

ORIGINAL ARTICLE

Attitude of Junior and Secondary School Students towards Basic Science Subjects in North Gondar, Ethiopia

Missaye Mulatie Mengstie¹

Abstract

Education has become one of the most powerful weapons to reduce inequality and poverty (UNESCO, 2000). The main purpose of this study was to investigate attitude of junior, secondary and preparatory school students towards basic science subjects in North Gondar. The study used a quantitative research approach with cross-sectional survey design. To this end, 150 junior/secondary and preparatory school students who were selected from North Gondar zone to attend kiremt (rainy season) STEM (Science, Technology, Engineering and Mathematics) training at University of Gondar participated in the study. Data were collected through self-report questionnaire and analyzed using inferential and descriptive statistics. The results indicated that those students scored high on attitude towards basic science subjects (chemistry, biology and physics) and had excellent Grade Point Average. Besides, there was no significant difference in attitude towards basic sciences between male and female students. Most importantly, attitude towards science significantly influenced Grade Point Average on chemistry and biology subjects. Here, career interest was found to be the most important predictor of achievement in biology. But, the adoption of positive attitude toward science was the most important factor to explain achievement in chemistry. Career interest and adoption of scientific attitudes are vital dimensions influencing students' achievement in chemistry and biology respectively. Overall, this study concludes that attitude towards science has a colossal influence on students' achievement in chemistry, biology and physics. Therefore, institutions such as the Ministry of Education, teachers, and parents should plan and work in tandem to maximize students' positive attitude towards chemistry, biology and physics education.

Key terms: Attitude, Basic Science, Achievement, Students

Introduction

Background

Education has become one of the most powerful weapons to reduce inequality and poverty (UNESCO, 2000). Quite recently in 2011, the Ethiopian Government has given priority to Science, Technology, Engineering and Mathematics (STEM) education. And, a 70:30 mix ratio has been implemented where universities enroll 70 % of students in science and technology and the remaining 30 % in social sciences (MoE, 2012). The main purpose of 70:30 mix ratio is to produce competent workforce in order to fill the human resource shortage in STEM areas. Emphasizing on science and technology and increasing the number of students majoring in these areas may help to address the market demand in the industry and in the health care sector. However, the 70:30 mix ratio has been challenged as negative perception about STEM has become a serious problem for the success of the 70:30 plan.

Nevertheless, scholars such as Worth (2010) underscored the importance of learning science in early childhood as it is a basis for building interests in science. Children develop wishes to become scientists when they are between grade 4 and 6 (Tylor et al., 2001). Tylor et al. (2001) suggested that students should be encouraged to learn science at early stages so that they persistently love and stay in the field. However, offering science courses such as chemistry, physics and biology at the Ethiopian schools commence from grade seven, 1 Department of Psychology, University of Gondar. Email: mulate2002@yahoo.com

indicating that students do not have access to basic science lessons in their early ages. As mentioned above, increasing early enrollment of students in science will help Ethiopia to meet its priority for sustainable growth and development. This requires developing a positive attitude towards science fields among students. Ravad and Assaraf (2011) argued that promoting and developing positive attitude towards science field and supporting students to succeed in science are important factors in development. The Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), suggested that attitude of a person influences his/her behavior as there are natural interactions among attitude, purpose and behavior. Thus, students' attitudes towards science influence the amount of time and effort they exert on learning/studying which ultimately determine their academic successes.

Statement of the Problem

Although the 70:30 intake policy of Ethiopian education system increases enrollment of both male and female students in science and technology fields, women shared only 16 % professional position in science and engineering in contrast to a relatively higher proportion (46.8 %) they achieved in health profession (Beyene, 2015). These figures indicate high attrition rate of female students in science fields and/or little motivation to join science (physics, chemistry and biology). According to Feist (2006), gender influences attitude towards science, boys having more favorable attitude toward science as compared to their female counterparts. As compared to male students, female students' interest and attitude towards science diminish as their level of education increases (Christidou, 2011). Morley et al. (2006) stated that the presence of socially accepted perception on inappropriateness of 'hard' sciences to female students affects their enrollment and resumption in the field.

After the implementation of 70:30 policy, issues of gender stereotypes, and achievement discrepancy and attrition in science fields are well documented. Local researchers (like, Semela, 2010; Bekele et al., 2007) found the prevalence of gender inequality in STEM fields. However, the influence of attitude on academic achievement has not been given due emphasis, even after the implementation of 70:30 policy. Hence, this study aims at investigating attitude of junior, secondary and preparatory school students in relation to their achievement in chemistry, biology and physics studies.

Research Questions

The following research questions are stated to guide the study:

1. What is the level of attitude towards science among students at different levels of education?
2. Does attitude towards science significantly explain achievement in chemistry, biology and physics?
3. Is there a significant difference in attitude towards science across sex and grade level?
4. Is there a significant relationship between age and attitude towards science?

Methods

Study area

This study was conducted at the University of Gondar. The university offers a special training to students of junior, secondary and preparatory schools during the kiremt (rainy season) season to promote and strengthen their knowledge and skills in Science, Technol-

ogy, Engineering and Mathematics (STEM).

Participants

Participants of the study were junior, secondary and preparatory school students. The students came from different rural and urban districts of North Gondar to attend STEM program at the University of Gondar during 2017 kiremt season. All the students (a total of 150) who were attending in STEM program in the university have participated in the study. Nevertheless, 7 of the students failed completing the questionnaires. Hence, the responses of 143 participants were used for analysis -with 95% response rate.

Instruments

Grade Point Average (GPA) of students was used to measure their achievement to basic science (chemistry, physics and biology). Attitude of students towards science was measured through self-report questionnaire. The four domains of Test of Science Related Attitude (TOSRA) sub-scales (adoption of scientific attitudes, enjoyment of science lessons, attitude to scientific inquiry and career interest in science) developed by Fraser (1981) were used to measure attitude of respondents toward science. Each sub-scale consists of ten items with response scale ranging from strongly agree (5) to strongly disagree (1). The adoption of scientific attitudes measures open-mindedness or how likely students change their way of viewing the world based on scientific evidence. The enjoyment of science lessons' scale measures the extent of enjoying and participating in science laboratories and attending classes. The attitude to scientific inquiry sub-scale measures the degree to which students accept science as a way of thought. Finally, the career interest in science sub-scale measures students' aspiration and interest to pursue a career in science. The English version of the instruments was translated into Amharic (local language). Again, the Amharic version was translated back into English by the researcher. The language equivalence of the Amharic and the English versions of the instruments were also checked for congruence.

Data collection procedure

The researcher of this study has no role in the STEM training and, thus, had to seek permission from the director of the training to get access to the students. After securing permission from the director, the researcher asked participants about their willingness to give response to the questionnaires. Besides, a brief orientation was given to the participants about the purpose of the study. They were assured of the confidentiality anonymity of their identity. After doing this, assistant data collectors were given brief orientation about the procedures of collecting the quantitative data. Then, the assistant data collectors and the researcher distributed questionnaires in classrooms.

Data analysis techniques

Inferential and descriptive statistics were used to analyze the quantitative data. Predictions of the independent variables on the dependent variables were computed using standard multiple regression. Pearson's correlation was computed to see relationship among variables. Independent samples t-test was used to check if there is a significant difference in attitude towards science and science achievement across gender and residence. One-way ANOVA was computed to check if a significant difference exists in science attitude among students at different grade levels.

Results

Preliminary analysis was conducted to check assumptions of t-test, one-way ANOVA, and linear multiple regression.

Table 1: Demographic characteristics of the respondents

Variables	Category	N	Percent
Sex	Female	33	23.1
	Male	110	76.9
	Total	143	100.0
Grade	Grade 7	13	9.1
	Grade 8	20	14.0
	Grade 9	16	11.2
	Grade 10	37	25.9
	Grade 11	36	25.2
	Grade 12	21	14.7
	Total	143	100.0
Residence	Urban	100	69.9
	Rural	43	30.1
	Total	143	100.0

Among the total number of participants, the majority (76.9%) were male students whereas the remaining 23.1% were females, indicating low proportion of female students in the STEM program. Regarding place of residence, most of the students who attended the STEM program came from urban areas although few were from rural areas.

Correlation among variables

Table 2: Mean, standard deviation and correlation coefficient

Variables	Mean	St.dev.	Correlations						
			1	2	3	4	5	6	7
Age	16.34	2.39							
Attitude to scientific inquiry	37.92	4.99	.11						
Adoption of scientific attitudes	35.78	4.83	.36**	.38**					
Enjoyment of science lessons	41.51	6.50	.38**	.46**	.63**				
Career interest in science	35.46	5.05	.36**	.38**	.47**	.62**			
Chemistry score	95.19	4.40	.14	.06	.19*	.08	.18		
Physics score	95.05	4.31	.16	.03	.03	.04	.01	.28**	
Biology score	96.67	3.64	.15	.07	.22	.19*	.31**	.56**	.18*

Note: *= $p < .05$; **= $p < .01$

The results in Table 2 indicated that age of students was positively correlated with adoption to scientific attitude ($r = .36$, $p < .01$), enjoyment of science lessons ($r = .38$, $p < .01$) and career interest in science ($r = .36$, $p < .01$). From Table 2 one can understand that achievement in biology was positively and significantly correlated with enjoyment of science les-

sons ($r=.19$, $p<.05$) and career interest in science ($r=.31$, $p<.01$). There was also a significant correlation between achievement score in chemistry and adoption of scientific attitudes ($r=.19$, $p<.05$).

Gender difference in Science subjects achievement

Table 3: Gender and achievement in Science subjects

Subject	Sex	Mean	Standard deviation	t	Sig
Chemistry	Male	95.42	4.19	1.1	.273
	Female	94.37	5.08		
Physics	Male	95.20	4.48	.71	.479
	Female	94.53	3.66		
Biology	Male	96.63	3.57	.19	.846
	Female	96.78	3.90		

Independent samples t-test (Table 3) was computed to check whether science scores differ by gender of participants. The result indicated that there was no significant difference in the achievement of students in chemistry ($t=1.1$, $p>.05$), physics ($t=.71$, $p>.05$) and biology ($t=.19$, $p>.05$) subjects between male and female students. Male and female students scored similar values in the three science subjects (chemistry, physics and biology), indicating that gender has no significant influence in science achievement. The average achievement scores in Table 2 indicated that both males and females scored very high ($GPA>90$) in chemistry, physics and biology.

Attitude towards science across gender

Table 4: Gender and attitude in science

Science attitude dimensions	Sex	Mean	Standard deviation	t	Sig
Attitude to scientific inquiry	Male	37.96	4.79	.17	.860
	Female	37.78	5.67		
Adoption of scientific attitudes	Male	36.06	4.73	1.27	.206
	Female	34.84	5.09		
Enjoyment of science lessons	Male	41.40	6.56	.36	.712
	Female	41.87	6.41		
Career interest in science	Male	35.88	4.96	1.83	.069
	Female	34.06	5.17		

Independent samples t-test was also computed to check whether or not there is attitudinal difference between male and female respondents towards science subjects (Table 4). The t-test did not show significant mean difference between male and female students in their attitude towards scientific inquiry ($t=.17, p >.05$), adoption of scientific attitudes ($t=1.27, p >.05$), enjoyment of science lessons ($t=.36, p >.05$), and career interest in science ($t=1.83, p >.05$). The mean scores, as displayed in Table 2, indicated that both male and female students reported favorable attitude towards science (scientific inquiry, enjoyment of science lessons, career interest in science, and adoption of scientific attitude).

Attitude towards science across grade levels

Table 5: Grade level and attitude towards science

Science attitude dimensions	Grade level	Mean	Standard deviation	F	Sig
Attitude to scientific inquiry	Grade 7	36.30	3.66	1.955	.089
	Grade 8	36.90	3.98		
	Grade 9	39.81	4.60		
	Grade 10	36.70	5.55		
	Grade 11	39.27	5.22		
	Grade 12	38.28	4.79		
Adoption of scientific attitudes	Grade 7	30.38	6.64	5.16	.000
	Grade 8	35.25	5.51		
	Grade 9	36.43	1.96		
	Grade 10	35.37	4.53		
	Grade 11	37.22	3.95		
	Grade 12	37.38	4.09		
Enjoyment of science lessons	Grade 7	35.23	8.57	5.96	.000
	Grade 8	39.05	5.31		
	Grade 9	44.68	4.25		
	Grade 10	40.89	6.97		
	Grade 11	44.22	5.02		
	Grade 12	41.76	5.54		
Career interest in science	Grade 7	32.30	4.46	4.69	.001
	Grade 8	33.10	4.98		
	Grade 9	38.25	3.89		
	Grade 10	34.43	5.47		
	Grade 11	37.19	4.83		
	Grade 12	36.38	3.58		

When we see the mean scores of the respondents from grade 7 to grade 12 (Table 5), we can understand that students had favorable attitude towards science (mean > 30). However, results of the one-way ANOVA in Table 5 indicated significant mean difference in adoption of scientific attitudes ($F=5.16$, $p < .05$), enjoyment of science lessons ($t= 5.96$, $p < .05$), and career interest in science ($t=4.69$, $p < .05$) among grade 7, grade 8, grade 9, grade 10, grade 11 and grade 12 students. The Scheffe Post-hoc test confirmed that the mean of adoption of scientific attitudes for grade 7 students was significantly lower than that of grade 9, grade 10, grade 11 and grade 12 students. Similarly, grade 7 students scored significantly lower in enjoyment of science lessons than grade 9 and grade 11 students.

Attitude towards Science predicting achievement in science

Table 6: Multiple regression on influence of attitude towards science and on achievement in science

Science attitude dimensions (Dimensions of attitude towards science)	Chemistry		Physics		Biology	
	β	R2	β	R2	β	R2
Attitude to scientific inquiry	-.173	.08*	-.228	.005	-.066	.11**
Adoption of scientific attitudes	.202		-.192		.126	
Enjoyment of science lessons	-.050		-.487		-.020	
Career interest in science	.183		.541		.291**	

Note: *= $p < .05$; **= $p < .01$

As demonstrated in Table 6, multiple linear regression was conducted to see the influence of students' attitude towards science in their academic achievement in science field. The above results demonstrated that dimensions of attitude towards science significantly explain 8% and 11% variations in students' achievement in chemistry and biology respectively. Career interest was the most important predictor of achievement in biology whereas adoption of scientific attitudes was an important predictor of achievement in chemistry.

Discussion

The current study revealed that junior, secondary and preparatory school students scored high on attitude towards basic sciences and obtained excellent Grade Point Average in science subjects (chemistry, biology and physics). The finding of this study also indicated positive relationship between age and attitude towards science. As students' age increases, they tend to pursue a science career, use science as a way of thought, view the world based on scientific evidence and enjoy science lessons.

Interestingly, this study revealed no significant difference in chemistry, physics and bi-

ology between male and female students. Both male and female students scored similar and excellent grade in chemistry, biology and physics subjects, indicating that gender has no significant influence on their achievement in science. Previous studies yielded mixed results on the role of gender in science achievement. Consistent with the present study, Wang and Berline (2010) found out that gender difference did not have an impact on achievements in science. Contrary to the present study, previous studies in Ethiopia by Semela (2010) and Bekele et al. (2007) unveiled gender disparity in science achievement.

This finding also shows that there was no significant difference in attitude between male and female students towards science. The results indicated high mean score in attitude on scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons and career interest in science. This implies that gender has no significant effect on science promoting attitudes. Contrary to this study, Feist (2006) found out the influence of gendered-attitude towards science, indicating that male students had more favorable attitude towards science vis-à-vis their female counterparts. As a survey study in Ethiopia shows, female students dislike science and had negative attitude towards science subjects, especially to physics (Hamel, 2016).

But, the finding of this study indicated significant difference in adoption of scientific attitudes, enjoyment of science lessons and career interest in science across educational levels. The mean value of adoption of scientific attitudes of grade 7 students was significantly lower than that of grade 9, grade 10, grade 11 and grade 12 students. In addition, grade 7 students scored significantly lower scores in enjoyment of science lessons as compared to grade 9 and grade 11 students. This shows that there is an influence of educational level on attitude related to science. Accordingly, as grade level increases, attitude of students towards science becomes favorable. Contrary to the present study, George (2006) and Weinburgh (2000) had argued that the favorability of students' attitude towards science lessons decreases as their education levels increase.

Finally, attitude towards science had significant influence on achievement in chemistry and biology. Career interest was the most important factor that positively contributes to biology achievement whereas adoption of scientific attitudes was the most important factor that positively influences achievement in chemistry.

Conclusion

Junior, secondary and preparatory school students who scored high on attitude towards basic science subjects had excellent Grade Point Averages in science (chemistry, biology and physics). The finding indicates that age has a positive relationship with attitude towards science. That is, as their age increases, students develop favorable attitude towards science subjects. Gender did not implicate significant difference on attitude towards basic science as well as on achievement. Both male and female students had similar and high level of science achievement and science attitude. In addition, grade level had positive influence on science attitude and as grade level increases, attitude of students towards science becomes favorable. Finally, students' attitude towards science had a positive influence on their achievement in science field.

Recommendations

Based on the results of the study, the following recommendations are forwarded:

1. Since the achievement of students in science subjects was high, the students should

be reinforced to persist in their success in the field.

2.The study clearly shows that attitude towards science subjects significantly influences achievement. Hence, teachers, school counselors, and administrators should strongly support students to maximize a positive attitude towards science.

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