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Effect of experiential concept mapping teaching strategy on students' motivation in learning chemistry based on gender in Tigania West sub County

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Abstract
Motivation is a significant factor for academic learning and achievement across all ages since it initiates and encourages students to actively learn difficult concepts in science. Thus, this study aimed at establishing the effect of experiential concept mapping teaching strategy on students' motivation in learning chemistry based on gender in Tigania West Sub County. A quasi-experimental research design which utilized the Solomon Four non- corresponding control cluster design was employed. It involved a target population of 1765 Form two learners from Tigania West Sub County. The sample size comprised 182 students from four sub county coeducational secondary schools, selected using simple random sampling. Simple random sampling technique was employed to allot the schools to either investigational or regulator groups. The study comprised four clusters; two investigational clusters (E1 and E2), and two regulator clusters (C1 and C2). Student Motivation Questionnaire (SMQ) was administered to both control and experimental groups. Data obtained was analyzed by use of Statistical Package for Social Science (SPSS) version 24. For descriptive statistics, mean ranks were used while Mann-Whitney U- test was used for inferential statistics. The statistical significance was tested at $\alpha = 0.05$. The results established that gender of students had no significant effect on motivation to learn chemistry when learners were taught using Experiential Concept Mapping teaching method. Therefore, the adoption of ECM is recommended as appropriate for instruction of chemistry in secondary schools. The findings of this study will be of significance for reference among instructors, educational stakeholders, related researchers and other academicians.

Keywords: Gender, motivation, achievement, chemistry, student, Tigania

1. Introductions
Motivation to learn refers to the deposition of students to find academic activities relevant and worthwhile and to try to derive the intended academic benefits from them [14]. Motivation is a significant important factor for academic learning and achievement across all ages [6]. Motivation initiates and sustains the learners and directs students towards achieving specific self-directed goals that encourages students to actively learn difficult concepts in science [21].

[7], asserts that when a learner is asked about the factors which influence individual levels of success in any activity, most of them would certainly mention Motivation, there are two main types of motivation; intrinsic and extrinsic, that can affect the learning process. Intrinsically motivated students tend to employ strategies that demand more efforts which enable them process information more deeply. Students were confronted with complex intellectual tasks, those with intrinsic motivation used more logical information gathering and decision making strategies than students with extrinsic motivation [4]. [4] declared that a high level of motivation and engagement in learning has consistently been linked to a reduction in the number of dropouts and increased levels of student success. In an academic setting, whether in elementary, secondary or higher education, a student motivation for learning is generally regarded as one of the most important determinants of success and quality of learning outcomes [4].

Through interaction with family, peers, teachers and the environment, children begin to form schemas or organized networks of knowledge about what it means to be male or female [1]. Gender differences in sciences have been widely investigated. Females are found to be less interested in science as opposed to males. However, there are some subject areas in science that are more interesting to females such as human biology, and human health [10].

Different gender may have different levels of intrinsic motivation. In this fast-paced society

in order to achieve eminent performance [3]. Pointed out that in the society people need to have high competitiveness, wide range of knowledge and high lCT skills. Boys and girls do not like accounting and medicine careers in equal measure. [21], indicated that gender preference towards careers are aligned to gender roles that is, nursing for women and engineering for men, which is in line with the gender schema theory [2] where girls align themselves to feminine role, while boys prefer masculine roles. Gender affects the skills or traits people find fascinating or personally relevant [21]. It implies that different gender tends to have different perception and thoughts. Students having good academic performance are found to have higher intrinsic motivation [5].

Carried out a study on gender inclusivity in secondary school chemistry on male and female participation in Australia. The study analyzed the participation rates in chemistry by developing the "story" behind the national trends and subject selection patterns within an independent school located in Australia city. The student's comments indicate that despite the quantitative transformations that demonstrate increasing female success over the past few decades, chemistry is not totally gender inclusive [5]. Further observed that secondary school chemistry has not yet reached total gender inclusion due to the common gender differences that still occur in the students' motivation to select chemistry and the influence that gender stereotypes still have on students' subject selection.

Another research focusing on the subject of physical education, the result is different. One study by [17] in Taiwan focusing on physical education classes in junior high school, it was found that female students have lower intrinsic motivation which is relevant to their interest or enjoyment and perceived competence than male students in most of the sub-scale of the study, but have higher effort put into the learning tasks. It not only proves that learning environment is different for male and female students, but it also emphasizes that males perceive the learning environment as more challenging and competitive while females perceive higher threat than males in physical education classes [17].

[16] investigated the effects of cooperative computer-assisted learning method on male and female students' achievement in biology. The students were randomly grouped into cooperative computer-assisted learning and traditional method groups. The analysis of results indicated that gender did not express any significant influence on biology achievement. However, male and female students in the cooperative computer-assisted instruction group showed remarkable post-test mean differences over their respective counterparts who learned the same biology concepts through traditional method [14].

carried out a study on effect of concept mapping instruction and gender on secondary students achievement in difficulty physics concepts in Yola Nigeria. The population consisted of all co-educational senior secondary schools in Yola. The pre-test post-test control group quasi experimental group design was adopted for the study. Results indicated that there was no effect of treatment and gender on motivation and achievement of learners [14]. Posits that concept mapping has the potency to improve motivation and achievement of learners without bias to gender [12].

Carried out a study on the Effect of Gender on Motivation and Students Achievement in Digital Game Based Learning. The study used a pre-test post-test, a system usability scale and a questionnaire on learning. The results show that gender has significant effect on the learning achievement but causes significant differences in learning motivation. These scholars also noted that female learners' motivation is significantly higher than that of male learners [8].

Carried out a study on effects of Collaborative Concept Mapping Teaching Approach on secondary school students' achievement and motivation to learn Biology in Nakuru North Sub county Kenya The study pointed out that both boys and girls were motivated to the same level by collaborative concept mapping teaching approach. This could be attributed to inclusiveness of the ECM teaching strategy and therefore viable for implementation in secondary schools [20].

Examined how the cooperative class experiment (CCE) teaching methods affect students' achievement in Chemistry. Findings from the study indicate that there was no significant difference in gender achievement between the experimental and control groups, but girls had a slightly higher mean score than boys. More so, the girls taught through CCE method performed better than girls taught through the conventional teaching method in the post-test scores. Similarly, boys who were taught using CCE method performed significantly better than the boys in the control groups in the post-test scores. The researchers also pointed out that there was no significant difference in achievement between boys and girls exposed to CCE method, both performed significantly better than those taught through conventional lecture method. The researcher, in the current study wanted to establish whether gender affect students' motivation to learn chemistry.

2. Materials and Methods

2.1 Location of the Study Area

This study was carried out in Tigania West sub county, Meru County. The Sub County comprises of learners with varied academic potentials and different social economic origin. Additionally, Tigania West sub-county has consistently posted poor academic attainment in KCSE especially in chemistry, nevertheless there is no empirical study which has been conducted in the sub county to aid the education stakeholders have an insight to the reasons contributing to this dismal achievement in chemistry thus the need for this study.

2.2 Target Population

The study targeted all public secondary schools in Tigania West Sub County. The learners population comprised of 1765 Form two students in Tigania West Sub County as shown in Table 1. Form two students were targeted as the respondents of this study because, the main topic; the structure of the atom and the periodic table is taught at this level.

Table 1: Target Population

School type	Number of schools	Total number of students
Girls only	4	365
Boys only	3	400
Co-educational schools	20	1000
Total	27	1765

Source: Tigania West Sub County Education Office (2021)

Information on Table 1 indicates that there were 4 girls' boarding schools in Tigania West sub- county with 365 form two students, 3 boys' boarding schools with 400 form two students and 20 co-educational schools with 1000 Form two learners. The study targeted 1765 Form two learners in Tigania West sub-county.

2.3 Sample Size and Sampling Procedures

Simple random sampling method was employed in the selection 4 sub county co-educational secondary schools in Tigania West Sub County. The sampled schools were further assigned as either control group or experimental group using simple random sampling (Table 2).

Table 2: Sample Size

School type	Sample school	Total population	Number of Students		
			Experiment Group	Control Group	Total
	4	40 48	50	40	90
Sub county schools		50 44	44	48	92
Total		182	94	88	182

The learners in sampled schools were 40, 48, 50 and 44, giving rise to a total of 182 form two students (Table 2). The schools assigned as experimental groups had 50 and 44 students, while those assigned as the control groups had 40 and 48 students. Cases whereby a school comprised of more than one stream, all of them were allowed to take part in this investigational study.

2.4 Data Collection Instrument

Student motivation questionnaire (SMQ) was used to assess student motivation towards chemistry when taught using Experiential Concept Mapping teaching strategy and conventional methods before and after the course. The questionnaire consisted of 25 items developed using five point Likert scale extending from strongly agree with 5 points to strongly disagree with a score of 1 point. Students were required to state whether they strongly Agree (SA), agree (A), Not Sure (NS), Disagree (D), or Strongly Disagree (SD). In the current study, a perception of the student was taken to be a measure along the continuum from the strongly negative to a strongly positive effect based on Likert scale notations.

2.5 Data Collection Procedure

After visiting the sampled schools, the investigator trained the instructors of chemistry on how to utilize SMQ. Student Motivation Questionnaire (SMQ) was administered to both control and experimental groups. Data collected was given scores and then coded for analysis.

2.6 Data Analysis

The data gathered was coded and prepared for analysis. Descriptive statistics (mean and standard Deviation) and inferential statistics (Mann-Whitney U- test) were employed in the analysis of the gathered data. This was aided by the use of the Statistical Package for Social Sciences (SPSS) version 24. The analyzed data was then presented using tables and graphs.

3. Results

3.1 Respondents' Demographic Information

The SMQ mean ranks for male and female students were analyzed and compared to find out if there was significant difference between them. Table 3 shows the post-test SMQ mean ranks for students taught using ECM teaching strategy.

Table 3: Post–test SMQ Mean Ranks for Boys and Girls Taught using ECM

Gender of students	N	Mean Rank
Boys	45	3.7197
Girls	42	3.7369

Results from Table 3 indicates that the mean rank for girls motivation (M=3.74) than male students (M=3.72) Female students attained a slightly higher mean rank than males. Mann Whitney u-test was conducted to find out whether the observed difference was significant. Table 4 provides information on Mann Whitney u-test results for post- test SMQ mean ranks based on gender.

Table 4: Mann Whitney U-Test Results for Post-test SMQ Mean Scores based on Gender Taught using ECM Strategy

Gender of students	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Male	45	42.99	1934.50	899.500	1934.5	-0.0387	0.699
Female	42	45.08	1893.50				
Total	87						

Significance level =0.05

Results in Table 4 show that (U = 899.5, p = 0.69), since p value is greater than 0.05 significance level, then it implies that there is no significant gender difference in motivation when students when are taught using ECM, This indicates that the difference in SMQ post-test means was not statistically significant. Therefore, both male and female students were motivated to the same level by ECM teaching

strategy. From the findings of the current study, it can be concluded that the use of ECM teaching strategy is not gender biased in terms of motivation in learning chemistry.

4. Discussion

Findings of the current study are consistent with findings of a study by [8] on effects of Collaborative Concept Mapping Teaching Approach on secondary school students' achievement and motivation to learn Biology in Nakuru North Sub county Kenya. The study pointed out that both boys and girls were motivated to the same level by collaborative concept mapping teaching approach. This could be attributed to inclusiveness of the ECM teaching strategy and therefore viable for implementation in secondary schools.

Findings of the study are also consistent with the findings of [13] on Effect of Concept and Vee Mapping Strategy on students' motivation and achievement in Biology in secondary schools in Uasin Gishu District, Kenya. The study indicated that students' gender did not affect motivation in learning Biology. Findings from the present study concur with the findings of [10] on investigation on the effects of using the cooperative concept mapping (CCM) teaching approach on secondary school students' motivation in biology in Gucha, district Kenya. According to their study, there was no statistically significantly gender difference in motivation towards the learning of biology among secondary school students exposed to CCM.

The study findings are consistent with the findings of [19] on the effects of Computer Based Instruction on student motivation and achievement in secondary schools business education in Kenya. The study showed that the student on experimental group had a higher rating on the nature on double entry account course in business studies than students in the control group.

In support of these findings, [9] carried out a related study on the effect of teaching with computer as a technology tool on leaner motivation and achievement. The study compared the motivation and achievement in science among secondary schools in Embu District- Kenya, when taught using traditional methods and the use of computers. Findings of the study reveal that students of both gender who were taught by use of computers had a higher motivation to learn than those their counterparts who were exposed to traditional methods of teaching.

The findings of the present study concur with those obtained by [15], who carried out a related study on the effect of computer assisted instruction in performance of senior high school biology students in Ghana. The finding of the study established that with the utilization of computer assisted technology strategies enhances learning through general positive motivational variables.

However, findings of the present study contradict with those obtained by [11], on an investigation on the relationship between students' perceptions of classroom learning environment and motivational achievement goal orientation towards Biology and Physics as well as the influence of gender. The findings indicated that there was a significant gender difference in favour of the females on a number of domains of motivation. Findings of the present study also contradict with the findings by [4] on an investigation of factors affecting Turkish primary students' motivation towards science. The data was collected using leener's motivation toward science learning questionnaire. The findings of the study indicated statistically significant gender differences in motivation towards science. The female students were significantly more motivated than the male students in learning science were. However, boys were more self-efficacious with low-test anxiety than girls were.

Similarly, the findings from the present study also contradict with findings obtained by [18] who investigated the effect of using advance organizers on students' motivation to learn Biology from an experimental perspective in Bureti District, Kenya. Data was collected using the Student Motivation Questionnaire. The findings indicated that students taught using advance organizers had a higher level of motivation than those taught using conventional methods. Further the findings indicated that following the intervention, there was a significant gender difference in motivation to learn Biology with the male students having a higher level of motivation than the female counterparts.

5. Conclusion

Gender difference in students' motivation does not have an influence in learning chemistry. However, ECM teaching strategy is equally effective in motivating learners from both gender.

6. Recommendations

Chemistry teachers should embrace the use of ECM teaching strategy as a way of motivating students of both gender in order to cultivate interest in the subject and also in chemistry related careers.

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