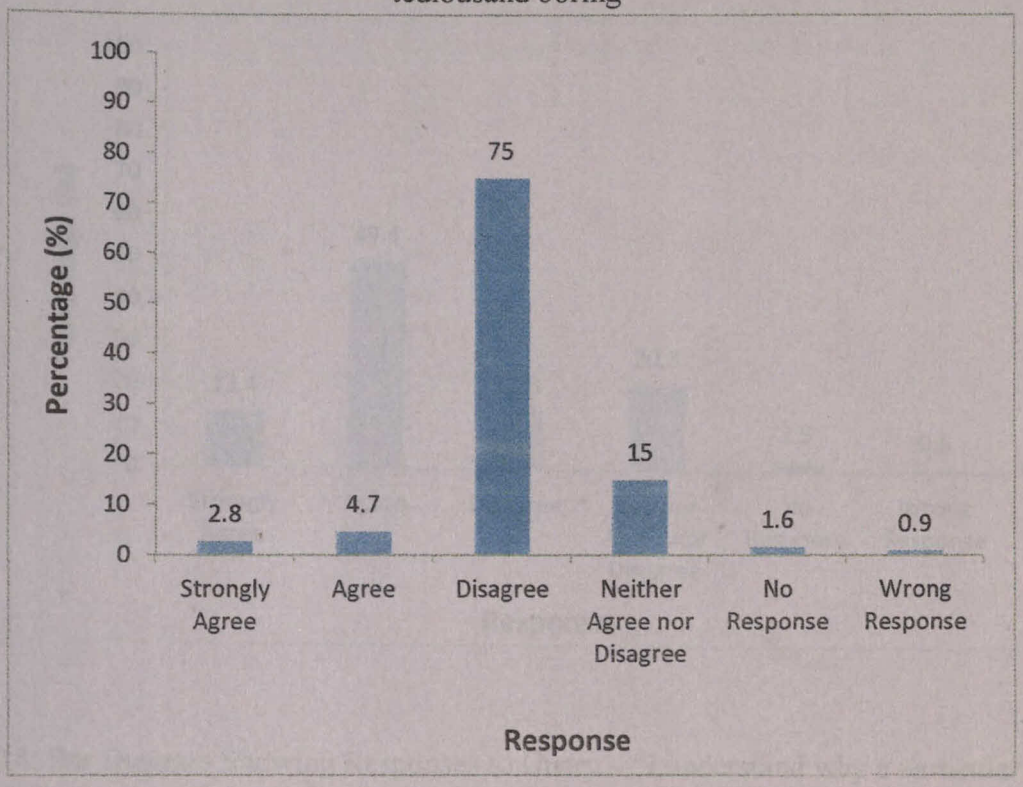


Figure 15: Bar Diagram Showing Responses to Query – "I think the laboratory work is tediousand boring"



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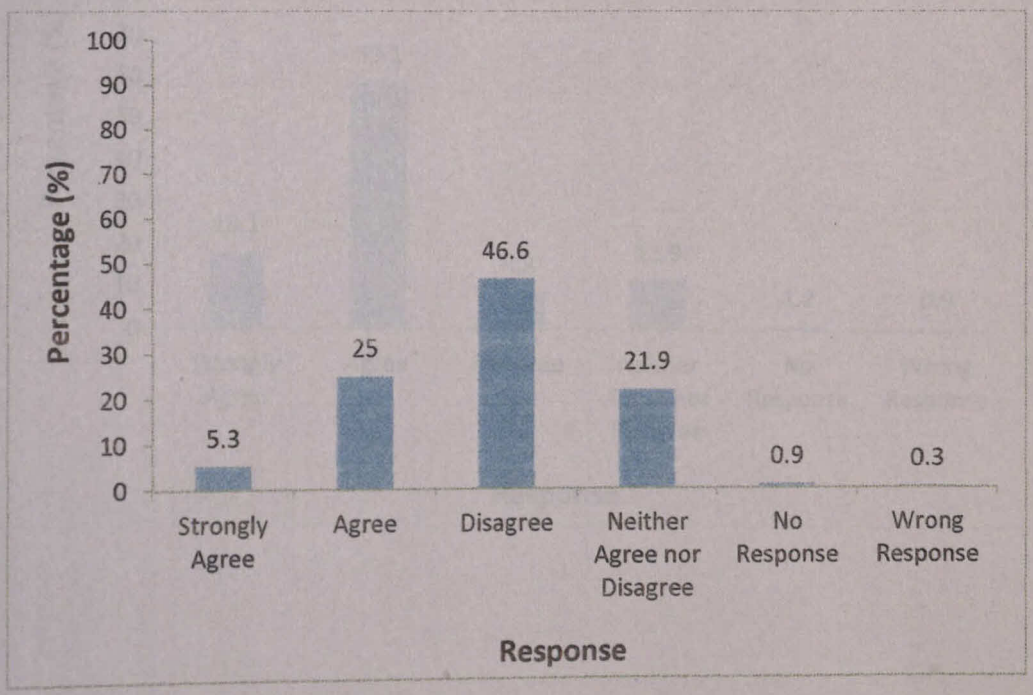

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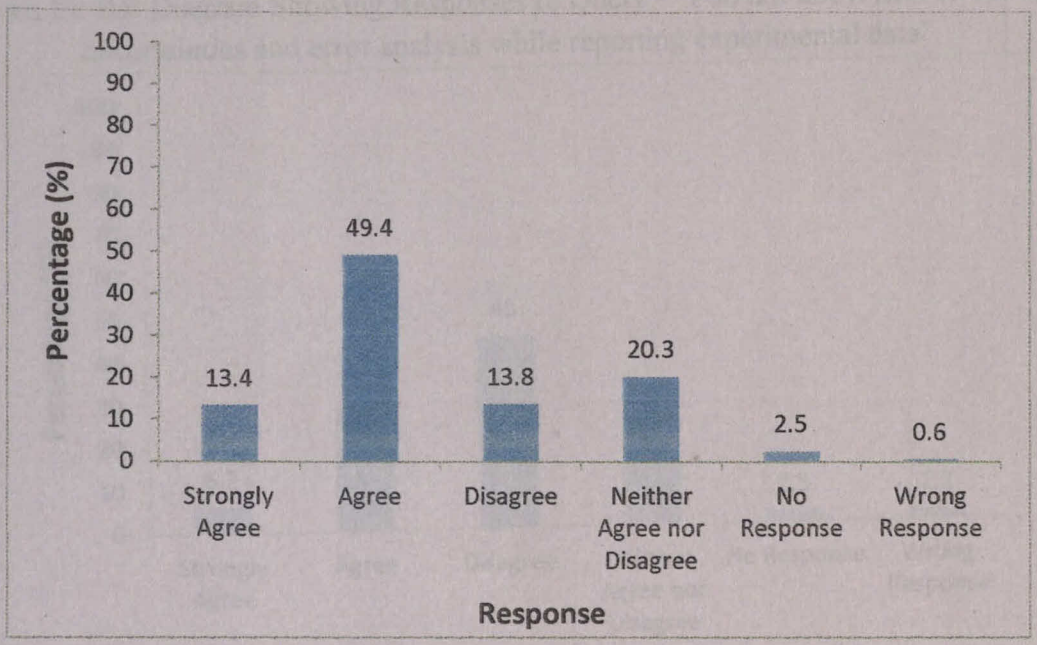

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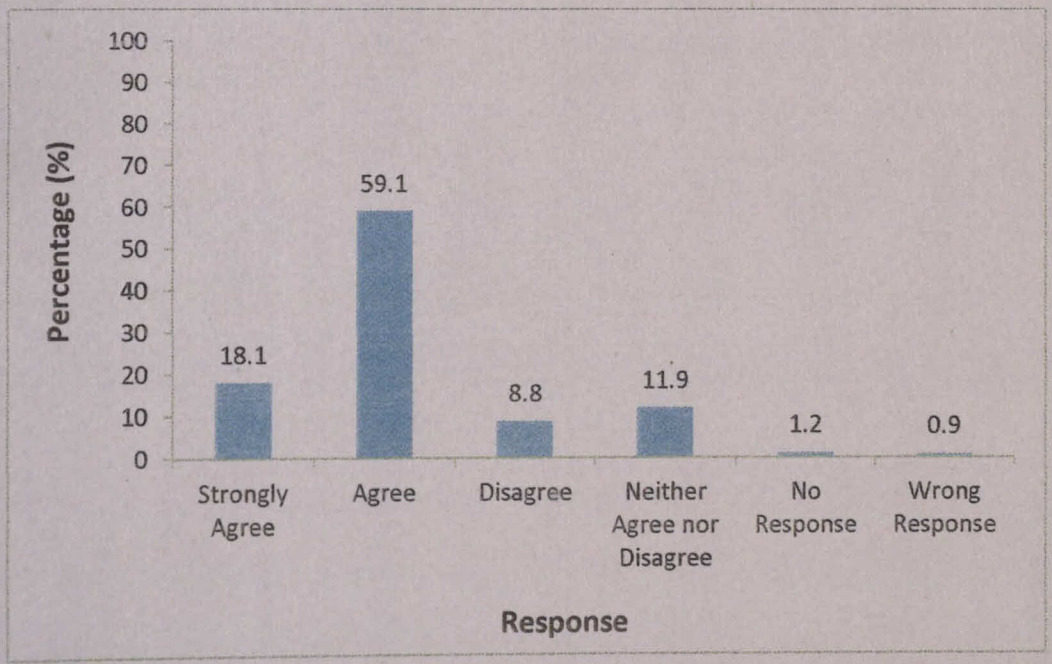

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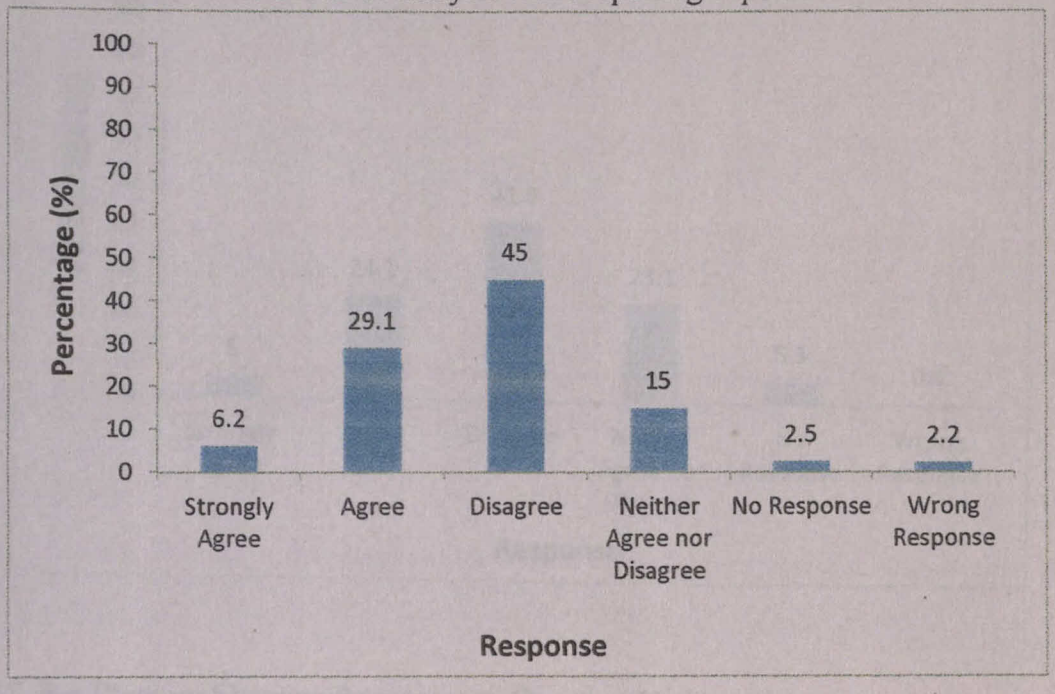
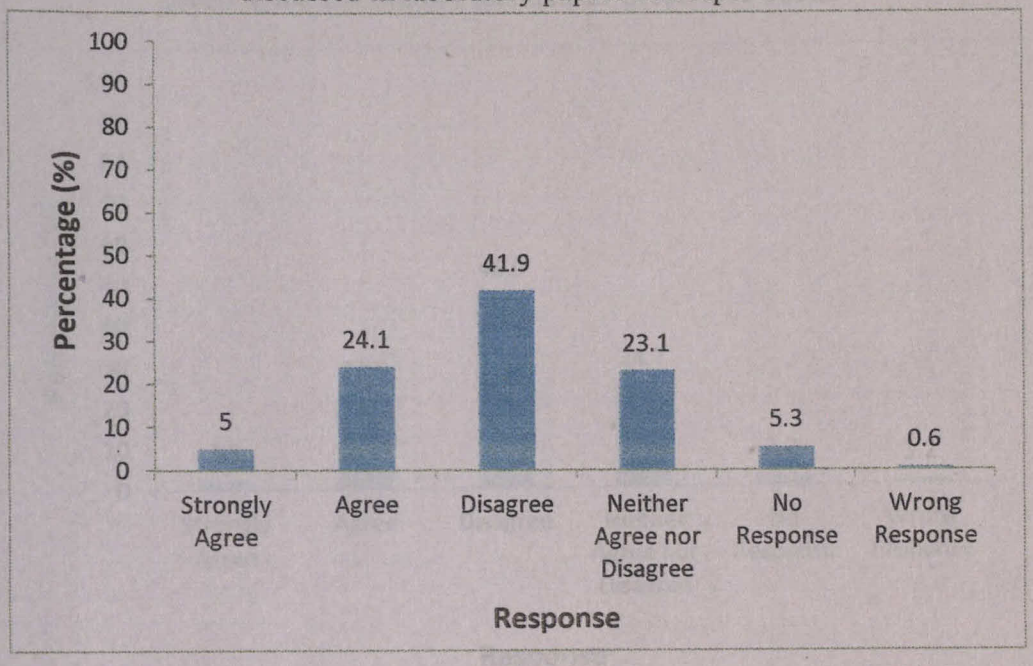


Figure 20: Bar Diagram Showing Responses to Query - "Experimental uncertainties are never discussed in laboratory papers and reports"



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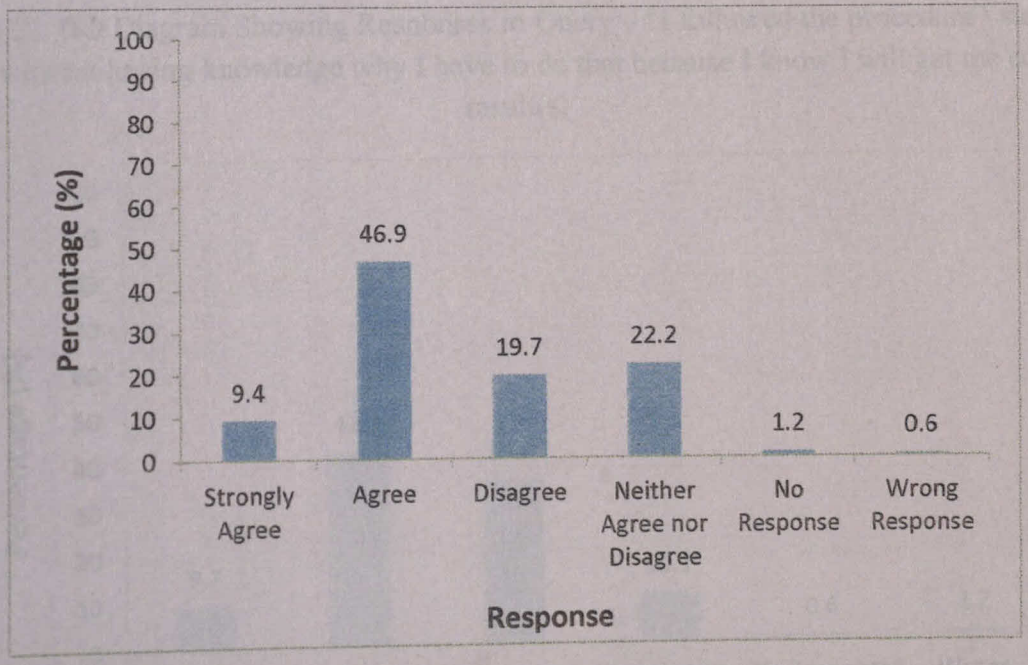
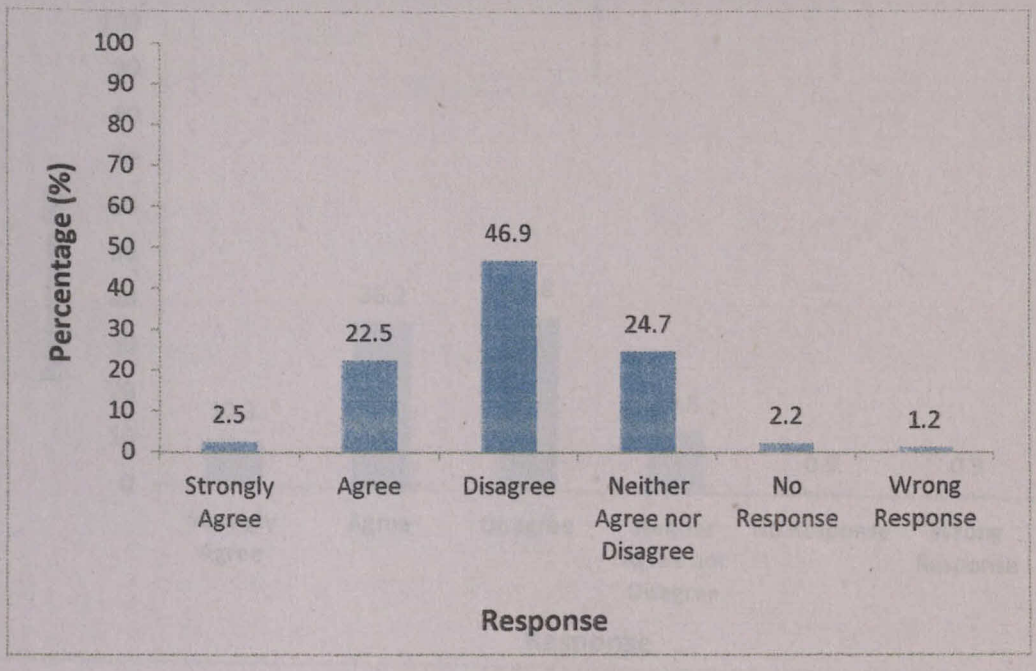


Figure 22: Bar Diagram Showing Responses to Query – "I totally understood whatever that are given in the Laboratory manuals or prescribed books"



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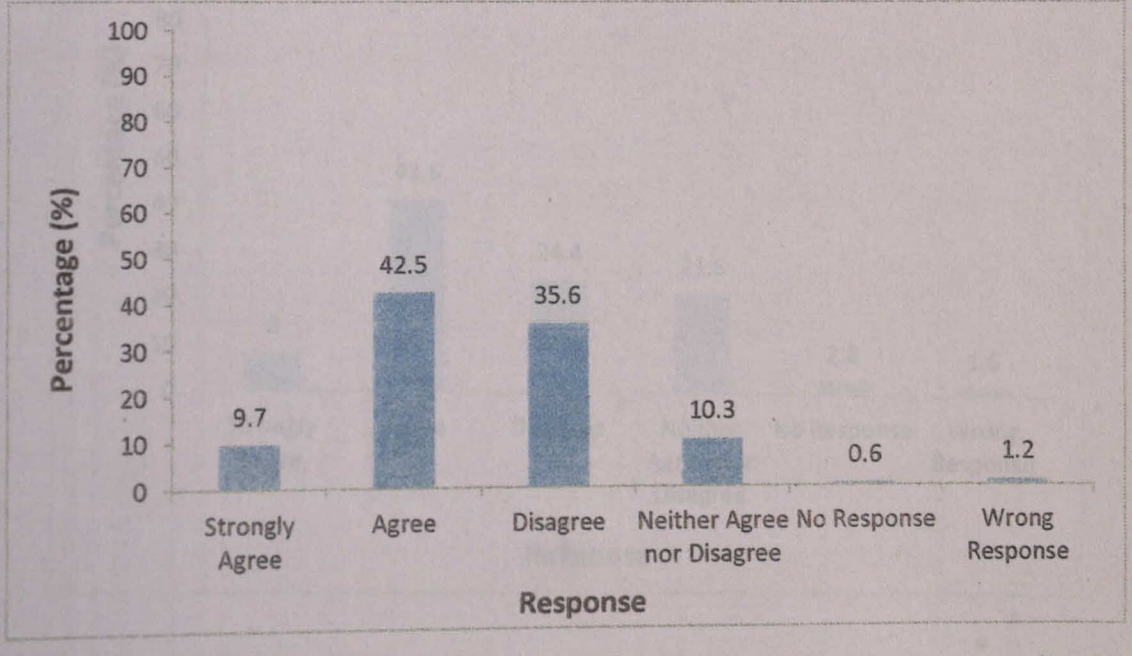


Figure 24: Bar Diagram Showing Responses to Query – "In the laboratory I am more concern about the result(s) than the theory behind the experiment"

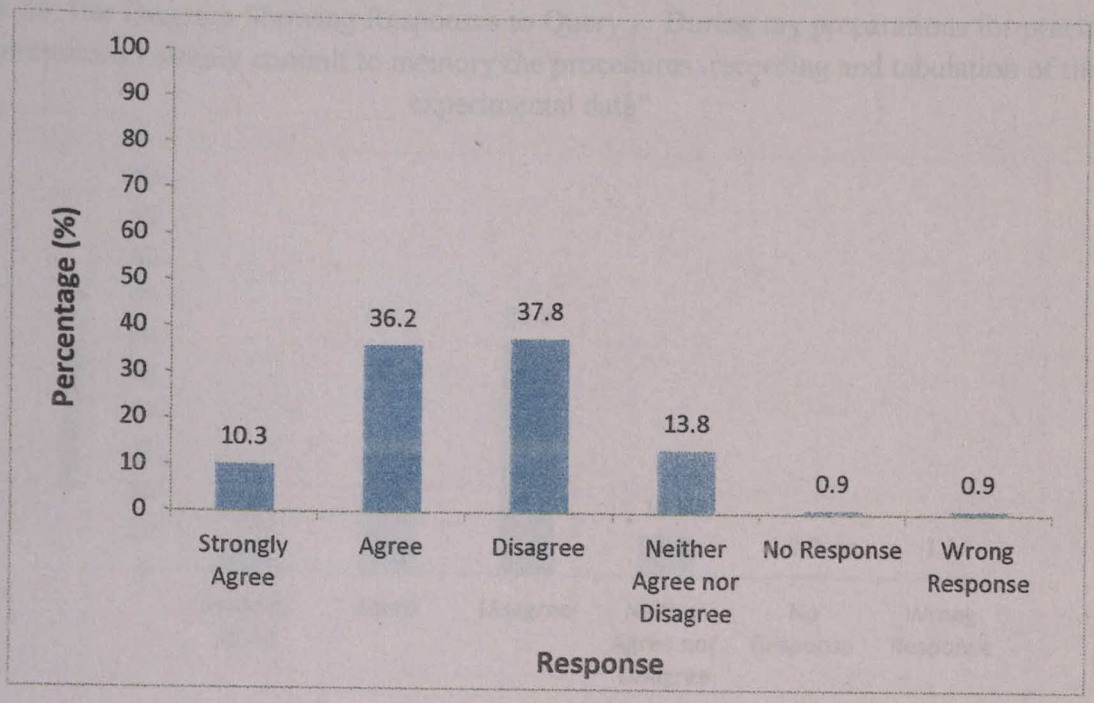
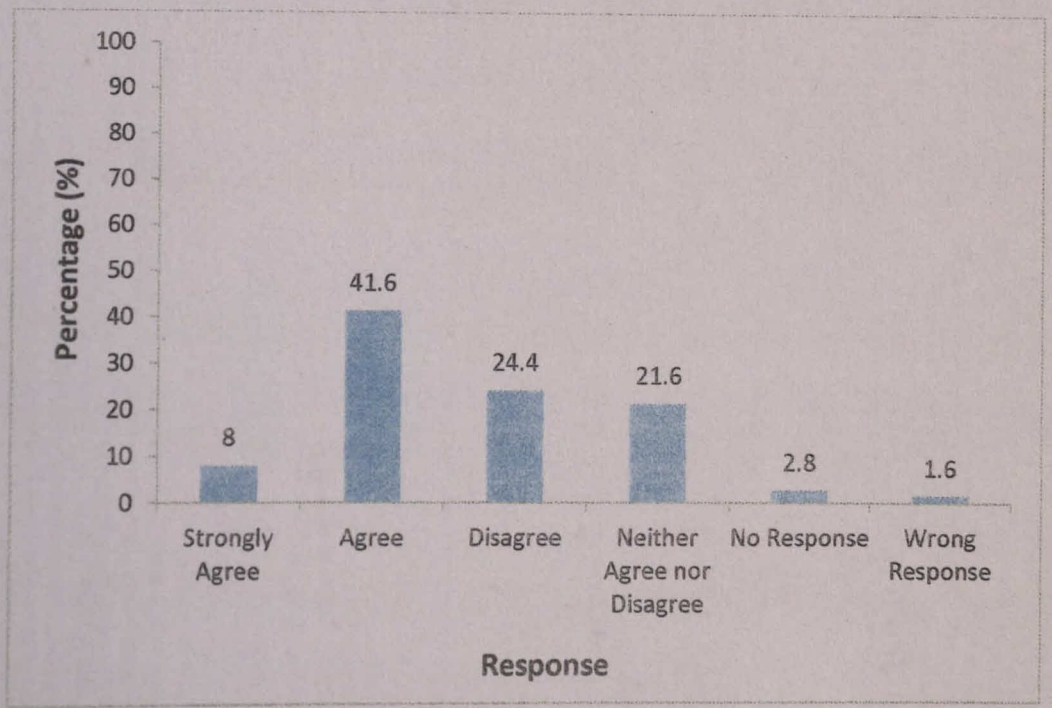


Figure 25: Bar Diagram Showing Responses to Query – "Experimental results are difficult to interpret hence I never try to interpret the result of experiment on my own"



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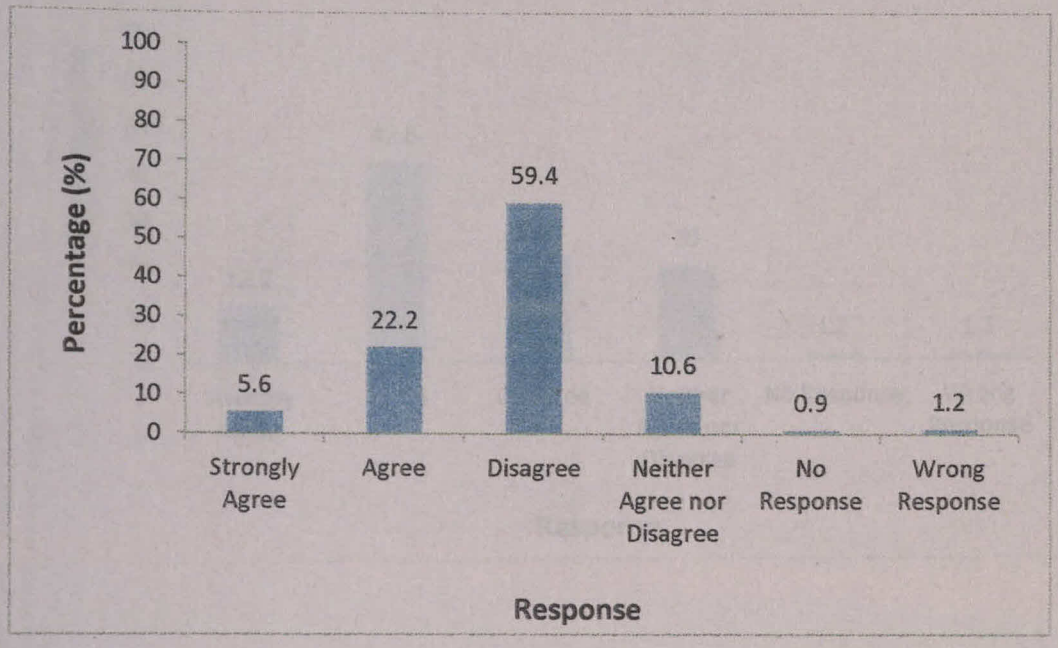

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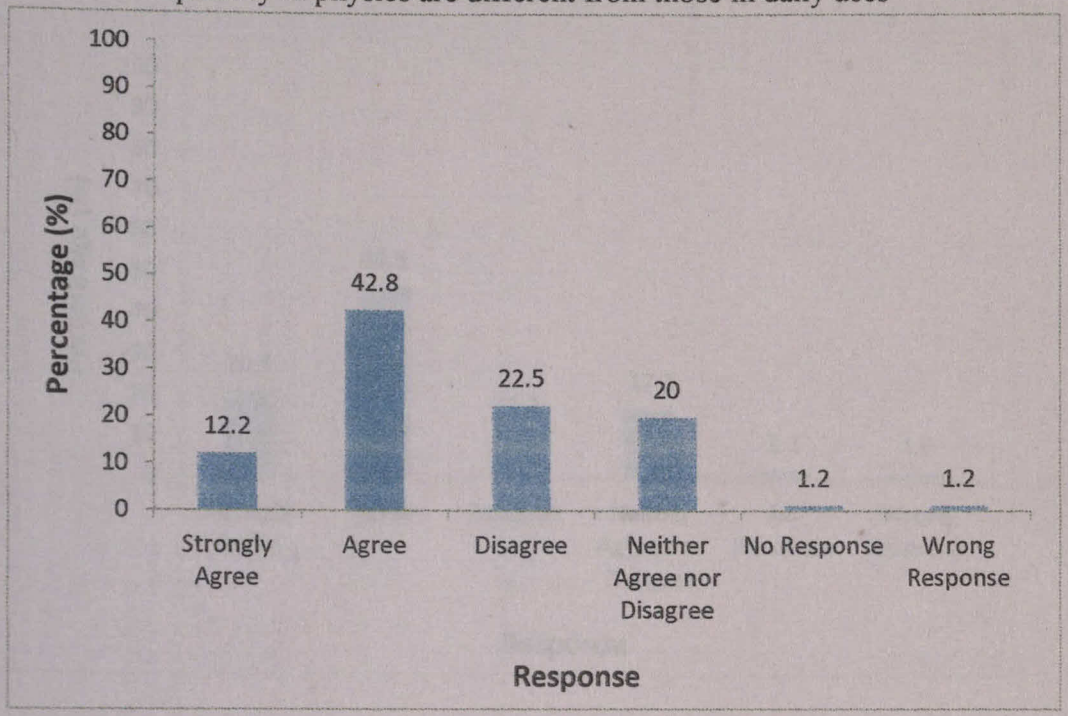


Figure 28: Bar Diagram Showing Responses to Query – "My teacher is very helpful when it comes to doing the practical works"

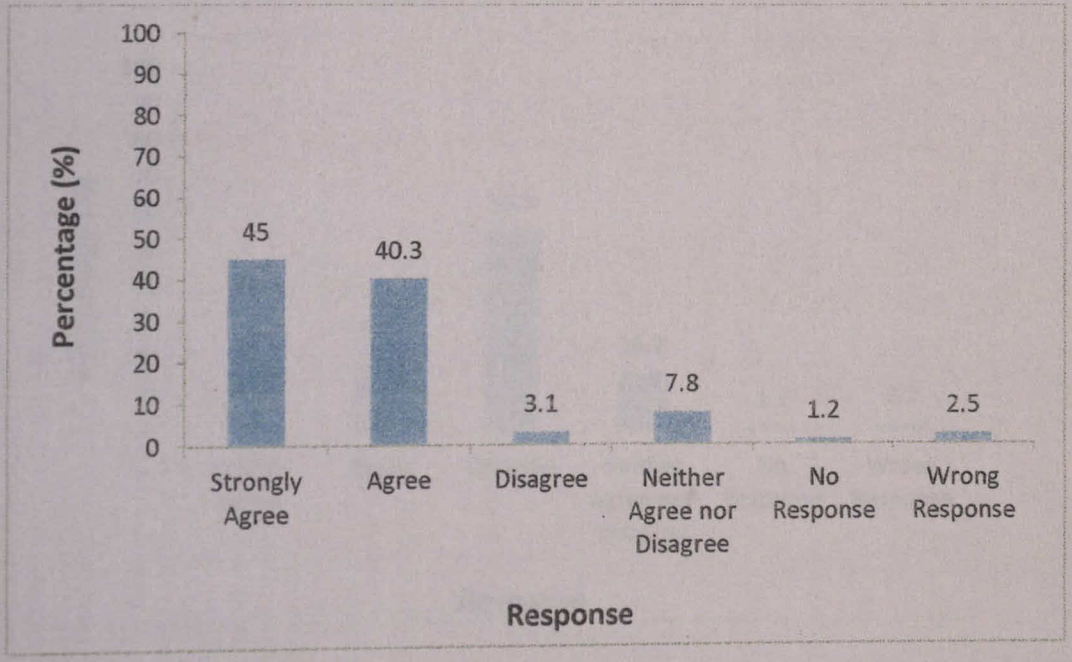


Figure 29: Bar Diagram Showing Responses to Query – "Our lab attendant is proficient in all the experiments"

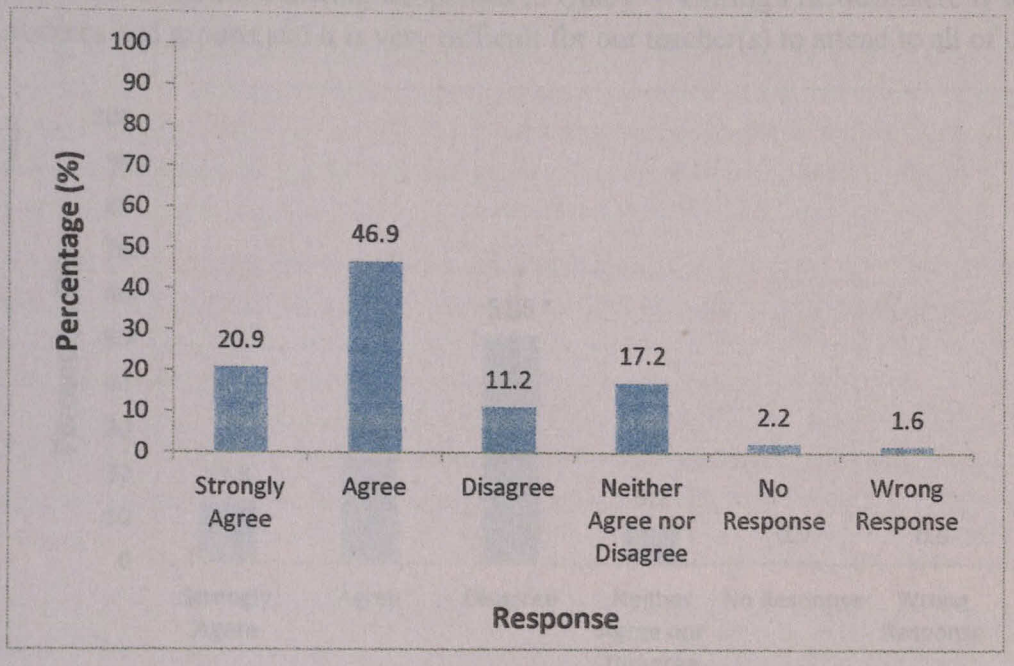


Figure 30: Bar Diagram Showing Responses to Query – "There is pressure from teacher to complete the experiment"

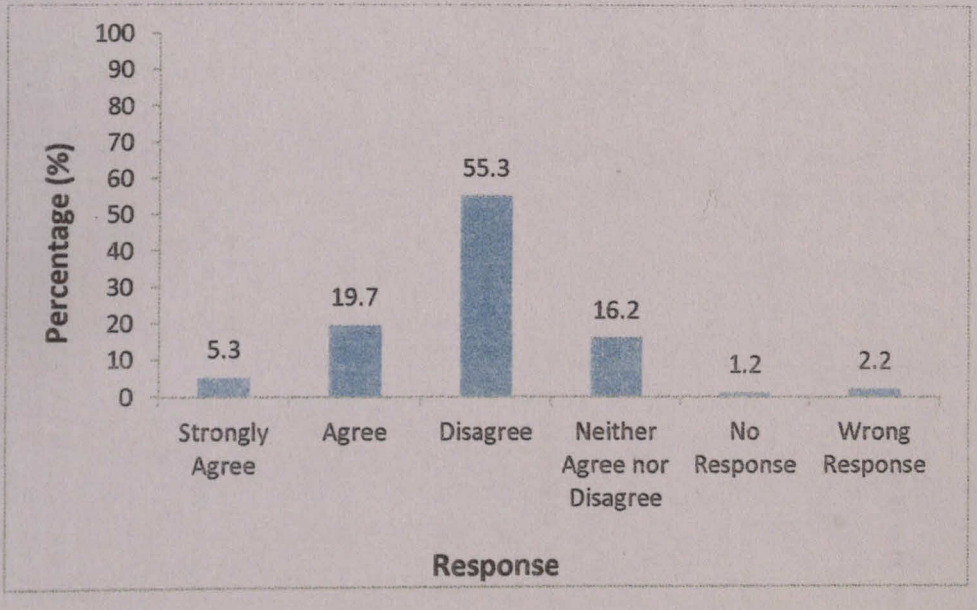
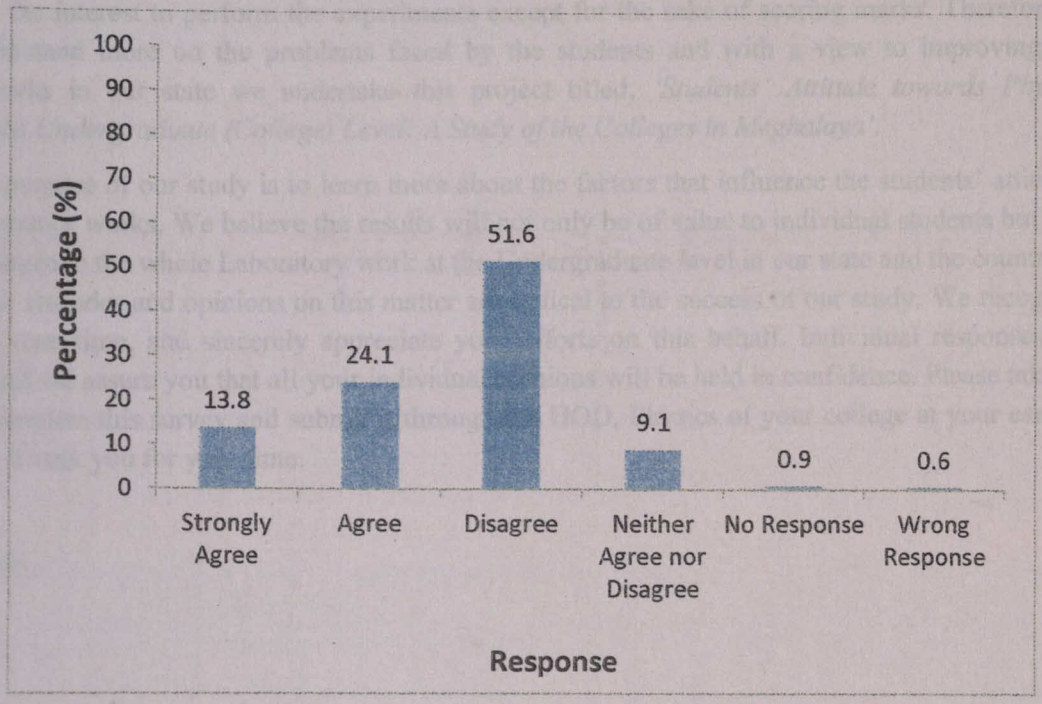


Figure 31: Bar Diagram Showing Responses to Query – "During Practical there is so many students and groups and it is very difficult for our teacher(s) to attend to all of us"



Dear students,

We are currently teaching Physics at the Undergraduate level in Shillong College, Shillong. It has been our experience during our course of teaching that there are certain difficulties on the part of the students to understand the purpose of Laboratory works in their studies and also, it is found that the students lack the interest to perform the experiments except for the sake of scoring marks. Therefore in order to understand more on the problems faced by the students and with a view to improving the laboratory works in our state we undertake this project titled, *'Students' Attitude towards Physics Practical at the Undergraduate (College) Level: A Study of the Colleges in Meghalaya'*.

The purpose of our study is to learn more about the factors that influence the students' attitudes towards Laboratory works. We believe the results will not only be of value to individual students but will also help to improve the whole Laboratory work at the Undergraduate level in our state and the country as a whole. Your attitudes and opinions on this matter are critical to the success of our study. We recognize the value of your time, and sincerely appreciate your efforts on this behalf. Individual responses are anonymous and we assure you that all your individual opinions will be held in confidence. Please take 10 minutes to complete this survey and submit it through the HOD, Physics of your college at your earliest convenience. Thank you for your time.

Yours sincerely,

(L. Khongiang)
Assistant professor,
Department of Physics,
Shillong College,
Shillong

(A. Dkhar)
Assistant professor,
Department of Physics,
Shillong College,
Shillong

Name:_____

Institution:_____

Class in which currently studying: BSc: 3rd year ☐ 3rd Semester ☐

Gender: Male ☐ Female ☐

Date:

A.

	[please put a tick mark (√) against the column that you think is correct in your opinion]	*Strongly Agree*	*Agree*	*Disagree*	*Neither Agree nor disagree*
1.	Physics experiments are interesting.				
2.	The experiments in the B.Sc Syllabus are still relevant even in the modern context of science.				
3.	The experiment and lab work help me in understanding the theoretical concepts better.				
4.	The physics lab work, I believe, is going to help me later when I'm doing my research.				
5.	I like spending time in the laboratory to perform the experiments.				
6.	I usually question the results of a particular experiment and do not simply accept them.				
7.	I also try to perform the experiments in other ways other than such ways as prescribed in the textbooks.				
8.	I also try to incorporate my own ideas while performing an experiment.				
9.	I am much more interested in the marks than in understanding the experiments.				
10.	I usually enjoy performing the experiments and do not feel any pressure at all to complete the experiments.				
11.	I wish the experimental lab work is not part of the curriculum.				
12.	I just want to complete the experiments even if I don't understand them.				
13.	I think the lab work is just an extra burden on my already heavy syllabi.				
14.	I think the lab work is tedious and boring.				
15.	Performance of experiments in physics Increases my interest in the subject.				

B.

Sl. No.	*[please put a tick mark (√) against the column that you think is correct in your opinion]*	*Strongly Agree*	*Agree*	*Disagree*	*Neither Agree nor disagree*
1.	The methods of measuring a physical quantity in physics are different from those in daily uses.				
2.	The methods of measurement in physics are tiresome.				
3.	I understand the significance of high precision instruments in making measurement of physical quantity.				
4	I understand why a particular quantity is measured many times.				
5.	I totally understood whatever that are given in the Laboratory manuals or prescribed books.				
6.	I followed the procedure stepwise even without having knowledge why I have to do that because I know I will get the correct result(s).				
7.	In the lab I am more concern about the result(s) than the theory behind the experiment.				
8.	During my preparations for practical examinations I simply commit to memory the procedures, recording and tabulation of the experimental data.				
9.	I believe there is an absolute true value in any measurement of a physical quantity.				
10.	Experimental uncertainties are never discussed in laboratory papers and reports				
11.	Experimental results are difficult to interpret hence I never try to interpret the result of experiment on my own.				
12.	I do not know how to use the uncertainties and error analysis while reporting experimental data.				
13.	My teacher is very helpful when it comes to doing the practical works.				
14.	There is pressure from teacher to complete the experiment.				
15.	During Practical there are so many students and groups and it is very difficult for our teacher(s) to attend to all of us.				
16.	Our lab attendant is proficient in all the experiments				