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EFFECT OF HARKNESS TEACHING METHOD ON STUDENTS' ATTITUDE IN CHEMISTRY IN SECONDARY SCHOOLS IN KAJIADO COUNTY, KENYA

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ABSTRACT

Chemistry education is an important part of our daily lives in acquiring the fundamental knowledge about the universe. The acquired knowledge is key as it helps a person shape and reshape the world for their benefit. Though various factors may be responsible for the poor students' attitude in chemistry in secondary schools in Kenya, research has shown that teaching methods used in chemistry influence the attitude of students. Hence, this study investigated effect of Harkness teaching method on students' attitude in chemistry in secondary schools in Kajiado County, Kenya. Quasi experimental research design was employed and in particular Solomon's four group design. The research was carried out in four sub-county mixed secondary schools in Kajiado County, Kenya. The target population was chemistry students in secondary schools in Kajiado County. The accessible population was 5,289 form three chemistry students in sub-county mixed secondary schools. The purposive sampling was used to draw sub-county mixed secondary schools from a list of mixed secondary schools in Kajiado County. Simple random sampling was used to draw the participating sub-county mixed schools. Simple random sampling was used to select and assign participating schools in experimental and control groups. The actual sample size was 124 students from four schools. The research instruments used was Chemistry Attitude Questionnaire (CAQ). The instrument was piloted to determine its reliability in a school in Tharaka Nithi County, while validity of the instrument was ascertained by experts' opinions from department of education of Chuka University. The reliability coefficient for Chemistry Attitude Questionnaire was 0.774. Experimental group (E1 and E2) was taught using Harkness teaching method while control groups (C1 and C2) was taught using conventional teaching method. Statistical Package for Social Science (SPSS) version 25 aided in data analysis. The raw data obtained was analyzed using inferential statistics (Mann-Whitney U test, Kruskal Wallis test and Bonferroni adjusted alpha levels post hoc analysis). The level of significance for rejection of null hypothesis was at $\alpha = 0.05$. The finding of the study indicated that Harkness teaching method significantly improved the students' attitude in chemistry. The findings of this study may help teacher training

colleges in integration and incorporation of innovative instructional methods that would enhance learning of chemistry. The findings of this study may also contribute to the knowledge base for Harkness instructional method and form a foundation for future studies.

KEYWORDS: *Attitude, Harkness Teaching Method and Conventional Teaching Method.*

1. Background Information

The principal objective of education has been the development of the whole individual. The only way to achieve this is by giving the child education that is of high quality and standard. Education involves the total efforts of the community to raise its political, social and economic standard of living (Agboola & Oloyede 2007). The implication of this is that it is an inevitable tool for surmounting ignorance, disease, poverty and to produce functional individuals who have positive attitudes towards the growth and development of the society. Attitude is an important concept in learning. Among learners, it denotes interest or feeling towards studying particular subjects.

One of the objectives of science education is to develop students' interest in science and technology, as today's society depends largely on development in science and technology. Chemistry is central to many of the scientific fields of human endeavors; therefore, the teaching of chemistry should be given serious attention. According to Ibrahim, Hamza, Bello and Adamu (2018), chemistry has helped in the development of modern technology through the application of its principles to modern invention, its study also enhances an understanding of the interplay of forces in nature because it forms veritable arm against superstition which muddles technological advancement anywhere. Chemistry as a course of study is perceived generally to be very interesting, vast, mathematical and experimental, almost all aspect of life science, both living and nonliving has something to do with chemistry, ranging from engineering to mathematics, biology and physics (Ware, 2001). Chemistry is one of the pre-requisite subjects for the study of engineering, technological, medical and other applied science courses in the university. The study of chemistry has been and will remain of tremendous importance to mankind because it is capable of explaining natural phenomenon and everyday occurrences.

Chemistry curricula incorporate many abstract concepts, which are central to further learning in both chemistry and other sciences (Taber, 2002). Generally, most students perceive chemistry as difficult subject despite being the most industrially relevant science that features every aspect of human endeavor and natural phenomena (Mugwiria, 2016). These perceptions may have been attributed by the abstract conceptions of chemistry which is unrelated by many students to the world they live in. According to Espinosa, Monterola and Punzalan, (2013) chemistry students find chemistry too abstract and mathematical. In teaching chemistry, it is not enough to simply give facts, figures, theories, laws and other ideas without representations of the image or application in the real –life situation. Because of the critical role of chemistry in the social and economic life of a nation, the teaching of chemistry should be done in such a manner that students have deep understanding and liking for it. O'dwyr (2012) pointed that chemistry is generally a difficult subject to students at all levels. This is also reflected in the poor performance of students in chemistry. For instance, in Kenya, KNEC (2018) reported generally poor performance in chemistry KCSE examinations. Poor performance of students in chemistry could also be ascribed to learner's attitude and conception towards the subject in addition to many other factors. There is a great agreement among science theorists and practitioners on the importance of students' attitude toward chemistry lessons in school. In the same vein, Olatoye (2000) pointed out that there was a relationship between students' perceptions and attitudes towards chemistry course and their course achievements.

Attitude towards chemistry refers to a person's liking or disliking of chemistry (Osborne, Simon, & Collins, 2003) or having a positive or negative feeling with respect to chemistry. Attitude is deemed an important predictor of behavior, academic self-concept which is a cognitive characteristic. Attitude outcomes are exhibited in a different way and have deeper roots in the experiences that students bring to school. Attitude

development is a lifelong process that involves the home, school and environment. Development of a positive attitude plays an important role in student's growth by interacting with intellectual development and creating a readiness for response application of what is taught (Albert, 2004). The need for conducting studies related to attitude in chemistry is undertaken for two main reasons; namely the attitude feasible power to predict future behaviour like subject and career preferences of students, and the correlation existing between attitude and academic achievement (Osborne & Collins, 2000).

In their meta-analysis of attitude related factors that predict future behaviors, Glasman and Albarracin (2006) concluded that there is a correlation between attitude and future behaviours, that is attitude has potential for predicting future preferences, especially if there is direct interaction between participants and attitude objects (objects that are related to attitude like science lessons). Osborne and Collins (2000) argued that various objects can be related to attitudes like science lessons, scientist or science in real life. Attitude should be considered as an outcome of science education, since attitude form and change during a life time of a person, thus facilitating this process of attitude change should be an important part of the work of science teachers.

The quality of science teaching is an important factor affecting students' attitude towards school science (Osborne, Simon & Collins, 2003). Osguthorpe and Graham (2003) in Brigham Young University in the United States of America found out that blended instructional methods improved pedagogy, increased access to knowledge, fostered sound interaction and increased teacher presence during learning and improved cost effectiveness. Using laboratories in chemistry lessons positively affects students' attitude towards that lesson (Adesoji & Raimi, 2004). Olatoye (2000) in Nigeria found that student's attitudes towards science have significant direct effect on students' achievement in the subject. Furthermore, Adesokan (2002) asserted that in spite of the recognition given to chemistry among the sciences, it is evident that students still show negative attitude towards the subject thereby leading to poor performance and low enrolment. In a study of the influence of student's attitude towards mathematics, Bolaji (2005) found that the teaching method and teachers' personality greatly accounted for the student's positive attitudes towards mathematics.

Thompson and Soyibo (2002) in North America investigated whether the use of the combination of lecture, teacher demonstrations, class discussion and students practical work in small groups significantly improved the experimental subjects' attitudes to chemistry more than control group. The results showed that the experimental subjects' posttest attitude to chemistry were statistically significantly better than those of their control group counterparts. Tüysüz (2010) examined the effect of the virtual laboratory on students' achievement and attitude in chemistry in Turkey. The findings of the study revealed that the use of virtual laboratory made a positive impact on students' attitudes towards chemistry. Yunus and Ali (2013) carried a study on the attitude towards learning chemistry among secondary school students in Malaysia. The results of this study revealed that a majority of the students had a positive attitude towards learning chemistry when they conduct chemistry experiments in the laboratory. Adesoji and Raimi (2004) investigated the effect of supplementing laboratory instruction with problem solving strategy and or practical skills teaching on students' attitude towards chemistry. The results revealed that the use of enhanced laboratory instruction strategy significantly improved the attitudes of students towards learning chemistry. Also, Chepkorir (2013) examined the impact of students' attitude on the teaching and learning of chemistry in secondary schools in Bureti district. The results showed that anxiety over career opportunities and peer influence influences students' attitude.

A number of reasons have been suggested for negative attitudes including students' undesirable experiences in previous science courses with teachers, lack of needed skills to learn and apply scientific concepts and lack of motivation, biasness of peer groups and students' perception of rewards associated with learning (Rogers & Ford, 2004). Students' attitude towards science determines the interest in science. Many students develop negative attitudes towards science mainly due to some misconceptions. Some may think science is a collection of facts or "truth", others consider science as a difficult subject and not relevant to their lives at the present time (Salta & Trougraki, 2004). Some may even think intelligence in science is fixed, and that they might need

to be gifted to learn science. Students coming from introductory science courses often feel such misconceptions (Seligin, 2012). Misconception is generally the result of incorrect understanding of ideas, objects or events that are constructed based on person's experience. Once misconception has been formed due to previous bad experiences, it is extremely difficult to change such cognitive thought using conventional pedagogical methods (Eggen & Kavchak, 2004). Teachers should integrate new teaching methods through different hands-on activities connecting to the experiences of the learners (Reyes, Espana & Belecina, 2014). Students' attitude could possibly be changed and chemistry achievement can be improved if teachers make chemistry more relevant to the students' experiences by connecting the subject to everyday experiences. Teachers are expected to device ways of motivating students to develop positive attitudes towards science and science related disciplines (Sola & Oso, 2007).

Koballa and Glynn (2007) pointed out that methods to positively affects students' attitude include instruction that emphasizes active learning and relevance of science to daily life such as Harkness teaching method. Since many activities such as instructional activities, interactions among students' participation are guided by teachers in science classrooms, science teachers play a key role in promoting positive attitudes towards science in students. Students' science learning experiences affects their attitudes positively as a result increases their motivation to learn science. Students may have negative tendencies and pessimism towards chemistry due to the bad experiences that they have had with the subject (Mugwiria, 2016). However, there have been ongoing endeavors to explore and implement several possible interventions to improve students' attitude in chemistry. One of such interventions is Harkness teaching method. The inclusion of Harkness teaching method may instill a sense of ownership about the concept and improve the attitude of students in chemistry.

Harkness is a teaching and learning method in which small classes of students sit around an oval table with the instructor to discuss ideas in an encouraging, open-minded environment with only occasional or minimal teacher intervention. Harkness gift mandated Philip Exeter Academy to change their classroom from rows of desks with a teacher at the front to oval tables at which the teacher sat more democratically alongside their students in conference (Towler, 2015). The Harkness table offers a neutral, safe place for students to test out ideas, interpretations, and applications with peers and an expert who is the teacher. The Harkness tables are usually oval because an oval table permits universal eye contact with sitting in direct eye contact. Sitting in direct eye contact with other students generates participation and facilitates discussion –based learning (Stannard, 2016). Harvey and Kenyon (2013) noted that sitting facing each other makes it easier to speak up and share ideas and that has a psychological impact, making student feel more comfortable. By sitting around one table you explore ideas as a group, developing the courage to speak, the compassion to listen and the empathy to understand (Phillips Exeter Academy, 2015) it is an environment where everyone is encouraged to contribute.

The teacher's role around the Harkness table is a facilitator, the teacher channelizes the discussion and also helps elevate the preliminary understanding the students bring into the classroom to higher order learning (George, 2017). The adjustment to the teacher's role in the classroom is a key feature of Harkness lessons, alongside that of their students. According to Njagi (2019) a Harkness teacher will minimize the amount of information and answers they give directly to students, instead they will give students the resources in which information and ideas can be found, or at very least, they will help their students locate the necessary resources. Donarski, (2016) notes that the handing over of authority as adopting the role of referee, making sure that discussion etiquette is followed but otherwise witnessing the students' learning with the sensitivity of a bird watcher. Donarski (2016) argues that students need to be taught how to have effective discussions and ask good academic questions. Teaching students how to learn is a view shared by other Harkness practitioners (Backer, 2016). Waterman (2015) suggests that students need to be trained not to expect monologic lectures, with teachers indicating the shift from sage on the stage to a guide at the table who is not the fount of all knowledge.

Harkness lessons are committed to getting students to take responsibility for their learning and to take ownership of what is said in their lessons. Hassan (2015) suggests that Harkness lessons equip students with

the skills of dialogue, engagement and critical thinking, all of which are crucial in the digital age to prepare students to be positive contributors to society. Donarski, (2016) noted that preparation is essential for Harkness lessons, it is the ground work for discussions and the success of a lesson depends upon the preparatory work, because it is impossible to create or learn something out of nothing. Students cannot contribute to the discussions if they are unprepared therefore prior knowledge is vital. Bergofsky (2015) suggest that students quickly become honest regarding their preparation for lessons because the responsibility for the success of the lesson lies with the students, and this, according to Sevigny (2012), is the real genius of Harkness lessons because no-one can escape. A lack of preparation is quickly evident at the table and students consequently learn to take responsibility for not only their own learning, but that of others because whilst they might prepare independently, they learn collectively (Pettigrew, 2015) a responsibility that begins with homework.

Harkness teaching encourages students to learn from their mistakes, an essential part of learning at deep levels (Smith, 2016). When teachers immediately correct wrong answers and rectify misconceptions, students are never given the opportunity to struggle through their mistakes and come to their own conclusion about why their solutions were incorrect. By creating a supportive, safe environment, conducive to discussion, teachers allow students to learn from mistakes and adopt their problem solving. Harkness teaching tries to develop in students their own sense of responsibility for their education (Smith & Foley, 2009). Fostering independent thinkers and allowing curiosity to drive the engine of education are truly at the heart of the practice of Harkness. The pedagogy of Harkness challenges students to achieve a higher level of engagement, to extract and construct their own meaning from the content, and then to share it courageously and articulately with their peers and teachers while gaining respect for the voices of others. Little research has been reported in Kenya and in Kajiado county on effect of Harkness teaching method in chemistry. Thus, there was need to investigate the effect of Harkness teaching method on students' attitude in chemistry in secondary schools. In this regard, Kajiado county in Kenya was selected for the purpose of this research.

2. Statement of the Problem

The importance and value of chemistry in the social and economic sphere of any nation is immense and, Kenya is not an exception. The knowledge and skills in this central science is utilized in almost all the sectors of economy. Chemistry enables students to understand what happens in the world they live in and how it contributes to the quality of life on our planet. Chemistry curricula incorporate many abstract concepts, which are central to further learning in both chemistry and other sciences. Because of the critical role of chemistry in the social and economic life of a nation, the teaching of chemistry should be done in such a manner that students have deep understanding and liking for it. However, research shows that chemistry is generally a difficult subject to students at all levels. This is reflected in the poor performance of students in chemistry. For instance, the KNEC (2018) examinations' performance report revealed generally poor performance in chemistry KCSE examinations. The poor performance of students in chemistry has continued to trigger a lot of concern among educationists and other stakeholders nationally and also in Kajiado county over the years. In an effort to reverse the trend, the government of Kenya adopted a number of interventions targeting pupils, teachers and the overall teaching and learning environment. Even though innovative methods that engage learners actively have been shown to improve students' attitude, such information is little in relation to Harkness teaching in chemistry. Therefore, there was need to investigate the effect of Harkness teaching method on students' attitude in the learning of chemistry in secondary schools in Kajiado county, Kenya.

3. Objectives of the Study

The objective of the study was to determine students' attitude towards chemistry when taught using Harkness teaching method and when taught using conventional teaching method.

4. Hypothesis of the Study

There is no statistically significant difference in students' attitude towards chemistry when taught using Harkness teaching method and when taught using conventional teaching method.

5. Methodology

The study applied quasi experimental design of Solomon four group design. Solomon four-group design involves four groups (Ogunniyi, 1996). The central feature of Solomon four-group is that participants are randomly assigned to either receive or not to receive a pre-test and then randomly assigned to either a treatment or a comparison group. This design is preferred because it is based on groups of respondents rather than individuals. The design also enables the researcher to carry out studies in natural and real-life settings. Solomon four group enables the researchers to make a complex assessment of the cause of the change in the dependent variables and even tell whether changes in the dependent variables are due to interactions effect between the pretest and treatment. It allows the researchers to exert complete control over the variable and to test that the pre-test will not influence the results (Shuttleworth, 2009). The students were taught by their teachers so that were not aware of the experimentation. The experimental and control groups were from different schools to avoid interaction of subjects.

The target population was chemistry students in secondary schools in Kajiado County, Kenya. The accessible population was 5,289 form three students in sub-county mixed secondary schools where the study sample was drawn. The units for sampling in this study was schools and not individual students. The researcher purposively sampled Kajiado county out of the 47 counties in Kenya. Kajiado county consists of 165 secondary schools. The researcher used purposive sampling to draw sub-county mixed secondary schools from a list of mixed schools in Kajiado county. Purposive sampling techniques helped select schools with desired characteristic from a list of schools in Kajiado county. The desired features for the schools that qualified for the study was sub-county mixed secondary schools with a class size of at least 30 students. Frankel and Wallen (2000) recommend at least 30 cases per group for experimental research. The number of sub-county mixed secondary schools provided a large enough sample for the study to be carried out. Simple random sampling was used to select four mixed sub-county secondary schools that participated in the study. Simple random sampling technique was used to assign groups to experimental groups (E1 & E2) and control groups (C1 & C2). In case a school had more than one stream taking chemistry, all the streams were subjected to the study using similar method of teaching but only one stream was considered for analysis. The sample size for this study was 124 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.

The instruments used was Chemistry Attitude Questionnaire (CAQ). This questionnaire contained 28 closed-ended items adopted from Tapia and Marsh (2004) and adjusted to suit the study. Chemistry Attitude Questionnaire was used to solicit students' feelings on chemistry based on attitudinal scales. It was divided into four sections which include the fun factor, scale 1 with 7 items, practical investigations scale 2 with 7 items, committed scientist, scale 3 with 7 items and career scientist, scale 4 with 7 items. These items are based on 5-likert marking scheme ranging from strongly Agree SA-5, Agree (A)-4, undecided (U)-3, Disagree (D)-2, Strongly Disagree (SD)-1. The instrument was validated by experts from the department of education, Chuka University. The reliability of Chemistry Attitude Questionnaire was tested using Cronbach alpha coefficient. The reliability for Chemistry Attitude Questionnaire as estimated by Cronbach alpha value obtained was 0.774. Reliability co-efficient of above 0.7 was considered sufficient for the study. Therefore, the instrument was acceptable for the study.

The data was obtained within twenty lessons each consisting of forty minutes. The data obtained was analyzed using Mann-Whitney U test, Kruskal Wallis test and post hoc analysis using the statistical package for social sciences version 25 (SPSS version 25).

6. Results and Discussion

To establish whether there was difference in students' attitude towards chemistry when taught using Harkness teaching method and when taught using conventional teaching method, the CAQ was analysed. The section presents the findings and discussion.

6.1 Pretest for Chemistry Attitude Questionnaire

Before the start of the treatment, Experimental group (E1) and control growth (C1) were exposed to Chemistry Attitude Questionnaire pretest. Pretest was carried to ascertain whether the students selected to participate in the study had comparable characteristics before the study. In order to determine whether there was significant difference between mean ranks in Chemistry Attitude Questionnaire of E1 and C1, Mann-Whitney U-test was used. The results are as shown in the Table 1.

Table 1: Mann-Whitney U test Result of the Pre-test of Student Attitude on Experimental Group 1 and Control Group 1

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Experimental group 1	31	31.82	986.50	470.500	966.500	0.141	0.888
Control group 1	31	31.18	966.50				
Total	62						

The findings show that Experimental group (E1) had a mean rank of 31.82 while control group (C1) had 31.18. The Mann-Whitney U test results in Table 1 reveals that pretest of Chemistry Attitude Questionnaire mean ranks of both groups E1 and C1 were not significantly different at (α)=0.05; (u=470.0), p=0.888, p>0.05). The two groups contained learners with similar characteristics hence homogenous.

6.2 Effects of Harkness Teaching Method on Students Attitude

The hypothesis of the study sought to find out whether there was significant difference in students' attitude towards chemistry when taught using Harkness teaching method and when taught using conventional teaching method. Operationally, attitude to learn chemistry was defined as a composite variable derived from mean ranks of students' responses on 28 items measuring the construct on a five-point Likert scale, that is Strongly Disagree (SD)=1; Disagree (D)=2; Undecided (U)=3; Agree (A)=4 and Strongly Agree (SA)=5. All the four groups took the Chemistry Attitude Questionnaire posttest. To analyze whether students differed in attitude when taught using Harkness teaching and conventional teaching method, Man Whitney U test was run. The results are as shown in Table 2.

Table 2: Mann-Whitney U Test Result of the Post-test of Students' Attitude on Experimental Group 1 and Control Group 1

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Experimental group 1	31	39.74	1232.00	225.000	721.000	3.599	0.000
Control group 1	31	23.26	721.00				
Total	62						

The findings in Table 2 revealed that the mean ranks were 39.74 for the experimental group (E1) and 23.26 for control group (C1). The Mann-Whitney U test results in Table 2 show that posttest of Chemistry Attitude Questionnaire mean rank of both groups E1 and C1 were significantly different at (α)==0.005, (U=225.0, P=0.000, P<0.05) indicating that there is statistically significant difference in students' attitude between those taught using Harkness teaching and conventional teaching method. Mann-Whitney U test was run to analyze

whether students differed in attitude when taught using Harkness teaching and conventional teaching method in experimental group (E2) and control group (C2). The results are as shown in Table 3.

Table 3: Mann-Whitney U Test of the Post-test of Student' Attitude on Experimental Group 2 and Control Group 2

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Experimental group 2	31	40.95	1269.50	187.500	683.500	4.127	0.000
Control group 2	31	22.05	683.50				
Total	62						

The results of Table 3 reveal that mean ranks were 40.95 for experimental group (E2) and 22.05 for control group (C2). Experimental group E2 had a higher mean rank than control group C2. The Mann-Whitney U test results in Table 3 shows that posttest of Chemistry Attitude Questionnaire mean ranks of both groups E2 and C2 were significantly different at alpha (α)= (U=187.5, P=0.000, P<0.05) implying that there is statistically significant difference in students' attitude in chemistry between students taught using Harkness teaching and conventional teaching method. Table 4 shows the independent samples for Kruskal-Wallis test summary of the posttest Chemistry Attitude Questionnaire for the four groups.

Table 4: Independent-Samples Kruskal-Wallis Test Summary of Post-test Chemistry Attitude Questionnaire for the Four Groups

Total N	Test Statistic	Degree of Freedom	Sig.
124	30.241[a]	3	0.000

a. The test statistic is adjusted for ties.

The findings in Table 4 shows results of Kruskal-Wallis test. A Kruskal-Wallis test showed that there was a statistically significant difference in the students' attitude to learn chemistry between students taught using Harkness teaching method and those taught using conventional teaching method, H (3) = 30.241, P=000, P<0.05. The results therefore implied hypothesis of the study was rejected, which stated that the Harkness teaching method had a positive effect on students' attitude on Experimental group E1 and Experimental group E2. The P-value is less than 0.05 therefore a Bonferroni post hoc test is conducted to determine where the difference existed. Post hoc test using Bonferroni adjusted alpha levels was used to compare all pairs of the groups. The results are shown in Table 5.

Table 5: Post Hoc Comparisons of Post-test of Chemistry Attitude Questionnaire Mean Scores for the Four Groups

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
C1-C2	-1.903	9.125	-.209	0.835	1.000
C1-E1	33.323	9.125	3.652	0.000	0.002
C1-E2	-39.032	9.125	-4.278	0.000	0.000
C2-E1	31.419	9.125	3.443	0.001	0.003
C2-E2	37.129	9.125	4.069	0.000	0.000
E1-E2	-5.710	9.125	-.626	0.531	1.000

The findings on Table 5 shows that the pairwise comparisons of groups. Post hoc analysis using a Bonferroni adjustment alpha level of 0.05 were used to compare all the pairs of groups. Each row tests the null hypothesis that the sample 1 and sample 2 distributions are the same. The findings show that the groups C1 and C2, E1 and E2 were not significant (P=1.000, P=1.000) revealing that there was no significant difference in students'

attitude towards learning chemistry in control group (C1 and C2) and experimental group (E1 and E2). The findings show a significant difference in groups C1 and E1, C1 and E2, C2 and E1 and C2 and E2, (P=0.002, P=0.003, attitude towards learning of chemistry. This means that Harkness teaching method enhances students' attitude to learn chemistry more than the conventional teaching method.

The findings of the study are in agreement with Donarski (2016) who suggested that Harkness lessons can be used to build confidence prior to examinations by enabling students to explore their knowledge orally to identify whether they need to develop examination skills or subject knowledge. Findings of the study also is in line with Harvey and Kenyon (2013) studies which noted that sitting facing each other in a Harkness table makes it easier to speak up and share ideas and that has a psychological impact, making student feel more comfortable in learning. By sitting around one table one explores ideas as a group, developing the courage to speak, the compassion to listen and the empathy to understand (Philip Exeter academy, 2015), it is an environment where everyone is encouraged to contribute.

The findings of the study concur with findings of Crone (2011) whose research study concluded that when students are engaged in learning it motivates them to learn, engage them in higher level thinking, increases class morale, give feedback to teachers and develop more positive attitude towards instructions. The findings of the study contradict with the findings of Alexander (2016) who investigated the impact of a combined inquiry-based method and Harkness methods on students' attitude and confidence. The survey indicated a decrease in students' attitude and confidence of ninth grade physics classes. Findings of the study concurs with Davis (2016) study which reported that upon reviewing exit survey data from multivariable calculus class taught in the Harkness style, students enjoyed the problem sets more than the lecture, and that their enjoyment increased over the course of the term. The study witnessed a higher percentage of students willing to work on new and different types of problems verses problems they already knew how to solve. Enjoyment of chemistry and the ability to see its usefulness are important factors in students' attitude and performance.

Findings of the study are in harmony with findings of Isgitt and Donnellan (2014) study which concluded that debate in the math classroom encourages students to view cross-circular courses as reinforcement of each other and can help remove some of the traditional walls that schools place between STEM and humanities courses. The idea that their various classes are related, that problem solving can be used in language and humanity courses, and that literacy is vital to mathematical and scientific discoveries can support students in the move from the mindset that they are simply learning a set of desperate facts to a mindset that all education is worthwhile and necessary for their growth. The results of the study concur with a report by Botkin, (2017) which indicated that one of the Exeter's messages to their students is that the ability to communicate ideas is just as important as getting the correct answer. Many students question the real-life usefulness of their chemistry courses, but they would be hard pressed to find a job in which discussion, problem solving or presentation aren't vitally important for advancement.

The results of present study also concur with Davis (2016) who found out that students in Harkness classrooms report increased confidence while speaking in front of an audience, as well as showing increased aptness to ask relevant questions. Standing up and presenting in front of other people is a highly valued skill in the workplace, the presentation of solutions in class gives students the opportunity to practice and refine this important job competence. Findings of the study contradicts findings of Mullgardt (2008) who noted that one teacher reported students deciding they had the right to remain silent saying that Harkness discussion in mathematics was cruel and unusual punishment. Practicing a classroom structure different from the convention at a particular school can easily cause discussions to be chaotic, so teachers must be clear in their articulation of procedures and guidelines.

Results of the study are also in harmony with findings of Geary and Atif (2013) who reported that teachers at Exeter claim that even experienced math teachers who work through the problem for the first-time using

Harkness discover new ideas and rich connections. The finding of the study is in agreement with Carl and Rachel (2015) study using year 9 geography class which established that a sense of progress was recognized by the students who commented that they grew in confidence and were increasing willing to participate in Harkness discussions, as well as deriving greater enjoyment from that style of lesson over time. The vast majority of students reported that they found the discussion lessons, extremely useful in enhancing their communication and critical thinking skills.

The findings of the study do not agree with findings of Sirhan (2007) who reported that there is negative attitude regarding the usefulness of the chemistry courses for the students' future career, and a neutral attitude regarding the interest in the chemistry itself. Chemistry teachers bear a huge responsibility of promoting and developing students' positive attitudes regarding chemistry as a subject. Results of the study are consistent with Sneedon (2015) who identifies a subtle pressure on students to participate in Harkness lessons, enabling them to gently overcome their fears and anxieties about contributing ideas, others perceive students being compelled to talk because no-one can hide so active participation is necessary. Learning to seek affirmation from a source other than the teacher is an essential skill to learn, as is learning how to disagree in a collegial way (Moore, 2015). The results of the study do not agree with Adesokan (2002) who asserted that in spite of realization of recognition given to chemistry among the science subjects, it is evident that students still show negative attitude towards the subjects, thereby leading to poor performance.

7. Conclusion

The findings of the study revealed that Harkness teaching method facilitates students' attitude towards learning chemistry. The results of the study showed that students in the experimental groups had a higher favorable attitude towards chemistry compared to conventional groups. Harkness teaching method was effective in enhancing students' attitude and students were more enthusiastic about their learning about the topic at hand which was organic chemistry 1, a chemistry topic taught in form three. Therefore, Harkness teaching method increases attitude in learners in chemistry lessons.

8. Recommendations

Based on the findings of the study it is recommended that chemistry teachers should embrace use of Harkness teaching method as a way of encouraging students' participation in instruction in order to have interest in the subject and improve academic achievements in chemistry.

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