Attitude of Physics Students towards Physics at College of Science and Technology – University of Rwanda

Mushinzimana Xavier[1], Sinaruguliye Jean de la Croix[1]

[1]Department of Physics, School of Science, College of Science and Technology, University of Rwanda

Abstract

A low performance of physics students at University of Rwanda – College of Science and Technology Nyarugenge campus in physics subjects is observed since it has been created. In some topics, the class average falls below 50%.Therefore there are very few students who graduated with mention "First class" and even with "Upper second honors". This poor performance is attributed to their negative attitude towards Physics. This study sought to establish the attitude of students in Physics department towards Physics, in the objective to find means to improve their performance. The analysis of the results shows that only 58 % of students entering Physics department have enrolled voluntarily. Their attitude towards physics is slightly positive (3.6 on a 5 point Likert scale). It was found that neither gender, option at secondary school nor level of study influence this attitude.

Keys words: *Physics, attitude, performance, t – test, ANOVA.*

Introduction

Students 'attitude to one or another subject has been proven to lead to good performance in that subject. Negative attitude towards a certain subject makes learning difficult, while positive attitude stimulates students to do effort and leads to the high achievement in that subject (Veloo, Nor, & Khalid, 2015). Relative to Physics, Godwin and Okoronka(2015)showed that a significant relationship exists between students' attitude and their corresponding academic performance in physics. Determining students' attitude towards a subject is therefore a useful task if one wishes to improve the performance of students in that subject. The estimation of students' attitude towards natural sciences has been carried out by many researchers. In their researches, Wilson et al. (2000)and Kaya and Boyuk(2011)came to the conclusion that students' positive attitudes towards science highly correlate with their achievement in science. In the particular area of physics, because of a visible decline in the enrollment in physics and a fall in the interest in physics around the world, many researchers have been made to estimate the attitude of students towards physics at secondary schools and at universities. Many of them (Akinbobola, 2009; Alimen, 2009; Mekonnen, 2014) came to the same conclusion that the decrease in Physics academic achievement is alarming. The outstanding factor that caused this is the students' attitude towards Physics(George, 2000).

Purpose of the study

The purpose of this study is to investigate the attitude of physics students towards physics. The questionnaire has been designed to check their attitudes towards learning of physics, towards usefulness of physics in everyday life, and towards teaching of physics. The influence of gender, year of study and option at secondary school were also investigated.

Hypotheses

In this study, two hypotheses were tested:

1. The low performance of Physics Students at CST is due, among others, to their attitude towards Physics.

2. Gender, year of study and option at secondary school do not influence the attitude of Physics students toward Physics.

Literature review

Poor academic performance in Physics has been a concern in many high learning institutions in the last years around the world. Different authors attribute this poor performance to different causes, namely poor learning environment, poor teaching, inexperienced teachers, learning approaches, cognitive style of students, career interest, influence of parents and friends, low ability of the student, socio economic level and so on (Erdemir, 2009; e.g. Ibeh et al., 2013; Olusola & Rotimini, 2012). But most of them agree on that the attitude of students toward Physics plays a big role in this poor performance. George (2006) defines the attitude toward science as the positive or negative feelings about science, specifically to science classes. The attitude of a student toward a learning subject has therefore an object of intensive research in the last years to determine its responsibility in poor performance in science in general and in physics in particular. Once this responsibility is determined, researchers seek to find a way to improve the attitude in order to improve students' performance. Akinbobola (2009) introduced cooperative learning to boost students attitude toward Physics. She found that students taught using cooperative strategies show more positive attitude toward Physics compare to those taught with competitive and individualistic strategies. Marusic and Slisko (2012) opted for active learning to increase the students' attitude toward Physics. A positive shift of attitudes was observed in both groups of the experiment. In this research, we first investigated the attitude of Physics students at CST toward Physics, before suggesting some strategies to be used to improve this attitude and subsequently improve students' performance in Physics subjects.

Methodology

Population and sample

The participants in the study were physics students from first year up to fourth year. All students have been invited to participate due to their low number: 24 in first year, 11 in second, 21 in third and 14 in fourth year. However not all students submitted back the questionnaires. Furthermore, some students skipped one or more questions. The not completely answered questionnaires have been eliminated. At the end we remained with 43 questionnaires which were in due form. They represented 61 % of all physics department students. This percentage can be taken as the population sample and then can be used to conclude about the students attitudes toward physics. As the sample is quite large, the answers given by the respondents highly reflect the opinion of the entire population.

Characteristics of students

The distribution of respondents according to the level of study, option at secondary level and gender are indicated in the table 1:

Table 1 Distribution of respondents according to different variables

		Frequency	Percentage (%)
Year of study	Year 4	5	11.6
	Year 3	14	32.6
	Year 2	11	25.6
	Year 1	13	30.2
Option at secondary school	PCM[1]	31	72.1
	MPG[2]	7	16.3
	MPC[3]	5	11.6
Gender	Male	32	74.4
	Female	11	25.6

Data collection

A questionnaire was used as the instrument to collect necessary data. The questionnaire comprised 20 items, randomly distributed. Five (5) statements were designed to survey the attitudes of students towards learning, five (5) others surveyed their attitude towards usefulness of physics in everyday life, and ten (10) surveyed their attitude towards teaching of physics. Teaching of Physics has been divided into two (2) parts: lectures and experiments. For each statement, students were asked to indicate their level of agreement or disagreement using a 5-point Likert scale with points 1 = strongly disagree (SD), 2 = disagree (D), 3 = neither agree nor disagree (NAND), 4 = agree (A) and 5 = strongly agree (SA).

Data analysis

Data collected from the 43 respondents was analyzed using descriptive statistics in the form of frequency, percentage mean, and histograms were used to show graphically the relative proportion of each level of agreement for each attitude. A t – test and a one way ANOVA analysis have been applied to investigate the difference in attitudes based on gender for a t – test, and level of study and option at secondary school for one way ANOVA.

Results and discussion

The number of respondents was 43, all from the department of Physics, School of Science, College of Science and Technology, University of Rwanda. The questionnaire was distributed two weeks after the students began the academic year 2015 – 2016 (beginning of October). They returned them a few days after the distribution.

[1] PCM = Physics, Chemistry and Mathematics option
[2] MPG = Mathematics, Physics and Geography option
[3] MPC = Mathematics, Physics and Computer science option

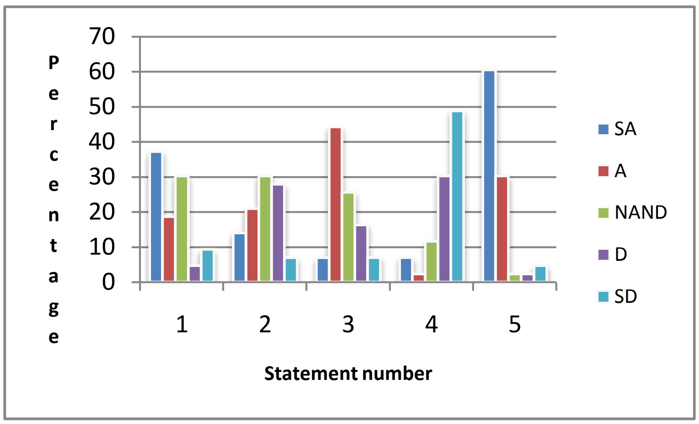
Students attitude towards learning of physics

Students were asked to show their level of agreement with five statements about their learning process. Table 2 and figure 1 show what have been their answers.

Table 2 Students' attitude towards learning of physics

S/N	Items	SA	%	A	%	NAND	%	D	%	SD	%
1	I like physics lectures more than the others	16	37.2	8	18.6	13	30.2	2	4.7	4	9.3
2	I easily learn physics topics	6	14.0	9	20.9	13	30.2	12	27.9	3	7.0
3	I get good marks from physics topics	3	7.0	19	44.2	11	25.6	7	16.3	3	7.0
4	I only fail in physics topics	3	7.0	1	2.3	5	11.6	13	30.2	21	48.8
5	I like studying physics	26	60.5	13	30.2	1	2.3	1	2.3	2	4.7

Figure 1 Histogram illustrating students' attitude towards learning of physics



Both Table 2 as well as the histogram on figure 1 shows that about 56 % of Physics students like physics lectures more than others, but only 35 % of them easily learns physics. Despite this, 51 % claim that they get good marks in physics, which shows that although they do not easily learn physics topics, there are students who use enough efforts to perform well.

Attitudes towards Physics usefulness in everyday life

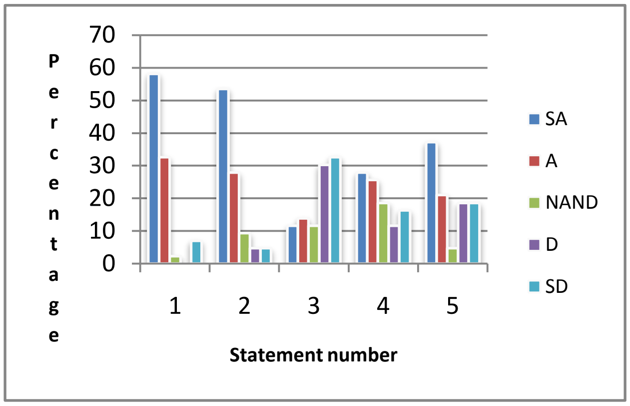
The low enrollment of students in physics department has attracted the attention of researchers and they checked the perception of students about the usefulness of physics in everyday life. The frequencies, percentages and histogram of the answers to survey statements about the attitudes of physics students towards physics usefulness in everyday life are displayed in table 3 below and figure 2.

Table 3 Students attitude towards physics usefulness in everyday life

S/N	Items	SA	%	A	%	NAND	%	D	%	SD	%
1	I learn interesting things in physics	25	58.1	14	32.6	1	2.3	0	0	3	7
2	I am convinced that what I study in physics will be useful for me in life	23	53.5	12	27.9	4	9.3	2	4.7	2	4.7

3	I don't see physics relevance to everyday life and society	5	11.6	6	13.9	5	11.6	13	30.2	14	32.6
4	Physics is a difficult subject	12	27.9	11	25.6	8	18.6	5	11.6	7	16.3
5	From secondary to university, I made physics my first choice	16	37.2	9	21	2	4.7	8	18.6	8	18.6

Figure 2 Histogram illustrating students' attitude towards usefulness of physics in everyday life



The first finding in table 3 and figure 2 is that the number of students that entered physics department voluntarily is 58.1 %. This means that more than 40 % students are enrolled in physics department despite their willingness to be enrolled in other departments. This agrees well with answers to the negative statement "I don't see physics relevance to everyday life and society" for which 25.5 % strongly agreed or agreed, while 11.6 % responded by neither agree nor disagree.

The second finding from table 3 is that 53.5 % of all students consider physics as a difficult subject. The overall average scored by these items is 3.6 on Likert scale, which shows that physics students have only a slightly positive attitude towards the usefulness of physics.

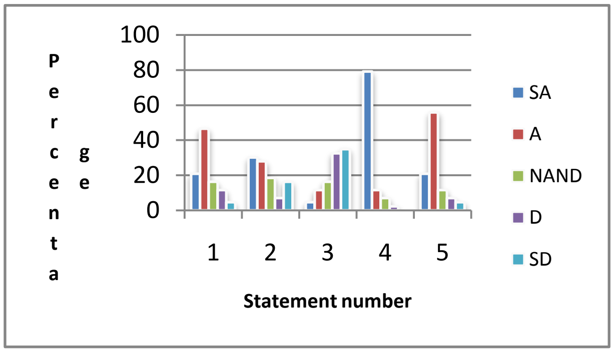
Students attitude towards teaching of physics

The teaching process can also affect the performance of a student in a given subject. In this research, five statements surveyed the students' perception of lectures. The results are summarized in the table 4 and figure 3.

Table 4 Students' attitude towards teaching of physics

S/N	Items	SA	%	A	%	NAND	%	D	%	SD	%
1	Physics lectures are exciting	9	20.9	20	46.5	7	16.3	5	11.6	2	4.7
2	Mentorship helps me understand better physics	13	30.2	12	27.9	8	18.6	3	7.0	7	16.3
3	Physics lectures are boring	2	4.7	5	11.6	7	16.3	14	32.6	15	34.9
4	The physics lecturers' role is important for my success in physics topics	34	79.1	5	11.6	3	7.0	1	2.3		
5	The way I am evaluated in physics stimulates me to study	9	20.9	24	55.8	5	11.6	3	7.0	2	4.7

Figure 3 Histogram illustrating students' attitude towards teaching of physics



From the table and histogram, it is seen that 67.4 % of students consider physics lectures as exciting and only 16.3 % consider them as boring. Moreover, 90.5 % highly appreciate the role of the lecturers in their study process, but only 58 % see mentorship as helping them to improve their understanding of physics. The evaluation mode also plays a key role as 80% of students confirm that the way they are evaluated stimulates them to study physics.

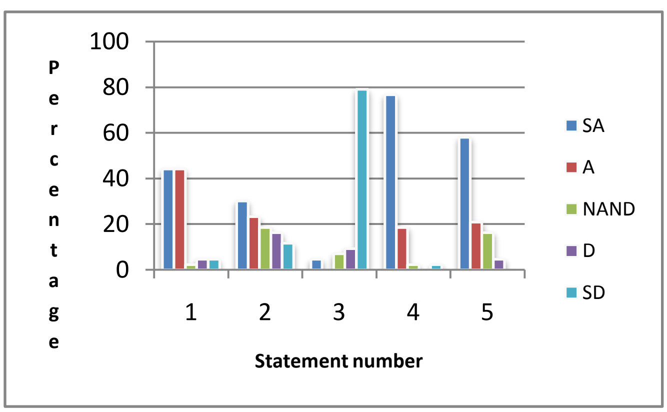
Students attitude towards physics experiments

Physics experiments constitute another way of teaching physics, superimposed on lectures and tutorials. The attitude of students towards experiments was surveyed by 5 statements. The students' level of agreement with each of them is summarized in table 5 and figure 4.

Table 5 Students' attitude towards physics experiment

S/N	Items	SA	%	A	%	NAND	%	D	%	SD	%
1	We learn physics topics better when we do physics experiments	19	44.2	19	44.2	1	2.3	2	4.7	2	4.7
2	Physics experiments are useful because during experiment sessions I am talking with my classmates	13	30.2	10	23.3	8	18.6	7	16.3	5	11.6
3	Physics experiments are useless	2	4.7			3	7.0	4	9.3	34	79.1
4	I would like to have more experiments in physics	33	76.7	8	18.6	1	2.3			1	2.3
5	Physics experiments are exciting	25	58.1	9	20.9	7	16.3	2	4.7		

Figure 4 Histogram illustrating students' attitude towards physics experiments



About 70 % agree that experiments are useful and 88% are convinced that they learn better when they do physics experiments. This result is similar to that obtained by Olusola and Rotimi (2012) and Rakhee and Sharma (2013). Table 5 and Figure 4 show also that more than 50 % of the students declare that the physics experiments are useful because during experiment sessions they are talking with their classmates. This largely positive attitude towards physics experiments suggests that collaboration between students while learning may be useful and productive.

Assessment of students' attitudes according to different variables

In this paragraph was statistically analyzed the attitude variation according to gender variable, to option at secondary school variable and according to the students' level variable. The null hypothesis in these three tests is that the mean scores are same among different groups and the significance level is set to $\alpha = 0.05$.

Students attitude according to gender variable

Using Excel, an independent t – test was applied to the gender variable with two independent groups. The results are summarized in the table 6.

Table 6 t-test: two groups assuming unequal variances

	Male	*Female*
Mean	76.2	76.8
Variance	130.0	119.4
Observations	32	11
Hypothesized Mean Difference	0	
df	18	
t Stat	-0.16	
P(T<=t) one-tail	0.44	
t Critical one-tail	1.73	
P(T<=t) two-tail	0.88	
t Critical two-tail	2.10	

As can be seen from Table 6, the mean scores for both groups are only slightly different. However, this difference is statistically insignificant ($p > 0.05$)at 0.05 significance level and we fail to reject the null hypothesis. We can therefore conclude that there is no difference in the attitudes towards physics among male and female students.

Students attitude according to level of study

There were four class - levels and we were investigating whether the level of study influences the students' attitude towards physics. The difference in attitude among the four groups if any can be obtained by the use ofone way ANOVA[4]. The null hypothesis is that the mean score for all groups is the same: $\mu_1 = \mu_2 = \mu_3 = \mu_4$. The Excel data sheet summarizes the results in table 7 below:

Table 7 One way ANOVA investigating the influence of level of study on students attitude towards physics

ANOVA						

[4] ANOVA is a statistical method that compares the variance of the data between groups to the variance of the data within groups. The SS in table 7 is the "sum of squares": SS between groups is the sum of squared deviations for each group mean about the grand mean; SS within groups is the sum of squared deviations for all observations within each group from that group mean, summed across all groups. The grand mean is the mean of all observations. The "*df* "in table 7 is the number of degrees of freedom: the *df* between groups is the number of groups minus one, while the *df* within groups is the number of all observations minus the number of groups, or equivalently it is the sum of *df* in each group. The symbol *MS* means the mean of the squares and is calculated as the ratio of the sum of squares SS to the number of degrees of freedom *df*. The F – value is the ratio of the mean square between groups to the mean square within groups. A large F – value indicates that there are large differences between groups than there are within groups. The p – value represents the smallest value of α at which the null hypothesis is rejected, while F crit is the F – value below which we fail to reject the null hypothesis.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	298.9	3	99.6	0.789	0.51	2.8
Within Groups	4927.2	39	126.3			
Total	5226.1	42				

As it can be seen, the F – value (0.789) is less than the critical value (2.8) and is less than one. This means that the variance between groups is smaller than the variance within groups. And this situation will be found in 51 % of all observations (p = 0.51). So the test was not statistically significant $F(3,39) = 0.789, p > .005$ as the p – value is well above the significance level α = 0.05. Therefore we failed to reject the null hypothesis. This suggests that the level of study does not influence the attitudes of students towards physics.

Students attitude according to their options at secondary school

A similar test was carried out and the tested parameter was the students' option at secondary school. They actually come from three options: PCM, MPG and MPC. The use of one way ANOVA was applied to analyze the attitudes of more than two groups. The results of this analysis are displayed in table 8.

Table 8 One way ANOVA investigating the influence of option at secondary school on students' attitude towards physics

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	35.4	2	17.7	0.14	0.87	3.23
Within Groups	5190.7	40	129.8			
Total	**5226.1**	**42**				

These results also show that there is no statistical significance $F(2, 40) = 0.14, p > .005$. This means that in view of these results, the option of students at secondary school does not influence their attitude towards physics.

Results of paragraphs 6.5.1 to 6.5.3 show that neither gender, level of study nor option at secondary school influences the attitude of physics students toward physics.

Conclusion and recommendations

Conclusion

As said at the beginning of this paper, the performance of physics students at the department of Physics in the School of Science at UR- CST Nyarugenge Campus is low. This survey has shown that only 51 % of students agree with the statement "I get good marks from Physics topics", 26 % are in an indecisive position while 23 % disagree. These numbers show that the students' performance is low and should be increased.

This low performance is all a big problem that it is combined with a low enrollment in the department of Physics: Physics department is the least populated among all departments of College of Science and Technology. However, low performance and low enrollment have the same origin. On one side, only 58 % of our students have applied for physics at university level, and 42 % are enrolled despite them. This low percentage of applications to physics department originates from the students' view of physics. Really, freshly enrolled physics students do not see physics relevance for society at the level of 38.5%. On the other side, it is seen that 27 % of second year students, 43 % of third year students and 20 % of fourth year students neither see physics relevance for society, and yet the low performance has been observed in these three (3) groups (first year students had not passed any test at the time of the survey). These percentages corroborate well the mean score of 3.6 on Likert scale, scored by the attitude towards usefulness of physics in everyday life. While not being negative, the mean score of 3.6 shows that physics students have only a slightly positive attitude towards physics. Then, we can conclude that it is this attitude that is at the origin of their low performance in agreement with hypothesis number 1. Hypothesis number 2 is also in agreement with the test results as no influence due to gender, option at secondary school or level of study was observed.

Recommendations

First, as stated in section 6, Physics students' low performance in Physics subjects is due to their almost negative attitude towards Physics. Then the improvement of their performance goes necessarily through the improvement of their attitude towards physics. To change this attitude, the physics department should organize sensitization sessions at the College level and even in secondary schools. This sensitization should focus on the role of physics in modern society and especially on physics based carriers. The statement about physics based carriers is very important as many students complain that they do not get good jobs after being graduated in physics. It is probably to answer to these complains that a "creating job creators" program has been initiated by the College. This program should be strengthened and supplemented by a carrier guidance sessions at each level.

Second, almost all students agree that the physics lecturer's role is important for their success in physics topics. Therefore to support the sensitization, the role of lectures should be reinforced by mentorship program recently introduced at CST.

Third, while 67 % of the students estimate that physics lectures are exciting and the same percentage disagree with the statement "Physics lectures are boring", more than 88 % think that they learn better when they do physics experiments and 95 % would like to have more experiments for a better understanding of physics. Then, lecturers should be encouraged to introduce more experiments in their lectures to make physics classes more attractive.

Fourth, organizing field trips would help to enhance the learning process.

Implementing these recommendations would lead to the improvement of enrollment in physics and students' performance. However, research should be carried out to discover at which level different factors, other than gender, option at secondary school and study level considered in this study, affect students' attitude towards physics and elaborate appropriate strategies. These factors include but are not limited to lecturers' training, teaching method, learning environment, students' family's socio–economic status, carrier interest, and so on.

References

Akinbobola, A. O. (2009). Enhancing Students' Attitude Towards Nigerian Senior Secondary School Physics Trough the Use of Cooperative, Competitive and Individualistic Learning Strategies. *Australian Journal of Teacher Education*, *34*(1), 1–9. https://doi.org/10.14221/ajte.2009v34n1.1

Alimen, R. A. (2009). Attitude Towards Physics and Physics Performance, Theories of Learning, and Prospects in Teaching Physics. *Liceo Journal of Higher Education Research*, *6*(1), 301–320.

Erdemir, N. (2009). Determining students' attitude towards physics through problem-solving strategy. *Asia-Pacific Forum on Science Learning and Teaching*, *10*(2), 1–19.

George, R. (2000). Measuring change in Students' Attitude toward Science over Time: An Application of Latent Variable Growth Modeling. *Journal of Science Education and Technology*, *9*(3), 213–225. https://doi.org/10.1023/A:1009491500456

Godwin, B. A., & Okoronka, U. A. (2015). *Attitude and Academic Performance of Senior Secondary School Students in Physics in Nigeria*.

Ibeh, G. F., Onah, D. U., Umahi, A. E., Ugwuonah, F. C., Nnachi, N. O., & Ekpe, J. E. (2013). Strategies to Improve Attitude of Secondary School Students towards Physics for Sustainable Technological Development in Abakaliki L.G.A, Ebonyi-Nigeria. *Journal of Sustainable Development Studies*, *3*(2), 127–135.

Kaya, H., & Boyuk, U. (2011). Attitude towards physics lessons and physical experiment of the high school students. *European Journal of Physics Education*, *2*(1), 38–49.

Marucsi, M., & Slisko, J. (2012). Many high school students don't want to study physics: active learning experiences can change this negative attitude! *Revista Brasileira de Ensinode F´ısica*, *34*(3), 3401-1-341–11. https://doi.org/10.1590/S1806-111720/2000300013

Mekonnen, S. (2014). Problems Challenging the Academic Performance of Physics Students in Higher Governmental Institutions in the Case of Arbaminch, Wolayita Sodo, Hawassa and Dilla Universities. *Natural Science*, *6*, 362–375. https://doi.org/10.4236/ns.2014.65037

Olusola, O. O., & Rotimini, C. O. (2012). Attitudes of students towards the study of Physics in College of Education Ikere Ekiti, Ekiti State, Nigeria. *American International Journal of Contemporary Research*, *2*(12), 86–89.

Veloo, A., Nor, R., & Khalid, R. (2015). Attitudes towards Physics and Additional Mathematics Achievement towards Physics Achievement. , 8(3), 35 – 43. *International Education Studies*, *8*(3), 35–43.

Wilson, L. V., Ackerman, C., & Malave, C. (2000). Cross - Time Attitudes, Concept Formation, and Achievement in College Freshman Physics. *Journal of Research in Science Teaching*, *37*(10), 1112–1120. https://doi.org/10.1002/1098-2736 (200012)37:10<1112:: AID-TEA5>3.0.CO;2-M