How can we augment female students' participation in first and second year Physics classes; The case of Adigrat University

[1]Mengisteab Gebrehiwot Meressa, [2]Berhe Zewde Aregawi, [3]Haftom Gebremariam Mihretu
[1]Head, Department of Chemistry, [2]Head, College quality assurance office, [3]Lecturer
[1] Department of Chemistry, College of Natural and Computational Science, Adigrat University P.O. Box 50, Adigrat, Ethiopia

Abstract - The primary purpose of this study was to enhance female students' participation by recognizing and diminishing the existing factors that affect female students' participation in case of First and Second Year Physics students at Adigrat University. Physics learning content in University classrooms would not only be related to the textbooks and materials used in classrooms, but would also be embodied in the knowledge structure, the ways the knowledge was presented, as well as being strongly associated with classroom activities and classroom teaching strategies. Contextual and content factors are likely to interact with each other to have a combined influence on female students' learning motivation and career interests in physics, which in turn jointly have an influence on learning experiences, and hence, the development of physics self-efficiency. However, little research has been conducted at the University level with respect to considering the relationship between physics learning content and physics self-efficiency. In order to address this gap, this study was conducted to evaluate the factors that affect female students' participation in physics classes. Study data was collected by the researchers using data collection instruments such as questionnaires, interview and observation. The data collected through interviews, questionnaires and observation was analyzed using descriptive statistics such as frequency distribution and percentages. In this analysis descriptive statistics frequency was calculated and tabulated. Based on the research findings it was concluded that the most influential factor on female students' low participation in physics is their poor opinions about physics classes

Keywords – Physics, questionnaire, interview, observation

I. INTRODUCTION

Background of the study

Physics plays a key role in understanding the world we live in, and physicists contribute strongly to the welfare and economic development of nations. The knowledge and problem-solving skills of physicists are essential in many professions and industries and to society at large. To thrive in today's fast-changing, technological world, every country must achieve a highly educated population in physics, fully engaged in making decisions important to their well-being [1].

Another report revealed that it is an undeniable fact that any country which wants to develop must place some emphasis on education. Education equips labour with the necessary skills for making production with the most efficient and up-to-date technology. Education also offers the opportunity for extensive research into any discipline and thus enables a nation to discover new ways of improving the economic and social welfare of its citizenry. Female education affects family health and nutrition, agricultural productivity and fertility, yet in many organizations and institutions people hold the view that particular jobs and activities are suitable for women and others are suitable for men. There is often more respect for male professionals than there is for female [2].

Career women often have to work harder at their jobs to keep even with their male counterparts. Despite all these obstacles, women continue to move into different professions, including those traditionally seen as male jobs, such as engineering and architecture. Women can be found at senior levels in many organizations in many countries. They are also taking up various different professions such as law, medicine, politics among others but these women may be in the minority [2].

A research revealed that professional studies of engineering, architecture, astronomy and physics are dramatically underrepresented by females. While women represent over half the general population, they represent only a tiny minority of professionals in physics with majority going into biology [3].While females represent over half the general population worldwide, they represent only a tiny minority of professionals in physics with majority going into biology. History has it that this imbalance was thought to be the result of differing brain structures and functions. However, explanations based on gender-specific socialization have largely displaced the brain difference model. Theories of Socialization hold that females are directed away from physics studies/ courses by parents, teachers, and peers (male and female) because such studies are considered to be unfeminine . Such theories as reported by Baird further argue that females themselves select out of physics courses because the careers involved in those fields do not match the careers with which girls are encouraged to be concerned[4].

The literature shows that college teachers are generally aware of low female participation in physics courses and the growth of this low participation at higher levels of study [4, 5]. Another report reveals that college teachers assign a number of reasons to low female participation in physics courses. Among them are:

a. Societal and cultural influences

b. Lack of female role models
c. Discouragement from parents, counselors and teachers
d. Lack of interest in physics
e. Lack of confidence in physics
f. Aptitude, ability or brain differences

The number of females taking science programs, particularly physics at the higher education level is low. Physics in particular, is the least successful of all the sciences in attracting and retaining females within the field [6]. Another report revealed that at the higher educational level, few females choose to enroll in most science courses, both at undergraduate and postgraduate level and among these females who choose to enroll in science courses only a handful choose to study physics [7].
In Ethiopia, many studies revealed that only few females choose to study physics at the university compared to other subjects. For example at Adigrat University female enrolment figures in physics, chemistry and biology show a low trend of female participation in physics. This also confirmed by the experience and observation of the researchers in their respective classes at Adigrat University. Due to this an action research were conducted on to assess the female students interest towards physics and enhance their low level participation in class room in the case of Year I and Year II Physics students .

II. OBJECTIVES OF THE STUDY

General objective

The general objective of this study was to increase female students' participation by identifying and diminishing the existing factors that affect female students' participation of First and Second Year Physics students at Adigrat University at this time.

Specific objectives

The specific objectives of this study were:

- ✓ To study the female students' belief about the impact of physics learning.
- ✓ To scrutinize students' interest and participation in physics class.
- ✓ To investigate the factors that affect low participation of females in physics class.
- ✓ To take measures on these factors for improvement

III. LIMITATION OF THE STUDY

For more relevant and reliable results, it would have been better if it had included representatives of all female physics students in Adigrat University enrolled in physics department, but due to shortage of time, budget, over burdens in other regular teaching activities and resources the study was limited to First and second Year physics female students.

IV. SIGNIFICANCE OF THE STUDY

In fact physics is a challenging subject. The time and effort required for successful completion of physics course tend to rank among the highest of courses offered at a comparable level at the university. But students' perceptions and attitudes affect participation in physics class particularly female students. Therefore, the findings of this action research are expected to have the following significance:

- ✓ To increase female students participation in physics class.
- ✓ To reduce factors that affect low participation of female students in physics class.
- ✓ Can serve as valuable document to Higher Education Policy Makers.
- ✓ The study can facilitate the development of accurate visual and conceptual models of the underlining physical principles.

V. RESEARCH METHODOLOGY

Population of the Study

The target population of this study is First and Second Year female physics students of Adigrat University. Totally 18 respondents were involved in the final analysis. The respondents were totally taken from the department for it is near to the researchers and due to the prevalence of the problem.

Data collection instruments

As the purpose of the study was to increase participation of female students in physics classes at Adigrat University and to take action, primary data was collected by the researchers using data collection instruments such as questionnaires, interview and observation.

Data Analysis and presentation

Data Analysis

In the present study, the study data collected through interviews, questionnaires and observation was analyzed using descriptive statistics such as frequency distribution and percentages. In this analysis descriptive statistics frequency was calculated and tabulated.

Data presentation

After the data was analyzed, main features of findings were described using frequency distribution, percentages and tables to present the data.

VI. RESULT AND DISCUSSIONS

This section of the study deals with the analysis and interpretation of the data gathered from study targeted population using interview and questionnaires in the selected First and Second Year physics classes at Adigrat University. In this part, the most important findings from the study were discussed.

Age structure of respondents

As indicated in Table 1, majority of respondents (88.89%) fall between the age group of 18-25 years old. The remaining 11.11% were found to be less than 18 years old.

Table 1: distribution of respondents by age

Age group	Frequency	Percent
<18	2	11.11
18-25	16	88.89
Total	18	100.0

Source: own survey 2017

As shown in Table2 only 1 student out of 18 female students (5.56%) chose physics as her first choice from the given sample. This shows that most of the female students were forced to join physics department without their choice. It also indicated that more than 88.87% of the First and Second Year female physics department students joined the department as third choice and above. Table 1 shows that 66.67% of the female students were not interested when they join the physics department. This is because most of the female students assume that physics as a difficult subject.

Table2: Female students' response on physics choice when they joined the physics department of Adigrat university entry

Item	Choice	Frequency	Percent
When I joined university, physics was my	First choice	1	5.56
	Second choice	1	5.56
	Third choice	2	11.11
	Fourth choice	4	22.22
	Last choice	10	55.56
	Total	18	100.0
When I joined the physics department, I was	Very much interested	0	0.00
	Somewhat interested	5	27.78
	Undecided	1	5.55
	Not interested	12	66.67
	Total	17	100.0

Source: own survey 2017

As shown in Table 3 out of the 18 total respondents 50% of them agreed that girls can equally perform or participate as boys. However, 33.33% of the female students didn't agree that girls can perform or participate as equal as boys whereas the remaining 16.67% of the students were not sure whether girls can perform as well as boys. This indicates that the percentage of female students who argued that female students cannot participate equally with boys is significant i.e., they considered themselves inferior as compared to male students. This leads to low participation of female students because they already believed that as if they have insufficient know how in physics class. It is also shown that the level of giving attention of Physics lecturers' amongst the girls, which at University had been lower than boys, appeared to have dropped considerably so that the girls now gave the lowest response to questions. And hence more than 66.67% the respondents do not give attentions to their physics lectures.

Table 3: Female students' Attitude towards physics class

Source: own survey 2017

Item	Choice	Frequency	Percent
In physics class, girls could perform or participate equally as boys.	Agree	9	50.00
	not sure	3	16.67
	Disagree	6	33.33
	Total	18	100.0
Do you receive attention of your Physics lecturers' more than male students?	No	12	66.67
	Yes	6	33.33
	Total	18	100.0

As indicated table 4 when respondents interviewed stated that they did pursue physics due to the limited career opportunity in physics. But more than half of the respondents stated that students do not need to study physics due to difficulty of the subject matter.

Table 4: Reason offered by Female Students who would not want to Pursue Physics as a Course of Study at the University

Category	№	Percent (%)
Limited career opportunities in physics	2	11.11
Difficulty of physics	8	44.44
Mathematics factor	6	33.3
Abstract nature of physics	2	11.11

Source: own survey 2017

As indicated in Table 5 only 61.11% of the respondents respond that lecturers always encourage female students while 11.11% of them responded that their lectures encourage them occasionally. 27.78% of the respondents (22.22% rarely and 5.56% never) respond that the lectures' encouragement is not high. Lecturers' encouragement had a significant independent relationship with whether or not a female student was studying physics. The importance of how female students see themselves in relation to physics as a key factor in correlating with whether or not students study physics.

Table 5: Lecturers' encouragement to female students

Item	Choice	Frequency	Percent
How often do your lecturers give you enough encouragement?	always	11	61.11
	Occasionally	2	11.11
	rarely	4	22.22
	never	1	5.56
	Total	18	100.0

Source: own survey 2017

Table 6 shows that 78.58% of female respondents react "no" the teachers' expectations on girls that do teachers expect more from males than girls. In order to make physics lessons more interesting, physics instructors should convince students that physics serves them in an equal manner without discrimination of girls and boys. Physics instructors should spend more efforts to associate physics–technology–daily life. Physics instructors should like their profession and reflect this to their students. Such manners of instructors will improve the interest of students towards physics lessons in general, especially for female students.

Table 6: Teacher factors and Females Low Participation

Item	Choice	Frequency	Percent
Do you think that teachers in Adigrat University do have different expectations from girls and boys in your physics classes?	Yes	3	21.42
	No	11	78.58
	Total	14	100.0

Source: own survey 2017

In this study it was examined that the extents to which teachers demonstrate do not show significant differences in the different areas between boys and girls in physics classes. 16.67% of respondents react that, teachers give them high special attention, 77.78% react medium and few (5.55%) respondents respond low. In the same table the female students were asked whether their instructors give material incentives for female students. The result indicated that none of the respondents answered low. Similarly 27.78% of the respondents answered low that their instructors give the praise for the female students when they participate in the class.

The phenomena that a low participation of girls in physics class depend on the instructors' guidance and counseling. Among the respondents 11.11% of them respond that they receive high guidance and counseling. The same number of respondents (44.44%) agrees that the instructors give medium and high guidance and counseling.

Table7: Rate the extent to which teachers demonstrate differences in the following areas between boys and girls in your physics classes

Item	Choice	Frequency	Percent
Paying special attention	High	3	16.67
	Medium	14	77.78
	Low	1	5.55
	Total	18	100
Giving material incentives	High	11	61.11
	Medium	11	38.89
	Low	0	0
	Total	18	100
Praising	High	3	16.67
	Medium	10	55.55
	Low	5	27.78
	Total	18	100
Guidance and counseling	High	8	44.444
	Medium	8	44.444
	Low	2	11.111
	Total	18	100

Source: own survey 2017

VII. CONCLSION AND RECOMMENDATION

Conclusions

This work was intended to improve female students' participation by identifying and decreasing the existing factors that affect female students' participation of First and Second Year physics students at Adigrat University.

A number of research findings examined the factors affecting the participation of female students, and showed different factors affecting female students' participation in physics classes of Adigrat University. This study was conducted to identify the factors affecting the participation of female students in physics class. As indicated in the study findings, the most influential factor on female students' low participation in physics is their poor opinions about physics classes. The result in the findings indicates that the importance of how female students see themselves in relation to physics as a key factor in correlating with whether or not students study physics. Other factors that were important in correlating with low female participation include participation in physics, how students see their physics teachers (Paying special attention, Giving material incentives, Praising, Guidance and counseling), advice-pressure to study physics. This investigation shows that females can be easily discouraged and need a lot of guidance counseling before they can actually stand out as great Physicists.

Recommendation

- Well organized orientations which help female students to join physics department should be given.
- Tutorial classes should be arranged in order to increase participation of female students.
- Keep low achiever female students department choice and providing suitable reading room environment,
- Ask female students questions at the beginning of each class about the previous lesson, thereby helping them to revise the earlier material and providing continuity.
- Encourage female students to ask questions in class, giving extra chances to low achiever female students.

VIII. ACKNOWLEDGMENT

The author is thankful to the students of departments of Physics, Adigrat University for extending their cooperation for carrying out this study.

REFERENCES

[1] International Union of Pure and Applied Physics (2002). *Why women don"t flock to physic: A report on the IUPAP international conference on women in physics*. Paris, 7-9 March 2002.

[2] UNESCO (1993). *World educational report 1993*. New York: Oxford University Press.

[3] Donnellan, C. (2003). Does sex make a difference? An equalities peak for young people on international women's day. *The Gender Issues 64*, 14-17.

[4] Baird, D. (1996). The blowgun as a teaching tool. *The Physics Teacher, 34*(2), 98- 100.

[5] Dancer,D.,&Kamvounias,P.(2005).Student involvement in assessment: A project designed to assess class participation fairly and reliably. Assessment & Evaluation in Higher Education,30,445 454. (ES).

[6] Fritschner, L. M. (2000). Inside the undergraduate college classroom: Faculty and students differ on the meaning of student participation. The Journal of Higher Education, 71, 342 362. (LR).

[7] Hazari, Z. & Potvin, G. (2005) Views on female under-representation in physics: Retraining women or reinventing physics? *Electronic Journal of Science Education, 10*(1).

APPENDEX

ADIGRATUNIVERSITY
College of natural and computational sciences
Department of chemistry

A questionnaire to be filled by First and Second Year Physics Female Students

Title: How Can We Augment Female Students Participation in First and Second Year Physics Classes; The Case of Adigrat University

The purpose of this questionnaire is to collect information about the current status of the participation of female students in physics classes of Adigrat University. The information gathered through this questionnaire will be used only for Action research purpose and it is assured that your response will be held in strict confidentiality. Therefore, you are kindly requested to fill in the questionnaire frankly and responsibly for it is the chief determinant to the success of the study. The researchers express their thanks to you in anticipation that you would spare some time and energy to complete this questionnaire.

Part I: For each of the statements (questions) below, indicate your response from the given alternatives for each item by putting **tick (√) or encircling** the appropriate answer except for the questions which require written responses.

1. Sex: ☐Male ☐Female
2. Year: ☐First ☐Second and third
3. When I joined university, physics was my
   A. First choice B. Second and third choice C. Third choice D. Fourth choice E. Last choice.
4. When I joined physics department, I was
   A. very much interested B. Somewhat interested C. Undecided D. Not interested

Part II: For each of the items below, please indicate your position using the scale by encircling against each item in the corresponding column.

A. Female students' Attitude towards physics class (*encircle one of the given alternatives*); to what degree do you agree with the following statements?

5. In physics class, girls could perform or participate as well as boys. **Agree/ Not Sure /Disagree**
6. Do you receive attention of your Physics lecturers' more than male students? **Yes /No**
7. Are your lecturers giving you enough encouragement? **Always/ Occasionally/ Rarely/ Never**

B. SU and female participation (*encircle one of the alternatives given*)

8. From your experience, judge the extent to which the following factors contribute to the low participation of females for physics class in Adigrat University.

	High	**Average**	**Low**
Inadequacy of classrooms	_____	_____	_____
Shortage of instructional materials	_____	_____	_____
Lack of suitable library	_____	_____	_____
Lack of textbook and reference books	_____	_____	_____
Lack of gender sensitive facilities	_____	_____	_____
Inadequacy of reading rooms for females	_____	_____	_____
Risk of sexual harassment by Instructors	_____	_____	_____
Gender bias in class rooms	_____	_____	_____

Shortage of laboratory and workshop rooms	_____	_____	_____
Tutorial for female students	_____	_____	_____

C. Teacher factors and Females Low Participation

24. Do you think that teachers in Adigrat University do have different expectations from girls and boys in your physics classes?
Yes____ No_____

25. Rate the extent to which teachers demonstrate differences in the following areas between boys and girls in your physics classes.

	High	Average	Low
Paying special attention	_____	_____	_____
Giving material incentives	_____	_____	_____
Guidance and counseling	_____	_____	_____