

# Effect of Gender on Students' Attitude Towards Biology When Taught Using Experiential Learning Approach in Secondary Schools in Maara Subcounty, Kenya

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## ABSTRACT

The study aimed at determining the influence of gender on students' attitude towards biology when taught using experiential learning approach. Quasi experimental research design was employed and in particular Solomon four group design. The target population was 22,640 biology students in secondary schools in Maara sub-County, Tharaka Nithi County. The accessible population consisted of 1,557 form two students in Sub-County mixed secondary schools. The purposive sampling was used to draw four sub-County mixed secondary schools from a list of mixed secondary schools in Maara Sub-County. Simple random sampling was used to select and assign participating schools in experimental and control groups. The sample size comprised of 118 students in four schools. The research instruments used was Biology Attitude Questionnaire (BAQ). The instrument was piloted to determine its reliability in a Sub-County mixed secondary school in Meru-South Sub-County. Reliability coefficient for instrument was 0.762. The validity of the research instrument was ascertained by experts in the department of education of Chuka University. Experimental groups (E1 and E2) were taught using experiential learning approach while control groups (C1 and C2) were taught using conventional teaching approach. Statistical Package for Social Science (SPSS) version 26 aided in data analysis. The raw data obtained was analyzed using descriptive statistics (mean, standard deviation, percentages) and inferential statistics (Mann-Whitney U Test, Kruskal Wallis Test and Turkey post hoc analysis, and t-test). The null hypothesis was tested at  $\alpha = 0.05$  significant level. The findings revealed no statistically gender difference in students' attitude towards biology when taught using experiential learning approach. The study therefore recommended that experiential learning approach is an accommodative teaching approach that may be used with both male and female students. This means that, regardless of students gender, the experiential learning approach is appropriate in teaching and learning to promote positive attitude and academic achievement without biasness. Additionally, Experiential learning approach affords all students an equal access to the curriculum while maintaining their high expectations. The findings of the study may help curriculum planners and learning institutions to incorporate innovative techniques in classroom teaching to improve learning of biology subject for both boys and girls in Kenya. The findings also form a ground upon which likely further research could be built for innovative teaching techniques in secondary schools.

**Key words:** Experiential learning, Gender, Attitude

## BACKGROUND INFORMATION

Gender simply refers to the roles and characteristics that are socially and culturally developed to be identified with males and females in any given society (Nnamani & Oyibe, 2016). Due to the overemphasis on socialization throughout childhood, gender is the result of cultural learning and lifetime socialization. Some distinctive traits are assigned to males and others to females based on gender. Males are given attributes like dominance/assertiveness, tactfulness, intellect, self-confidence, bravery, aggression, and logical thinking, among others, while females are given traits like fearfulness, submissiveness, talkativeness, and tactlessness, among others (Nnamani & Oyibe, 2016). According to Ababneh and Samad (2018), there is a gender gap, with women experiencing disadvantages particularly when it comes to biology teaching and learning.

Perception causes students to see learning activities as either pleasant and valuable or unpleasant and useless on gender basis. In their 2009 study, Chang, Yeung, and Cheng examined ninth graders' learning interests, life experiences, and attitudes toward science and technology. Taiwan ninth graders from urban regions totaling to 942 took part in the survey. The findings indicated that boys were more interested than girls in learning science subjects and sustainability concerns. Therefore, understanding gender disparities in teaching and learning is important for designing a teaching approach that is inclusive.

The Almasri (2022) study compares the attitudes and academic success of male and female students in multiple types of learning environments based on collaborative and conventional learning pedagogies, single-gender and mixed-gender grouping, e-learning and in-classroom learning modalities in a Kuwaiti undergraduate biology course. Results showed that in single-gender classrooms as opposed to mixed-gender groups, females developed a more favorable attitude toward biology in conventional and collaborative learning sections. The study contributes to our understanding of the best learning environments for male and female students to lessen gender disparities, the harmful effects of stereotypical threats in various socio-cultural environments, and to develop learning approaches to further equalize opportunities for male and female students, thereby fostering students' attitudes and academic success in undergraduate biology education.

Prokop, Prokop, and Tunnicliffe (2007) investigated school students' interests and attitudes toward biology in Slovakia through their participation in extracurricular activities and their attitudes toward lessons as determined by interest, significance, and challenge. The majority of students learning zoology showed the highest preference for biology lessons, which were generally popular. Compared to boys, girls exhibited much more interest in biology. When studying botany in grade five (children aged 10 to 11), this difference was most pronounced. Compared to males, girls thought biology was more essential and simpler. Hobbies, movies, and books with a biological theme attracted more attention (10–20% more) and were strongly correlated. However, fifth graders' interest in biology dropped as time progressed and both boys and girls had difficulties learning botany. This implies that there is need for appropriate teaching approaches to be inculcated in the classrooms for equal motivation to both males and females.

Weinberg, Basile, and Albright (2011) examined the effects of experiential learning on middle school students' motivation and interest in mathematics and science in Nigeria using a mixed methods design. The Expectancy-Value model served as the theoretical foundation for the investigation of the 336 middle school participants. The findings showed that there were some gender disparities, with men exhibiting greater improvements in interest in mathematics than women. The effective learning approaches should be identified in order to enhance both boys' and girls' motivation for learning. It is therefore important to find out if experiential learning will have the same outcome on students' attitude in Kenyan schools.

Kabunga, Habiba, and Mnjokava (2018) examined the relationship between academic success and interest in natural science topics among secondary school students in western Uganda using a correlational research design. The 1350 senior four students were scheduled to attend 350 schools. For the study sample, 450 participants were randomly selected. The findings showed that there was no appreciable variation in gender interest in the natural sciences. At the secondary school level, career counseling should be offered professionally to improve students' interest in natural scientific courses. The government should keep up its initiatives and policies to advance gender parity in sciences. It is on the basis of these conflicting findings from various studies that the present study was born.

## METHODOLOGY

The study was conducted in Maara Sub-County in Tharaka Nithi County which lies 186km due North of Nairobi City. In the Northern, Tharaka Nithi County borders Meru County; to the East the County is bordered by Kitui County and to the South it is bordered by Embu County. To the Western side, Tharaka Nithi is bordered by slopes of Mount Kenya.

The study employed the quasi-experiment, and more particularly the Solomon four group design. Four groups are involved in the Solomon four-group design (Ogunniyi, 1992). The Solomon four-group main feature is that participants are randomly assigned to either a treatment or a comparison group after being randomly assigned

to either receive or not receive a pre-test. This design is preferred because it is based on groups of respondents rather than individuals. However, it is advised against dividing and reconstituting secondary school classes after they have been formed as whole groups for research. The design enables the researcher to conduct studies in natural and real-life settings while controlling and measuring the main effects of testing. The Solomon four group enables the researchers to conduct a detailed assessment of the cause for the change in the dependent variables and even determine whether changes are caused by interactions between the pretest and treatment.

According to Shuttleworth (2009), the design enables the researchers to have total control over the variable and determine if the pre-test would have an impact on the outcomes. The Solomon four group design involves four groups. The experimental group E1 received a pretest (O1), a treatment (X), and a posttest (O2). The experimental group E2 did not receive a pretest but received treatment (X), followed by a posttest (O5), while the control group (C1) received a pretest (O3), posttest (O4), and no treatment. Those in the control group (C2) received the post-test (O6). The conventional approach was used to teach C1 and C2. Testing and treatment interactions were eliminated by post-test (O5) and (O6). Students took the pre-test to ascertain their entry behavior before the experiment began. The experimentation went unnoticed by learners since they were being taught by their teachers. To prevent subjects' interaction, the experimental and control groups were drawn from different schools.

The target population was 22,640 biology students in secondary schools in Maara Sub-County, Kenya. The accessible population was composed of 1,557 form two students in the Sub-County mixed secondary schools where the study sample of 118 students was drawn. The researcher purposively sampled Maara Sub-County out of the 4 sub-counties in Tharaka Nithi County based on the low academic performance in biology. The researcher used purposive sampling to draw a total of four Sub-counties mixed secondary schools from a list of 58 secondary schools in the Sub-county. The selection of schools was guided by low academic achievement and mixed sub-county secondary schools. Simple random sampling technique was used to assign selected schools to experimental groups (E1 & E2) and control groups (C1 & C2). In case a school had more than one stream taking biology, all the streams were subjected to the study using similar method of teaching but only one stream was considered for analysis. The sample size of the study was 118 students. A list of all sub-county secondary schools from the county was obtained from county education office before sampling to establish whether they were suitable for the study. During the visit the researcher obtained information on the extent of syllabus coverage in form three chemistry classes.

The units for sampling in this study were schools and not individual students. The researcher purposively sampled Maara Sub-County out of the 4 sub-counties in Tharaka Nithi County based on the low academic performance in biology. The researcher used purposive sampling to draw a total of four Sub-counties mixed secondary schools from a list of 58 secondary schools in the Sub-county. The selection of schools was guided by low academic achievement and mixed sub-county secondary schools. Simple random sampling technique was used to assign selected schools to experimental groups (E1 & E2) and control groups (C1 & C2). In case a school had more than one stream taking biology, all the streams were subjected to the study using similar method of teaching but only one stream was considered for analysis.

The instruments that were used are: Biology Pre-Test (BPT) and Biology Achievement Test (BAT). The Biology Pre-Test (BPT) instrument was prepared on the topic of gaseous exchange in plants and animals. The main aim of the pre-test instrument was to measure the students' academic entry behavior in biology. The 30 marks test consisted of six questions drawn from KCSE biology paper 1 and 2. All of the questions were taken from previous KCSE biology paper 1 and paper 2 examinations to ensure content validity. Levels of knowledge, comprehension, application, and analysis were examined on the exam items. Students' biology achievement was measured using a Biology Achievement Test. Based on a post-test exam administered at the end of the treatment phase, the effect of the intervention on students' academic achievement in biology was tested. The researcher designed the BAT instrument based on the several subtopics of gaseous exchange in plants and animals. There were 6 total items in the test, totaling to 30 marks. The questions came from KNEC biology sample exams. The test items tested levels of knowledge, comprehension, application, and analysis.

The treatment ran for four weeks. Biology Students in the experimental group E1 and the control group C1 did a pre-test to determine their entry behavior. The BPT was administered before the treatment. The researcher

met with Biology teachers in E1 and E2 on weekly basis to discuss content, problem encountered and teaching approach applied. Biology achievement test was administered to all the groups concurrently after the four weeks of teaching. The biology teachers in the respective schools assisted to administer the instruments so that students were not aware of experimentation. The pre-test and post-test were both scored by the researcher in order to get quantitative data for analysis.

The researcher used the Statistical Package for Social Sciences (SPSS) version 26.0 to arrange, code, enter the data, score the pretest and posttest, and do data analysis. For data analysis, descriptive and inferential statistics were used. Raw data were summarized using descriptive statistics, such as mean, standard deviation, and percentages. The purpose of inferential statistics was to analyze, interpret, and make decisions based on the findings. To examine the mean differences across groups that have been split based on two independent variables and to ascertain whether there was an interaction between two independent variables and the dependent variable, two-way ANOVA was employed. To determine precisely where the differences between the multiple groups exist, a post hoc test, more particularly Tukey Honest Significant difference, was performed. A significance level of  $\alpha= 0.05$  was used to test the null hypothesis.

## RESULTS

The BAQ data were coded and analyzed to determine whether there was a difference in students' attitude towards biology among students taught using experiential learning approach.

### Gender

The number of males and females that took part in the study is as shown in Table 1.

Table 1: Gender Distribution of Respondents

	Gender				Total	%
	Male	%	Female	%		
Experimental Group 1	6	18.18	27	81.82	33	100.0
Control Group 1	13	39.39	20	60.61	33	100.0
Experimental Group 2	13	44.83	16	55.17	29	100.0
Control Group 2	9	39.13	14	60.87	23	100.0
Total	41	34.75	77	65.25	118	100.0

Information in Table 1 shows that there were 33 students for experimental group 1 of which 81.82% were females while 18.18% were males. Out of 33 students for control group 1, 39.39% were males while 60.61% were females. For experimental group 2, 44.83% were male while 55.17% were females. For control group 2, 39.13% were males while 60.87% were females. The total sample was 118 students of which 41 (34.75%) were males while 77 (65.25%) were females.

### Effect of Experiential Learning Approach on Students' Attitude in Biology based on Gender

The objective of the study was to determine whether there were any gender differences in the attitude towards biology among students who were taught using experiential learning approach. In order to assess participants' attitudes toward biology based on gender, participants were asked to respond to questions in the BAQ survey. Each question on the BAQ was assessed using a Likert scale with five possible outcomes: Strongly Agree (SA) = 5, Agree (A) = 4, Uncertain (U) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The average BAQ ranks for boys and females were calculated and compared in order to determine if there were any notable variations. Table 2 shows the findings.



Table 2: Mann-Whitney Test of the Pretest of Experimental Group 1 Student Attitude by Gender

Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Male	6	6.92	41.50	20.500	41.500	2.827	0.005
Female	27	19.24	519.50				
Total	33						

According to the analysis in Table 2, the pretest mean rank for male students and female students was 6.92 and 19.24, respectively. More female students than male students showed a high level of interest in biology. The results in Table 24 indicate that, at the 0.05 alpha level ( $U=20.500$ ,  $p=0.005$ ), there was a statistically significant difference in the degree of biology motivation between male and female students who were taught using experiential learning approach. In order to determine the effect of the experiential learning approach based on gender, the researcher additionally compared the posttest mean rank results of the BAQ between experimental groups. The results are summarized in Table 3.

Table 3: Mann-Whitney of the Post-test of Experimental Groups 1 Student Attitude by Gender

gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Male	6	12.50	75.00	54.000	75.000	1.263	0.207
Female	27	18.00	486.00				
Total	33						

Male students had a mean rank of 12.50 and female students of 18.00 as indicated in the Mann-Whitney of the Post-test analysis. Comparatively, male students showed a slightly less positive attitude towards biology than female students. This implies that there was no statistically significant difference in biology attitude between male and female students who were taught using experiential learning approach ( $U=54.000$ ,  $p=0.207$ ) at 0.05 alpha level. Before the experimentation process, male and female students' attitude towards biology for the experimental groups were compared using Mann-whitney test of the pre-test of student attitude by gender as shown in Table 4.

Table 4: Mann-Whitney Test of the Pre-test of Student Attitude by Gender for Experimental Group 1 and Experimental Group 2

Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Male	19	21.05	400.00	210.000	400.000	3.034	0.002
Female	43	36.12	1553.00				
Total	62						

The mean ranks of male and female students were 21.05 and 36.12 respectively. The female students had high level of attitude than male students. This means that female students had slightly negative attitude towards biology. It can be concluded that there was a statistically significant difference in the level of motivation in biology between male students and female students that were taught using experiential learning approach ( $U=210.000$ ,  $p=0.002$ ). To compare male and female students' attitude towards biology for the experimental groups after the treatment, Mann-Whitney test of the post-test of student attitude according to gender for experimental group one and experimental group two was done as shown in Table 5.

Table 5: Mann-Whitney test of the Post-test of Student Attitude by Gender for Experimental Group 1 and Experimental Group 2

Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Male	19	25.84	491.00	301.000	491.000	1.645	0.100
Female	43	34.00	1462.00				
Total	62						

The findings show that students who were exposed to the experiential learning approach had a mean rank of 34.00 for female students and 25.84 for male students. This indicates that there was no statistically significant difference in students' attitudes toward biology between male and female students who were taught utilizing experiential learning approach (0.05 alpha level;  $U=301.0$ ;  $p=0.100$ ). The research null hypothesis ( $H_0$ ) was therefore accepted. This suggests that when students learn through experiential learning, there is no statistically significant gender difference in the students' attitude toward biology. The results in Table 5 show that boys and girls had similar level of improved attitude towards learning biology subject.

## DISCUSSION

The findings of our study showed that gender had no effect on students' attitude towards learning biology. The results of the study correspond with those of Sofiani et al. (2017), who investigated gender differences in students' attitudes toward learning in Indonesia. The findings revealed that there was no substantial shift in attitudes toward science among boys and girls.

The results of this study agree with those of Ratamun and Osman (2018) who examined the impact of physical and virtual laboratories on students' attitudes about chemistry. Malaysian students in the fourth science subjects of upper secondary took part in this study. The gender differences in learners' attitudes about chemistry were investigated and the contact impact among subgroups and gender. The learner views about chemistry did not distinguish much between the virtual classroom and the physical classroom. The results of the study showed that there was no substantial interaction between group, gender, and attitude towards chemistry, nor is there a significant association between gender and attitude towards chemistry. If all actions in the virtual laboratory are doubled, or the series of research in the virtual laboratory increases, significant changes in mindsets can be achieved. Due to changes in virtual laboratory work, learners spend more time performing activities. Students develop good attitudes toward chemistry as a result of variations in virtual laboratory activities.

The findings of this research are in conflict with those of Almasri (2022) study. The study compared students' attitude and academic success of male and female students in various learning environments in a Kuwaiti undergraduate biology course. Results showed that females developed a more favorable attitude toward biology in conventional and collaborative learning sections. The study contributes to our understanding of the best learning environments for male and female students to lessen gender disparities, the harmful effects of stereotypical threats in various socio-cultural environments, and to develop learning approaches to further equalize opportunities for male and female students, thereby fostering students' attitudes and academic success in biology education.

The results of this study are not in line with those of Naizer, Hawthorne, and Henley (2014). Girls were shown to be less interested in science than male students in their studies. According to Naizer et al. (2014), female students experience a loss in science competence that is most obvious by the time they hit 17 years. Nevertheless, the result contradicts those of a Ugandan study on students' attitudes and performance in science done by Kabunga, Habiba, and Mnjokava (2018). The data revealed that most young female students had favorable feelings and, as a result, fared better than male students.

Contrary findings were made by Seba, Ndunguru, and Mkoma (2013), who examined students' attitudes towards physics and chemistry in a sample of secondary schools in Tarime-Mara, Tanzania. They discovered that students had a positive attitude towards the two subjects. Male and female students were compared, and it was found that female students had a more negative attitude about physics and chemistry. The study found that students' positive attitudes were associated with confidence, lack of anxiety, enjoyment, and excellent physics and chemistry performance.

The results of this study are inconsistent with those of Cheung (2009), who found that male students' attitudes towards chemistry in the physical laboratory are better than those of female students. In addition, the outcomes of Adesoji and Raimi (2004), who found that experiments in the physical laboratory might improve the attitude of male students toward chemistry, confirmed the inverse to this study results. This is because male students are more engaged in activities involving concrete items than in conducting activities involving abstract materials.

The findings of this research conflict those of a study conducted in 2011 by Weinberg, Basile, and Albright on the effect of experiential learning on middle school students' motivation and interest in mathematics and science in Nigeria. The 336 participants, who were middle school students, were investigated using the Expectancy-Value model as a theoretical framework. The findings showed that there were some gender disparities, with male student exhibiting greater improvements in interest in mathematics than female students. It is therefore of paramount importance to identify effective teaching approaches in order to enhance both boys' and girls' motivation for learning in order to achieve excellence in their studies.

## SUMMARY OF RESEARCH FINDINGS

In order to obtain results based on gender, the study compared students' attitude towards learning biology subject when taught experientially by gender. The findings of this study also indicated that there was no statistically significant gender difference in students' attitude towards biology among students taught experientially. Posttest means ranks for boys and girls showed similar level of improved attitude towards learning biology subject.

## CONCLUSION

Our study findings confirmed that when students are taught biology utilizing ELA, there was no discernible difference between males' and females' attitude towards biology. This implies that it is worthwhile to use gender sensitive approaches in teaching to close in the gender gap among the students; more especially in teaching science subjects.

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