# Academic Scaffolding as a Predictor of Achievement Motivation for Learning Chemistry Among Secondary School Students in Kenya

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***Abstract*: This research was carried to examine academic scaffolding as a predictor of achievement motivation for learning chemistry among secondary school students in Kenya. The study was anchored on scaffolding theory developed by Bruner and achievement motivation theory by McClelland. The researcher used convergent parallel mixed research design to examine the relationship between the study variables. The target population was 10528 form three students taking chemistry in 284 public secondary schools in Kiambu County in the year 2020. Purposive sampling was used to select Kiambu County and form three students taking chemistry. Stratified sampling was used to select the schools while simple random sampling was used to select students to participate in the study. The study was conducted in 17 secondary schools using a sample of 440 students. A pilot study was done in one school involving 40 students to establish the validity and reliability of the research instruments. Data were collected using questionnaires and interview schedules and then analyzed using both descriptive and inferential statistics. The results indicated that there was a moderate positive and statistically significant correlation between academic scaffolding and achievement motivation for learning chemistry, $r$ (336) = .50, $p$< .05. Academic scaffolding was found to be a significant predictor of academic scaffolding and $R$ square was .25 which suggested that 25% variance in achievement motivation for learning chemistry can be explained by academic scaffolding. Qualitative results also showed that academic scaffolding influenced the student's achievement motivation for learning chemistry. The study recommends that school counsellors and chemistry teachers should enhance academic scaffolding in order to boost the student's achievement motivation for learning chemistry for better learning outcomes in the subject.**

***Key Words*: Academic scaffolding, achievement motivation, chemistry**

## I. BACKGROUND TO THE RESEARCH

Achievement motivation has been considered as an important factor for learning and school achievement. In the absence of sufficient achievement motivation, it's very unlikely for meaningful learning to take place (Febriana, 2017). The concept was introduced into behavioral science by Murray (1938) and since then, it has become very popular in the study of human behavior especially in educational settings. Achievement motivation for learning chemistry is defined as the desire for learning and attaining quality grades in chemistry (Uno, 2013). It is considered as an important factor in learning and achievement in chemistry. Achievement motivation for learning chemistry is significantly associated with the efforts the students put to accomplish tasks in the subject and the grades they score. A student with high achievement motivation for learning chemistry feels pleasure from attaining success in learning chemistry concepts using efficient strategies. Owing to the abstract nature of most chemistry concepts, learners need to have high achievement motivation to effectively learn what they are taught.

Despite the efforts that have been made to enhance achievement motivation for learning chemistry among learners, many countries across the world are still struggling with low level of achievement motivation and below average performance in the subject (Bullock, 2017). The nature of achievement motivation for learning chemistry among secondary school students in Kenya remains largely unexplored. However, there is an abundance of literature on the factors associated with below average achievement in chemistry (Oluoch, 2018; Ogembo, 2013). Some of the studies revealed that low achievement motivation for learning chemistry contributed to below average achievement in the subject.

In Kiambu County, Wangui (2017) investigated the influence of motivational strategies on performance in chemistry and reported that among the science subjects, chemistry is the worst performed. The researcher associated below average performance with low level of achievement motivation towards learning chemistry. It was revealed that achievement motivation for learning chemistry determines the goals students set in the subject and how they strive to achieve them. The level of achievement motivation determines the choices that learners make; either to study chemistry or do something else. The initiative to start learning a chemistry task and persistence to work it out successfully largely depends on achievement motivation of the learner (Wangui, 2017). Based on data available regarding the performance in chemistry in the county, achievement motivation for learning chemistry among secondary school students is still an issue of concern. This study focused on academic scaffolding as a predictor of achievement motivation for learning chemistry among secondary school students.

Academic scaffolding refers to the process that enables learners to solve a task or achieve a learning goal that would be beyond

their unassisted effort (Wood et al., 1976). It requires the teacher or significant others who are proficient in the chemistry task to guide learning of what is being taught and once the skill is mastered, the support is withdrawn. Dixon et al. (1993) asserts that for scaffolding to be effective in learning, the support must be gradually withdrawn otherwise if it is done quickly, learning will not take place and the learner ends up being frustrated. To ensure effective learning, chemistry teachers must organize the content in ways that are consistent with the working memory and long term transfer (Fisher & Frey, 2010). This can be done through the use of mental schema to represent information. In this regard, the use of teaching aids, practicals and other teaching strategies that expose the learners to real life experiences prove to be vital. The scaffolds provide the chemistry learners with executive schema for mastering the content (Guthrie et al., 2004).

Education researchers have classified academic scaffolding into three categories namely; instructional scaffolding, planned scaffolding and interactional scaffolding (Athanases & De Oliveira, 2014; Hammond & Gibbons, 2005). In the context of this study, instructional scaffolding refers to the type of support provided by chemistry teachers, parents, guardians and peers to a learner's immediate academic needs. It is a dynamic process that involves face to face interaction out of which the learner's academic needs are intended to be met. Interactional scaffolding is the support that is mostly provided by the chemistry teachers during academic engagements and peers during group discussions or any other academic activity in learning chemistry. On the other hand, planned scaffolding is the support for learning chemistry that is provided by the instructional materials during the teaching and learning process. According to Volman and Beishuzen (2010), planned scaffolding is not contingent to the immediate needs of the learner.

Research has demonstrated that effective academic scaffolding improves learning behaviour and achievement. Chan (2020) found that cooperative scaffolding influence academic achievement of students in Singapore. Another study by Sutiarso et al. (2018) also demonstrated that media scaffolding had a positive impact on mathematics achievement of students in Indonesia. Similar results were reported by Moe et al. (2018) and Valencia-Vallejo et al. (2018). The studies showed that scaffolding is significantly associated with learning behaviour and academic achievement of students but the relationship between academic scaffolding and achievement motivation for learning chemistry has not been extensively studied.

## II. STATEMENT OF THE PROBLEM

The performance in chemistry experienced in KCSE in 2016-2020 in the whole country presents a worrying trend to any education stakeholder. In the five years period, approximately 80% of the candidates who sat for KCSE in the country scored grade D + and below in chemistry. In Kiambu County, the KCSE mean score in the year 2016, 2017, 2018, 2019 and 2020 were 2.86, 2.76, 3.06, 3.04 and 2.62 respectively (Kiambu County KCSE Statistics, 2022). The below average performance in chemistry among majority of the students has been associated with low level of achievement motivation for learning the subject. This large number of students who are scoring below average grades in chemistry is a matter of great concern considering the importance of the subject in equipping the learners with practical industrial skills necessary to realize vision 2030 and SDGs. Therefore, students' achievement in this subject and the factors related to its performance is a matter of serious concern that requires empirical inquiry to avert this situation. The large number of students who score below average grades in chemistry miss opportunities to advance their studies in science related fields and employment. There are limited studies on the predictors of achievement motivation for learning chemistry but related studies cite school related factors, quality of teaching and learner factors as the correlates of achievement motivation. However, the studies were carried out outside Kiambu County mostly using samples of college students. The studies largely focused on factors such as attitude, motivation, learning strategies and learning context and how they influence performance in chemistry. Locally, related studies focused on the relationship between motivation and performance in chemistry and therefore there was need to find out the factors that influence achievement motivation for learning chemistry. This research sought to examine academic scaffolding as a predictor of achievement motivation for learning chemistry among form three students in Kiambu County, Kenya to bridge the gap.

## III. SIGNIFICANCE OF THE RESEARCH

This study was carried out in response to dismal performance in chemistry among secondary school students in Kiambu County. The findings of this study may be of benefit to educational planners and KICD as it may provide useful information underlying achievement motivation for learning chemistry. The findings may be used to sensitize chemistry teachers on how to enhance achievement motivation for learning the subject to improve its performance. The findings may also provide important information to school counselors and chemistry teachers regarding the factors associated with achievement motivation for learning chemistry thus forming the basis for resolving dwindling performance in chemistry. The findings contribute to literature on the factors associated with achievement motivation for learning chemistry among secondary school students. The findings may be used for further research in an effort to improve chemistry performance in Kenya.

## IV. LITERATURE REVIEW

Research on achievement motivation for learning has paid much attention to academic achievement. A number of personal and environmental factors that influence achievement motivation for learning have been identified. These include mastery orientation (Dweck & Leggett, 1988), success expectancy (Atkinson, 1957; McClelland et al., 1961), self-efficacy (Bandura, 1977) and social setting (Osterman, 2000). A quasi experimental research by Byun and Cerreto (2014) explored the influence of question prompts strategies on

cognitive scaffolding and how it affected problem solving among university students who were studying chemistry in Korea. The findings showed that teacher-generated cognitive scaffolding was associated with better problem solving in chemistry.

A study carried out in USA by Toledo and Dubas (2016) analyzed the relationship between academic scaffolding and the development of higher order thinking skills in chemistry among university students. Observations from the study indicated that academic scaffolding had a positive impact on learning chemistry concepts. Another research by Duffy and Azevedo (2015) investigated interactions between achievement goals and scaffolding for self-regulated learning. The study adopted correlational research design to examine the nature of the relationships. Multivariate Analysis of Covariance (MANCOVA) results revealed that there is a significant interaction between achievement motivation and academic outcomes. The findings also showed that learners adopting dominant performance approach scored highly on achievement motivation.

In Singapore, Chan (2020) investigated if cooperative scaffolding influenced academic achievement among secondary school students. The results showed that cooperative scaffolding was significantly related to academic performance. The findings confirmed the importance of academic scaffolding in learning. In another research, Sutiarso et al. (2018) examined the impact of media scaffolding on learning mathematics concepts among fifth grade learners in Indonesia. The results showed that a majority of male students preferred scaffolding props while female students preferred media charts. It was further established that media scaffolding enhanced understanding of mathematics concepts.

Gita and Apsari (2018) investigated the relationship between scaffolding and performance in algebra. The results revealed that academic scaffolding was able to improve learning outcomes in algebra. The findings prompted the need for the current study to investigate if academic scaffolding was associated with achievement motivation for learning chemistry. In a related study, Rienties et al. (2012) explored the role of scaffolding and motivation in computer supported collaborative learning (CSCL) using quasi-experimental design. Multi-method analyses findings revealed that scaffolding was significantly related to achievement motivation.

In a similar study, Chen (2020) investigated the potential of augmented reality (AR) to address existing issues with insufficient scaffolding in video learning materials for English as a foreign language (EFL) learners. By overlaying rich media elements on the real-world learning setting, AR can provide students with adequate contextual scaffolding. To aid students' EFL learning, an AR video-enhanced learning (ARVEL) method was developed. In addition, an experiment was conducted to see how the applied strategy affected students' EFL learning outcomes. The ARVEL technique greatly improved the students' learning successes and intrinsic motivation, as well as their happiness with EFL learning, when compared to those studying EFL using traditional video-based learning.

Another research by Moe et al. (2018) examined the impact of perceived parental autonomy-supportive scaffolding on children's autonomous motivation, self-efficacy, affect, and homework involvement in two studies. The results of study one showed that the more autonomous motivation a parent had when scaffolding for motivation, their children regarded them as more autonomy-supportive, resulting in increased autonomous motivation, self-efficacy, and assignment involvement among the children. The lesson lowered parental dissatisfaction, prevented kid dissatisfaction from growing, and kept students motivated at school. The results showed that scaffolding is an important construct in the development of learning behaviour.

In an e-learning environment Valencia-Vallejo et al. (2018) explored the effect of motivational scaffolding on self-efficacy and learning accomplishment among students with distinct cognitive styles in the Field Dependence/Independence (FDI) dimension. The study employed a two-group experimental design. One group of the students worked in an e-learning environment with motivational scaffolding built in, while the other group worked in a computational environment without it. The influence of scaffolding was found to be responsible for significant disparities in learning achievement and academic self-efficacy. Furthermore, engagement with the computational environment was discovered to negate the impact of cognitive style learning behaviour.

Scaffolding's impact on game-based learning settings has been studied before, with variable findings. Cai et al. (2020) carried out a meta-analysis to investigate in digital game-based learning (DGBL), the role of scaffolding. To deal with data non-dependency difficulties of multi-effect sizes, the study adopted a 3-level meta-analysis procedure. The results showed that scaffolding in DGBL can help people learn, although there was a lot of variation across trials. Furthermore, studies with primary and university students showed larger scaffolding effect sizes than studies with secondary school students. Scaffolding is also shown to function differently in different types of games, with adventure, puzzle, and simulation games outperforming role-playing and strategic games.

In the African context, there is a scarcity of literature on the relationship between scaffolding and achievement motivation for learning chemistry. However, there is documented literature on the influence of scaffolding on academic achievement. Enyew and Yigzaw (2015) demonstrated that scaffolding reading strategy is effective in improving students reading ability. Mugambi and Wangeri (2014) carried out a study to investigate peer teaching as a predictor of reading motivation and literacy achievement among standard two pupils. The findings revealed that peer teaching predicted reading motivation. The findings also showed that reading motivation did not predict reading achievement among learners. The findings contradicts earlier studies and the sample used

consisted of primary school children. The current study investigated the extent to which academic scaffolding is related to achievement motivation for learning chemistry using a sample of secondary school students to bridge the gap.

## V. METHODOLOGY

The researcher used convergent parallel mixed research design to examine the relationship between the study variables. In this design, both quantitative and qualitative data are collected, analyzed and then the results are compared to see if they answer the research questions the same way (Creswel & Creswell, 2018). Questionnaires and interview schedule were used to collect data that were used to address the research issue.

The target population was 284 public secondary schools with 10528 form three students taking chemistry in the year 2020. This study used purposive sampling, stratified, proportionate and simple random sampling techniques to collect data. Using Slovin's (1960) formula, a sample size of 395 students was obtained from a target population of 20528 form three students.

Sample size was obtained using Slovin's (1960) formula; $n = \frac{N}{1+N(e)^2}$ where N is the target population and e is the margin of error (0.05).

$$n = \frac{28400}{1+28400(0.05)^2} = 395$$

To take care of non-response and attrition, the sample size was increased by 11% as recommended by Draugalis et al. (2008). Therefore, the sample size was 440 students. Qualitative data were collected from 30 students. Creswell and Creswell (2018) recommends that a sample size of 30-50 is large enough in a qualitative study.

The researcher used academic scaffolding scale with 19 items to measure academic scaffolding. This scale consists of three domains namely; instructional scaffolding, planned scaffolding and interactional scaffolding. Self-constructed interview schedule was used to collect qualitative data that was used to complement quantitative data. Student's Motivation towards Science Learning Questionnaire (SMTSL) was used to collect data on achievement motivation for learning chemistry. This questionnaire was developed by Tuan et al. (2005).

Data were obtained from the respondents through administering of questionnaires and interviewing. Data analysis was done using three methods; descriptive statistics, inferential statistics and thematic analysis. Descriptive statistics (frequencies, means and standard deviation) and inferential statistics (Pearson's product moment correlation and multiple regression) were used in analysis of quantitative data. Analysis of qualitative data involved grouping the responses into themes and sub themes, development of executive functioning skills, academic scaffolding and achievement motivation for learning chemistry rubric.

## VI. FINDINGS

### *6.1 Descriptive Statistics for Academic Scaffolding Scores*

Table 1 presents the descriptive statistics for academic scaffolding by gender.

Table 1 Descriptive Statistics for Academic Scaffolding by Gender

| Gender | N | Range | Min | Max | M | SD | Sk | Kur |
|---|---|---|---|---|---|---|---|---|
| Male | 174 | 64 | 28 | 92 | 68.45 | 11.71 | -0.41 | 0.25 |
| Female | 164 | 53 | 35 | 88 | 64.78 | 11.58 | -0.65 | 0.03 |
| Total | 338 | 64 | 28 | 92 | 67.53 | 11.67 | -0.52 | 0.16 |

Note. M = Mean SD= Standard deviation; Sk = Skewness; kur= kurtosis

The mean score of male students was 68.45 (*SD* = 11.71). The minimum score was 28 while the maximum score was 92 with a range of 64. Female students scored a mean of 64.78 with a standard deviation of 11.58. The minimum score was 35 while the maximum score was 88 with a range of 53. The results indicate that academic scaffolding was better among male students compared to female students.

Academic scaffolding questionnaire consisted of three sub scales and the descriptive statistics for the scores in each sub scale are presented in Table 2.

Table 2 Descriptive Statistics for the Types of Academic Scaffolding

| Type of Academic Scaffolding | M | SD | Sk | Kur |
|---|---|---|---|---|
| Instructional | 39.91 | 8.07 | -0.70 | 0.48 |
| Planned | 13.75 | 3.40 | -0.32 | -0.30 |
| Interactional | 13.88 | 3.41 | -0.34 | -0.41 |

Note.M = Mean; SD = Standard deviation; Sk = Skewness; kur = kurtosis; N=

The mean score on instructional scaffolding sub scale was 39.91 (*SD* = 8.07). On planned scaffolding sub scale, the mean score was 13.75 with a standard deviation of 3.4. The mean score on interactional scaffolding sub scale scores was 13.88 (*SD* = 3.41).

Table 3 Descriptives of Achievement Motivation

| Gender | *N* | Min | Max | Range | *M* | *SD* | *Sk* | *Kur* |
|---|---|---|---|---|---|---|---|---|
| Male | 174 | 53 | 116 | 63 | 97.48 | 13.67 | -0.23 | 0.47 |
| Female | 164 | 52 | 116 | 54 | 95.06 | 12.55 | -0.63 | 0.45 |
| Total | 338 | 52 | 116 | 64 | 96.30 | 13.18 | -0.37 | 0.51 |

Note.N=338; Min- Minimum; Max-Maximum; M-Mean; SD-Standard deviation; Sk-Skewness; Kur – kurtosis

The mean score of male respondents was 97.48 with a standard deviation of 13.67. Female students had a mean score of 95.06 with a standard deviation of 12.55. The results show that male students had a higher mean than female students. The scores for both male and female respondents ranged from 52 to 116.

### *6.2 Hypothesis Testing*

The main objective of this study was to find out the relationship between academic scaffolding and achievement motivation for

learning chemistry. To achieve this, the following hypothesis was advanced.

$H_0$ There is no significant relationship between academic scaffolding and achievement motivation for learning chemistry. The hypothesis was tested using Pearson correlation analysis and the results are presented in Table 4.

Table 4 Correlation between Academic Scaffolding and Achievement Motivation

| | | Achievement Motivation |
|---|---|---|
| Academic Scaffolding | Pearson Correlation | .50* |
| | Sig. (2-tailed) | .00 |
| | N | 338 |

The results indicate that there was a moderate positive and statistically significant correlation between academic scaffolding and achievement motivation for learning chemistry, $r$ (336) = .50, $p$ < .05. Based on the results, the null hypothesis was rejected. The findings suggest that high academic scaffolding is associated with high levels of achievement motivation for learning chemistry. Further analysis of the correlation between the types of academic scaffolding and achievement motivation for learning chemistry was conducted. The following supplementary hypotheses were tested.

$H_{0.1}$ There is no significant relationship between interactional scaffolding and achievement motivation for learning chemistry.

$H_{02}$ There is no significant relationship between planned scaffolding and achievement motivation for learning chemistry.

$H_{03}$ There is no significant relationship between instructional scaffolding and achievement motivation for learning chemistry.

The results are presented in Table 5.

Table 5 Correlations between Types of Academic Scaffolding and Achievement Motivation

| Type of Academic Scaffolding | | Achievement Motivation |
|---|---|---|
| Instructional Scaffolding | | .48* |
| Planned Scaffolding | | .35* |
| Interactional Scaffolding | | .22* |

Note. N =338; *P< .05

The results indicate that there was a moderate positive correlation between instructional scaffolding and achievement motivation for learning chemistry, $r$ (336) = .48, $p$ < .05. The correlation was statistically significant. There was a weak positive correlation between interactional scaffolding and achievement motivation for learning chemistry, $r$ (336) = .22, $p$ < .05. The correlation was statistically significant. Planned scaffolding and achievement motivation for learning chemistry had a moderate positive and statistically significant correlation, $r$ (336) = .35, $p$ < .05. Based on the results, all the three supplementary hypotheses were rejected. The study concluded that an increase in planned scaffolding, interactional scaffolding and instructional scaffolding leads to an increase in achievement motivation for learning chemistry.

Academic scaffolding was divided into two levels; insufficient scaffolding and sufficient scaffolding. To establish if students with different academic scaffolding differed significantly in achievement motivation for learning chemistry, the researcher conducted independent samples t-test. The results of level of academic scaffolding and achievement motivation for learning chemistry are presented in Table 6.

Table 6 Group Statistics for Levels of Academic Scaffolding

| Levels | | N | M | SD | SE |
|---|---|---|---|---|---|
| | Insufficient | 256 | 63.07 | 9.60 | .60 |
| | Sufficient | 82 | 81.45 | 4.14 | .46 |

As indicated in Table 6, it was established that the mean score difference in achievement motivation for learning chemistry among students who reported different levels of academic scaffolding was statistically significant. The findings support the correlation analysis results which showed that there was a significant positive relationship between academic scaffolding and achievement motivation for learning chemistry. As such, it was expected that respondents who reported sufficient levels of academic scaffolding had higher levels of achievement motivation for learning chemistry compared to respondents who reported insufficient levels of executive functioning skills. To establish if this difference in achievement motivation for learning chemistry between students who reported sufficient academic scaffolding and those who reported insufficient academic scaffolding was significant, the data were subjected to independent samples $t$ test and the results are presented in Table 7.

Table 7 Independent Samples T Test

| | | $t$ | $df$ | Sig. (2-tailed) | Mean difference |
|---|---|---|---|---|---|
| Academic Scaffolding | Equal variances assumed | -16.82 | 336 | .00 | -18.38 |
| | Equal variances not assumed | -24.36 | 309 | .00 | -18.38 |

*Note.* $N$ = 338

The results obtained showed that there was a statistically significant difference in achievement motivation for learning chemistry among students who reported sufficient academic scaffolding and those who reported insufficient academic scaffolding, $t$ (336) = -16.82, $p$< .05. Therefore, students who were sufficiently supported in learning chemistry had high achievement motivation for learning chemistry.

Academic scaffolding consisted of three levels; instructional scaffolding, planned scaffolding and interactional scaffolding. Since the study found that there was a significant and positive relationship between the sub scales of academic scaffolding and achievement motivation for learning chemistry, there was

need to investigate how the sub scales predict achievement motivation for learning chemistry. To achieve this, multiple regression analysis was used and the results are presented.

Table 8 Model Summary for Academic Scaffolding and Achievement Motivation

| Model | R | R Square | Adjusted R Square | SE |
|---|---|---|---|---|
| 1 | .50[a] | .25 | .24 | 11.46 |

Note.N = 338; Outcome variable = achievement motivation; predictor variables = planned scaffolding, instructional scaffolding, interactional scaffolding.

The results presented in Table 8 indicate that planned scaffolding, instructional scaffolding and interactional scaffolding moderately predicted achievement motivation for learning chemistry, *R* = .50. *R* square was .25 which suggested that 25% variance in achievement motivation for learning chemistry can be explained by academic the three types of academic scaffolding (planned, instructional and interactional). To stablish if the types of academic scaffolding significantly predicted achievement motivation for learning chemistry, ANOVA was conducted and the results are presented in Table 9.

Table 9 ANOVA Summary for the Types of Academic Scaffolding

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 14688.59 | 3 | 4896.20 | 37.30 | .00[b] |
| | Residual | 43845.02 | 334 | 131.27 | | |
| | Total | 58533.61 | 337 | | | |
| Note. N = 338<br>a. Dependent Variable: Achievement motivation | | | | | | |
| b. Predictors: (Constant), Interactional, Planned, Instructional | | | | | | |

Table 9 shows that interactional scaffolding, planned scaffolding, and instructional scaffolding significantly predict achievement motivation for learning chemistry. Further, analysis was conducted to establish the predictive weights of the types of academic scaffolding on achievement motivation for learning chemistry. The results are presented in Table 10.

Table 10 Regression Coefficients of the Types of Academic Scaffolding

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | ß | SE | Beta | | |
| 1 | (Constant) | 58.93 | 3.77 | | 15.63 | .00 |
| | Instructional | .63 | .09 | .39 | 6.55 | .00 |
| | Planned | .44 | .22 | .11 | 1.97 | .04 |
| | Interactional | .43 | .19 | .11 | 2.32 | .02 |
| Note. N = 338<br>a. Dependent Variable: Achievement motivation | | | | | | |

As shown in Table 10, instructional scaffolding had a positive and significant predictive value on achievement motivation for learning chemistry, ß = 0.63, $p < .05$. The results also indicated that planned scaffolding had a positive and significant predictive weight on achievement motivation for learning chemistry, ß = 0.44, $p < .05$. Interactional scaffolding was also found to have a positive and significant predictive value on achievement motivation for learning chemistry, ß = 0.43, $p < .05$.

Using the regression coefficients obtained, the following regression equation was developed.

$$\tilde{y} = 58.93 + 0.63X_1 + 0.44X_2 + 0.43X_3, P < .05$$

Where $\tilde{y}$ = Predicted achievement motivation for learning chemistry, $X_1$ = Instructional scaffolding, $X_2$ = Planned scaffolding $X_3$ = Interactional scaffolding.

Based on the results presented in the regression equation, a unit change in instructional scaffolding leads to 0.63 change in achievement motivation for learning chemistry. A unit change in planned scaffolding is associated with 0.44 change in achievement motivation for learning chemistry. The regression equation also indicate that a unit change in interactional scaffolding leads to 0.43 change in achievement motivation. From the results, instructional scaffolding had the highest predictive weight on achievement motivation for learning chemistry followed by planned scaffolding. Interactional scaffolding had the least predictive value on achievement motivation for learning chemistry. The results imply that adequate preparation and planning for a chemistry lesson greatly enhance students' achievement motivation for learning chemistry.

*6.3 Qualitative Data Results on Academic Scaffolding*

Table 11 shows the coding in academic scaffolding.

Table 11 Coding in Academic Scaffolding

| Academic Scaffolding Levels | String |
|---|---|
| Interactional | Other students and school environment influence chemistry performance |
| Planned | Teacher preparation |
| Instructional | The role the teacher plays to influence performance in chemistry |

The study aimed to establish the relationship between academic scaffolding and achievement motivation for learning chemistry. To complement quantitative data, the researcher collected qualitative data on academic scaffolding in learning chemistry. The sampled students were given random names to conceal their identity. Therefore, names used in the presentation of the findings are not their real names of the students.

Concerning instructional scaffolding, the students were asked to discuss ways through which chemistry teachers influence their performance and the responses were as follows:

Jane: "She gives me the drive of wanting to know more."

Mike: "By his teaching skills, some tell it like the story."

The different responses provided indicate that teachers play a significant role in supporting students to learn chemistry. To begin with, teachers enable students to learn chemistry by continuously urging them to put more effort in order to

understand the concepts more. This kind of support is called interactional scaffolding and it helps the students to develop a positive attitude towards chemistry. Moreover, the other type of support noted from the responses is instructional scaffolding. It entails the teaching methods and approaches used; indicated by the response 'some teachers pass chemistry knowledge like a story.' A study by Peleg et al. (2017) on teachers' perceptions of teaching chemistry through story telling technique indicates that the method was effective in teaching the subject. This is because the technique creates memory cues that enhance recall of the learnt information.

Furthermore, some participants said that chemistry teachers set challenging exams as a way of planned scaffolding so that the students can dedicate more time to study the subject. Jedi was asked how teachers support them in learning chemistry and the response was, "setting challenging exams and pressure from them to score more in the subject." Hirschman (2017) notes that challenging examination makes students to seek more clarification from the teachers and actively participate in the learning process to avoid low scores. It was also noted that pressure from the teachers pushes the students to put more effort in learning chemistry. This is in line with Malmberg and Martin (2019) who indicates that high academic expectations makes students to work harder.

One of the participants said that teachers' encouragement made him like the subject even though he was not performing well. Cyrus was requested to explain how teachers support him in learning chemistry and he replied, "He encourages me and tells me that I am a very bright student. He tells me to work hard and he is never disappointed with me as long as I have worked hard. He makes me happy when he motivates me by writing," keep it up", and "good work" in my extra workbook." From the participant's response, chemistry teachers encourage students to work harder to avoid disappointment. This indicates that to some extent chemistry teachers provided instructional and interactional scaffolding. This makes students to develop more interest in learning chemistry. Landrum and Sweigart (2014) concurs that teachers praise is a great motivating factor that enhances learning among students. Based on the analysis of the qualitative data, academic scaffolding was done to a moderate extent which corroborates the results of quantitative data.

Regarding the influence of the teacher on chemistry need to succeed in the subject, Jane responded that "I don't think teachers influence my desire to succeed in the subject. This is because many a times I fail because of lack of concentration in class and excessive anxiety during exams. Jane's response suggests that academic scaffolding by itself does not enhance the desire to succeed in chemistry. On the influence of other students on the desire to learn chemistry, Joan said, "Yes it does but to some extent. This is because my friends sometimes help me to understand some concepts. Somehow they influence my interest and performance in the subject." Joan's response indicates that interactional scaffolding plays a role in the desire to learn chemistry.

Mark's response on whether other students influence their desire to perform well in chemistry was, "Yes they do because they have a negative attitude towards chemistry. If I need help in chemistry they always say "I don't know." They say so even before reading the questions. I only depend on my teacher." This student's response clearly shows that even though some students fail to get assistance from their classmates, the teacher is always available to help. Jedi gave similar response, She said, "Yes because they keep on insisting chemistry is hard which demotivates me a lot."

From the above it is true that teachers as well as other students can affect achievement motivation in chemistry. Even though teachers provide instructional, planned and interactional scaffolding, some students would still not concentrate in class. Moreover, it was found that most students have developed a negative attitude towards chemistry and they influence each other negatively that the subject is hard. The below average performance in chemistry can be attributed to low achievement motivation for learning chemistry inferred from the students' responses. This includes, students' negative attitude towards the subject and lack of interest in the subject.

Regarding achievement motivation for learning chemistry, Mikes' response on whether they have what it takes to do well in chemistry was, "Yes, chemistry is an interesting subject that makes you want to know more things that you never knew. The teacher has a simple way of teaching chemistry that makes it more interesting. Our teacher goes an extra mile to give us questions, CATS to help us understand and improve in the subject." The response provided indicates that the teacher provides academic scaffolding and the student employs executive functioning skills. This enables the student to develop interest in learning and performance in the subject. Samson et al. (2018) argue that scaffolding through continuous assessment of students can help to improve academic performance. This demonstrates the importance of academic scaffolding in learning processes such as achievement motivation and its impact on learning outcomes.

Mike indicated that he feels bad when he performs poorly in chemistry compared to his friends. He said, "I feel bad and get the urge to work hard and pass like them. That makes me put extra effort in order to pass in chemistry like them." Mike's response indicates that he has the performance goal orientation in learning chemistry. Interactional scaffolding was evident when Mike said that he is motivated to perform like other students. Dan was asked how he feels when he did not perform well in chemistry compared to his previous performance. He replied, "I feel bad but tell myself am better than those I defeated." This indicates that interactional scaffolding impacts on achievement motivation and performance in chemistry.

The researcher collected qualitative data with the aim to answer the question, how does academic scaffolding help the student in achievement motivation for learning chemistry? Qualitative findings showed that academic scaffolding played a role in enhancing achievement motivation for learning chemistry among the students. The findings were consistent

with quantitative results which show a significant positive relationship between academic scaffolding and achievement motivation for learning chemistry.

*6.4 Discussion of the Results*

The present study found that there was a positive and significant relationship between academic scaffolding and achievement motivation for learning chemistry. The results demonstrate that academic scaffolding is an important construct in learning. The results support past research on the role of academic scaffolding in learning and educational attainment. The findings are in agreement with the results of Murdiyani (2013) in a study that investigated the role of scaffolding in mathematics performance. The researcher demonstrated that the support that students get from teachers has an impact on mathematics performance. The results showed that the learning support that students get from the teachers demystifies abstract concepts which gradually gives students autonomy resulting in better motivation in academic achievement.

The results of the current study corroborate the findings of Sutiarso et al. (2018) who established that media scaffolding improved understanding of mathematics concepts. Even though the study did not investigate achievement motivation for learning, Sutiarso et al. associated improvement in understanding of geometry concepts to enhanced persistence to complete tasks in geometry. Some of the characteristics of achievement motivation for learning include; persistence, resilience and attitude of cooperation. This indicates that academic scaffolding is an important aspect for achievement motivation. The results also support the theoretical perspective that academic scaffolding is an effective method in managing the dynamic classroom environment to enhance learning. Constructivism theorists argue that academic scaffolding helps students in learning abstract concepts which are mostly found in mathematics and science subjects. However, there has been a missing link between academic scaffolding, motivation for learning and learning outcomes. The results of the present study bridge the gap that has been existing and therefore opening new research opportunities on how academic scaffolding improves learning outcomes through achievement motivation.

The results of the present study corroborate the results of Pol et al. (2015) on the effect of scaffolding on student achievement. Pol et al. focused on support the students get from teachers, independent working time and their effect on student achievement. The results indicated that varying scaffolding time affected student achievement differently. It was also found that scaffolding was associated with increase in task effort. Even though the study did not directly investigate the effect of academic scaffolding on achievement motivation, increase in task effort suggests that the student is highly motivated to accomplish learning tasks.

Other studies have also established that academic scaffolding particularly teacher reinforcement increases students' effort to accomplish academic tasks (Bicard et al., 2012). The results suggest that when teachers support students in learning, the students learn the steps to follow to produce expected learning outcomes. Academic scaffolding enhances students' motivation because teachers support gives students confidence and direction on the path to be followed to achieve learning objectives. Additionally, in the process of academic scaffolding, the teacher is able to diagnose learning challenges and take remedial action. Through this support, the students and able to appreciate the work of teachers and the value of education which results to high task commitment.

## VII. CONCLUSIONS

The study found that there was a positive and significant relationship between academic scaffolding and achievement motivation for learning chemistry. It was established that instructional scaffolding had the highest correlation coefficient with achievement motivation followed by planned scaffolding. Interactional scaffolding was found to have the lowest correlation coefficient. The results suggest that academic scaffolding is an important construct that influence achievement motivation for learning chemistry. The results imply that for teachers to enhance achievement motivation for learning chemistry, it is important to support the students in the learning of chemistry through adequate lesson preparation and use of teaching aids.

## VIII. RECOMMENDATIONS

The results of the study showed that there was a positive and significant relationship between academic scaffolding and achievement motivation for learning chemistry. Based on the results, the study recommends that chemistry teachers should always strive to use effective teaching methods to enhance achievement motivation for learning chemistry among students. School counsellors should also develop guidance and counseling activities to empower chemistry students with skills to overcome negative peer pressure that affect achievement motivation for learning chemistry.

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