

Extrinsic Motivation Beliefs as Predictor of Students' Achievement in Chemistry in Public Secondary Schools in Kenya

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Abstract The present study investigated the extent to which extrinsic motivation beliefs predicted academic achievement in chemistry among students in public secondary schools in Kenya. The study was guided by Eccles-Wigfield's Expectancy-Value theory of motivation. Concurrent embedded design was used in the study. Both Stratified random sampling and purposive sampling techniques were used to select 351 form four students, 10 chemistry teachers and 10 guidance and counseling teachers who participated in the study from the 26 sampled schools in Rachuonyo South sub County, Homa Bay County, Kenya. Questionnaires and interview schedules were used for data collection. Quantitative data was analyzed both descriptively and inferentially while qualitative data was analyzed using thematic analysis. The finding of the study showed that there was statistically significant, though weak, positive correlation ($r=.274$, $n=308$, $p<.05$) between extrinsic motivation beliefs and chemistry academic achievement and extrinsic motivation accounted for only 7.5% (R Square $=.075$) of the variation in performance in chemistry in KCSE exams. Based on findings, the study recommended that for the purposes of enhancement of motivational beliefs like extrinsic motivation, school principals should arrange for workshops and seminars for chemistry teachers to help chemistry teachers develop skills which are essential for helping students enhance such motivational beliefs. This is because extrinsic motivation beliefs had positive, though weak relationship with chemistry academic achievement.

Keywords Extrinsic motivation beliefs, Chemistry achievement, Secondary school students, Kenya

1. Introduction

Chemistry is a science subject that is concerned with the study of composition and properties of natural substances and plays an outstanding function in the nation's economic growth. Consequently, there is emphasis on the promotion of Science as the means for achieving technological development in the world at large since it plays a pivotal role in science and technology and is needed in every aspect of human endeavor (Olayemi, 2009). Like any other intellectual discipline, it provides the means by which the individual can organize his or her concepts and attitudes, classify experiences and communicate with others (Wellington, 1989). According to Webster (2009), as much as chemistry is a science that underpins most of the science discoveries of 20th century and still doing so in the 21st century, chemistry subject has had low rates of students' success which has

resulted to limited access to science fields. Glynn, Tassoobshirazi and Brickman (2009) study in USA reported that university students with lesser motivation in science courses had lower performance in sciences. In Turkey, Ahmet and Kurbanoglu (2010) noted that chemistry achievement level of students was still low. In order to develop interest, curiosity, positive attitudes towards chemistry, creativity and problem solving ability another study in Turkey by Azizoglu and Uzintiryaki (2006) also noted that laboratory activities were essential and that could motivate students to learn. Still in Turkey, Ahmet and Kurbanoglu (2010) reiterated that self-efficacy beliefs had negative prediction on chemistry laboratory anxiety and that there is direct positive effect of Self-efficacy on chemistry attitude which affected chemistry laboratory anxiety. In addition, Kadioglu and Uzuntiryaki (2008) in Turkey add that intrinsic motivation, self-efficacy and test anxiety were major determinants of chemistry achievement.

In Nigeria, performance in chemistry subject has been very dismal in spite of the central position it played and its importance in sustaining economic growth and development and that the poor performance in chemistry was responsible for the slow pace of scientific and technological development in Nigeria (Titilayo, Oloyede & Adenkule 2016,

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Mbina, 2012). A number of studies have been done in Nigeria to find out the causes of poor performance in chemistry. Olayemi (2009) attributed the poor performance to a number of factors including lack of facilities, teachers' non-dedication to work, lack of interest in chemistry on the students side.

In order to improve students' academic achievement in sciences, educational psychologists, educational experts, curriculum developers, and science teachers have continuously investigated both environmental and personal variables that can be manipulated so as to improve academic gains. In addition to the factors and causes mentioned in literature that influence achievement, there are additional factors that can influence educational achievement such as cognitive ability and strategies, personality traits and motivation which are psychological factors in broader view. A psychological variable that attention has been paid to by educational researchers in the area of learning achievement is motivation. Motivation is as a driving force behind actions of a person that influences one's desires and needs which can impact strongly on the direction of a person (Glynn & Koballa, 2006). Motivation drives and sustains behaviors and learners need to be motivated to learn hence motivation is considered one of the most important components of learning in any educational environment. Schunck, Pintrich and Meece (2008) add that motivation is a process through which goal-oriented activity is initiated and sustained. Motivated learners enjoy learning science, take responsibility for their learning and trust their capability to learn (Sanfeliz & Stalzer, 2003). Britner and Pajares (2006) in USA reported in their research that motivation strongly predicted achievement in science.

Extrinsic motivation is engaging in a task so as to get external reward (Covington, 2000). Extrinsic motivation orientation sustains and drives behavior when individuals or learners complete tasks to get an external reward (Walker et al., 2006). According to Dev (1997), extrinsically motivated learners engage in learning purely for the sake of attaining reward or to avoid punishment. Lepper (1988) asserts that students who are extrinsically motivated incline toward tasks that are low in level of difficulty and are prone to put forth the minimal amount of effort necessary to get the maximal reward and that they usually drag themselves with academic tasks and assignment, feel forced to learn and they always put minimal efforts to achieve maximum appreciations. Levesque, Copeland, Pattie and Deci (2011) posits that externally regulated behaviors are only undertaken by learners in the presence of specific external rewards and that learners may not remain engaged in an activity, or can in the end quit or desert the activity, or may not be able to persist when the task becomes more difficult in the absence of specific external rewards.

A study by Lee, Hayes, Sietz, Distefano and O'connor (2015) in USA showed that there was no significant relationship between extrinsic motivation and both engagement and science achievement. In a nother study in Sweden by Sweden by Nilson (2016) that sought to

determine the relationship between students' achievement in biology and selected motivational variables, it was reported that there was a significant positive correlation between students' biology achievement and extrinsic motivation.

In Liberia, a study by Gbollie and Harriet was conducted to establish the role of motivation and strategy and perceived factors hindering academic achievement among junior and senior secondary school learning. The study findings indicated that there was a negative correlation between extrinsic motivation and academic achievement. A study in Kenya by Owino, Yungungu, Ahmed and Ogola (2015) on motivation and performance in KCSE biology subject in selected secondary schools in Nyakach District, Kisumu County indicated that there was a positive relationship between motivation and achievement in biology.

In Kenya, as much as most people in our society recognize and appreciate the essential role of chemistry in everyday life, it remains one of the poorly performed subjects in KCSE national examinations (Ongeri, 2012). Numerous studies in Kenya have been carried out to find out the reasons for the existence and persistent occurrence of low performance in chemistry subject in secondary schools. Attitude of learners towards chemistry, students' self-efficacy beliefs, inappropriate learning environment, shortage or total absence of trained chemistry teachers, inadequate learning facilities have also been cited as other possible factors that could be contributing to poor performance in chemistry in Kenya (Oluoch, 2013; Ogembo, 2013). Teacher related factors like teaching methods employed by the teachers, teachers' personal level of skills and knowledge of the subject matter in chemistry, teachers' attitude towards chemistry have also been cited as some of the factors contributing to poor performance in chemistry (Ogembo, 2013; Chepkorir, Cheptonui & Chemutai, 2014). However, there is very little literature on possible correlation between extrinsic motivation beliefs and achievement in chemistry in Kenya more so in Rachuonyo South Sub-County.

Data available indicates that chemistry performance in Kenya among secondary school students has persistently been low over the years at school, sub-county and national level.

Table 1. Comparison between academic performance in chemistry and other sciences in Rachuonyo South sub-County

Year	Subject		
	Physics	Biology	Chemistry
2012	6.431	4.813	4.141
2013	7.231	5.709	4.338
2014	6.613	5.849	5.147
2015	7.017	6.336	4.740
2016	6.461	4.610	4.457
2017	5.123	3.162	3.434
Average Mean	6.479	5.088	4.374

Source: Sub-County Director of Education Office, Rachuonyo South, 2018

Table 1 shows the sub- county chemistry mean performance in comparison to other science subjects. In the year 2012 the candidates managed a mean of 4.141 which translates to a grade D plus which was below Biology mean of 4.813. The mean achievement in chemistry has been fluctuating and rising at a slow rate in the sub county. Most of science oriented courses at diploma level require that a student must have scored at least a mean grade of C plain (Above 5.00) and evident from the performance trends it therefore implies that most students from Rachuonyo South sub-County are disadvantaged. In the year 2017, there was a drastic drop in performance of the three science subjects in the entire five sub Counties of Homa Bay County. Notably, Chemistry was above Biology subject. However, on overage for the years 2012-2017, the mean score for chemistry still was the lowest.

1.1. Statement of the Problem

One of the major millennium goals in Kenya is to be industrialized by year 2030. One of the ways for the vision 2030 to be achieved is by promoting science subjects in secondary schools of which chemistry is one of the core science subjects. Of all the sciences, chemistry performance both at school and national level has remained persistently low. In spite of the hard work made by researchers to improve chemistry performance in Kenya, data indicates that Rachuonyo South Sub-County has been recording comparatively lower academic performance in chemistry among the sub-counties of Homa-Bay County.

While there are previous studies, particularly in Kenya which have focused on other factors that influence students' academic achievement in chemistry like attitude towards Chemistry by students, teachers' attitude towards learners' abilities, insufficient teaching and learning resources, and unsuitable teaching methodologies, many students still perform poorly in chemistry.

A good number of the studies in Chemistry learning have paid attention to aspect of student cognition. In classroom learning, the process of cognition is determined and influenced by affective factors. Among the affective factors, motivation is identified to play an important role in process of cognition yet from the aforementioned background to the study, studies that incorporate motivational beliefs and chemistry achievement are scarce in Kenya. Based on this premise, the current study therefore was geared towards determining the extent to which extrinsic motivation beliefs predicted academic achievement in chemistry among secondary school students in Rachuonyo South sub-County, Kenya.

2. Research Methodology

The study used concurrent embedded design based on the mixed method approach whose characteristic is collection, analysis and integration of both quantitative and qualitative research methods within a single research study in order to

answer research questions. Its purpose is collection of both quantitative and qualitative simultaneously but with one form of data playing a supportive role to the other form of data. The reason for collecting the second form of data was to support the quantitative data (Creswell, 2014). The study targeted all the 3822 form four students of the year 2017 in the 79 public secondary schools, 101 chemistry teachers and 79 guidance and counseling teachers in Rachuonyo South Sub-county. Using stratified random sampling and purposive sampling techniques, 351 form four students, 10 chemistry teachers and 8 Guidance and counseling teachers were sampled for the study. Data collection instruments included questionnaires, for quantitative data and interview schedules for one to one interview with respondents.

Items to measure extrinsic motivation was adapted from chemistry motivation questionnaire (CMQ) previously used by Glynn and Koballa (2006). It was suitable because it was previously used to study chemistry motivation. In using the CMQ for these study, the items from the extrinsic beliefs to be studied were rephrased to specifically to align to Kenyan educational context to ensure that the students participants understand the survey item and respond appropriately and also to suit secondary school chemistry for it was previously used in college chemistry. The questionnaire had ten items for extrinsic motivation orientation and was based on a five point scale Likert scale ranging from strongly disagree to strongly disagree with ratings as: 1= Never, 2= Rarely, 3=Sometimes, 4=Often and 5=Always. The scale ranged between 10-50 with lowest scale being 10 depicting low extrinsic motivation beliefs while 50 depicted highest extrinsic motivation orientation.

To ensure that data collection instrument was valid, the instruments were pre-tested in 8 schools which were not involved in the actual study. Experts from department of Psychology and Educational Foundation of Jaramogi Oginga Odinga University of Science and Technology were consulted about the content validity of the instrument. Internal consistency technique was used to establish the reliability of the instruments and Cronbach alpha reliability coefficient of above 0.7 was obtained. Quantitative data was analyzed both descriptively and inferentially while qualitative data was analyzed using thematic analysis.

3. Findings and Discussion

To investigate whether there was any statistical significant relationship between intrinsic motivation and student achievement in Chemistry among form four students, the null hypothesis was tested. The hypothesis was state:

Ho: There is no statistically significant relationship between extrinsic motivation and student achievement in Chemistry in Rachuonyo South Sub-County, Kenya

To do this, a Pearson Product Moment Correlation Coefficient was computed, with scores on extrinsic motivation as the independent variable and academic

achievement in chemistry as dependent variable. The level of intrinsic motivation was computed from frequency of responses and converted into continuous scale, where high scale ratings implied high perceived level of extrinsic motivation and vice-versa. Achievement in chemistry for each respondent was obtained from the 2017 KCSE results. The significant level (p-value) was set at .05. If the p-value was less than 0.05, the null hypothesis would be rejected and conclusion reached that a significant difference does exist. If the p-value was larger than 0.05, it would be concluded that a significant difference does not exist. Table 2 shows the correlation analysis results output.

Table 2. Relationship between the level of Extrinsic Motivation and Chemistry Academic Achievement

		Chemistry Academic Achievement	Extrinsic Motivation
Chemistry Academic Achievement	Pearson Correlation	1	.274**
	Sig. (2-tailed)		.000
	N	308	308
Extrinsic Motivation	Pearson Correlation	.274**	1
	Sig. (2-tailed)	.000	
	N	308	308

**. Correlation is significant at the 0.05 level (2-tailed).

From Table 1, the finding of the study showed that there was statistically significant, though weak, positive correlation ($r=.274$, $n=308$, $p<.05$) between Extrinsic Motivation and Chemistry Academic Achievement, with high level of extrinsic motivation associated to better performance in chemistry among the form four students and vice-versa. Given that the relationship was statistically significant, the hypothesis that, "*there is no statistically significant relationship between extrinsic motivation and chemistry academic achievement among the form four students*" was rejected. Therefore, it was concluded that there is statistically significant positive relationship between Extrinsic Motivation and Chemistry Academic Achievement among form four students.

The findings of the study concur with the findings of Zhang *et al.* (2017) reported that extrinsic motivation had a direct effect over learning strategies and it has statistically significant positive relationship. Haider *et al.* (2015) study reported a positive relationship between extrinsic motivation and academic performance. Similarly, Owino *et al.* (2015) finding is in agreement with the present study which indicated a positive relationship between extrinsic motivation and academic achievement in Biology.

Similarly, the study sought to estimate the level of influence of Extrinsic Motivation on Chemistry Academic Achievement. This was done by use of regression analysis to compute a coefficient of determination and results shown in Table 3.

Table 3. Model Summary on Regression Analysis of Influence of Extrinsic Motivation Beliefs on Chemistry Academic Achievement

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.274 ^a	.075	.072	.66134

a. Predictors: (Constant), Extrinsic Motivation

Table 3 shows the result of regression analysis. The model summary reveals that the level of extrinsic motivation accounted for only 7.5% (R Square =.075) of the variation in performance in chemistry in KCSE exams among the form four students. This finding means that variation in academic achievement in chemistry test is 7.5% explained by the variability level of extrinsic motivation among the form four students. However, to determine whether extrinsic motivation was a significant predictor of academic achievement among the form four students, Analysis of Variance (ANOVA) was computed as in Table 4.

Table 4. ANOVA –Influence of Extrinsic Motivation beliefs on Chemistry Academic Achievement

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	10.839	1	10.839	24.783	.000 ^b
1 Residual	133.833	306	.437		
Total	144.673	307			

a. Dependent Variable: Chemistry Academic Achievement

b. Predictors: (Constant), Extrinsic Motivation

From Table 4, it is clear that Extrinsic Motivation beliefs was a significant predictor of Chemistry Academic Achievement among the secondary school students $F(1, 306) = 24.783$, $p < .05$. This further endorses that the earlier on established fact that Extrinsic Motivation significantly influences Chemistry Academic Achievement among secondary school students. Findings of the study contradicts the study by Lee *et al.* (2015) reported that extrinsic motivation did not have explanation for unique variance in academic performance.

Further, to estimate the actual influence of extrinsic motivation belief on chemistry academic achievement.

Linear regression was generated and result shown in Table 5.

Table 5. Coefficient Output of extrinsic motivation beliefs and Student Achievement in Chemistry

Model	Unstandardized Coefficients	Standardized Coefficients	T	Sig.
	B	Std. Error	Beta	
1 (Constant)	3.659	.347	10.532	.000
Extrinsic Motivation	.018	.073	.017	.2239

a. Dependent Variable: Student Achievement in Chemistry

Regression equation: $Y = 3.659 \text{ units} + .018x_1$

Where Y is the student achievement in chemistry and X_1 is the extrinsic motivation beliefs.

It is evident from Table 5 that one standard deviation rise in extrinsic motivation would only lead to a 0.017 standard deviation increase in student achievement in chemistry. This finding is supported by Haider et al. (2015) study that reported a positive relationship between extrinsic motivation and academic performance. Contrary, these findings are not in harmony with those of Becker et al. (2010) study in Germany reported a negative relationship between extrinsic motivation and reading literacy.

Qualitative findings on the relationship between extrinsic motivation beliefs and chemistry academic achievement among secondary school students were also obtained from interviews. Students, chemistry and guidance and counseling teachers were interviewed on the relationship between extrinsic motivation and students' chemistry academic achievement. From the qualitative finding, there was positive link between extrinsic motivation and students' chemistry achievement. To support this, student 2 and 6 observed:

I know chemistry subject is important for science courses in university like medicine and engineering. I am struggling with chemistry so that if I pass I can also do science based courses. I have greatly improved in the subject and I know I will pass in my final examination (Student, 2).

I believe that if I pass chemistry subject I will be able to pursue engineering course in the university. That is what makes me study chemistry. If there would be an alternative subject for engineering different from chemistry, I would not be struggling (Student, 6).

Student 2 revealed through verbatim quotation that he is only interested in getting a better course in the university. This suggest that the student only engages in the activity not because the subject is personally enjoyable but only struggling to get external satisfaction. Student 6 further asserts that he is only interested in chemistry just for the sake of being able to pursue engineering degree course in the university. The implication of these excerpts from student 2 and 6 is that they engage in the task for external reward. In extrinsic motivation, external rewards involve getting good grades, recognition from significant persons like teachers and peers, and even getting material rewards.

One chemistry teacher and one guidance and counseling teacher interviewed had this to say:

Most learners struggle to study chemistry so hard in order to get science based courses in the university. They realize that they may not get the carrier course because they find themselves performing poorly. They give up after realizing that they not meet the requirements for such courses after all (CT, 3).

Students who are interested in career like engineering, medicine and nursing really ask a lot of questions regarding the grades they should get in chemistry in order to secure those courses. It seems the only thing that makes them work extra hard in chemistry is purely to secure the courses. Most students in our school do very well in

chemistry and they get the courses they desire (G & CT, 7).

From the excerpts the concept of external reward as a factor of extrinsic motivation is revealed. External rewards range from verbal to non-verbal and material rewards from teachers, parents and fellow students. Working hard in a Subject just for the sake of getting a course in the university is considered as extrinsic motivation according to Expectancy-Value theory as postulated by Eccles and Wigfield (2002). However, students who expect the rewards like getting good courses in the university still perform well in chemistry. The findings are in line with Ayub (2010) study that reported that there was significant positive relationship between extrinsic motivation and academic achievement. However, the finding was in disagreement with Gbollie and Harriet (2016) study in Liberia that reported a negative relationship between extrinsic motivation and academic achievement.

Further, the qualitative finding indicated that there was a positive relationship between extrinsic motivation beliefs and chemistry academic achievement. When asked if they believed that aspects of extrinsic motivation beliefs influenced chemistry academic achievement; chemistry teacher 7 narrated:

Students work hard in order to get good grades. Those who shine in chemistry always feel good, happy and feel they can become engineers. They work hard so as to get good grades and join universities of their choice (CT, 7).

As observed in the above statement, working hard in order to get a good grade is itself a characteristic of extrinsic motivation. It is surprising that such students usually perform better in exams indicating that some form of extrinsic motivation promotes high academic achievement. The finding is in agreement with the findings of Nilson (2016) in Canada that reported that extrinsic motivation was positively related to students' academic achievement in biology. However, the finding was in disagreement with Gbollie and Harriet (2016) study in Liberia that reported a negative relationship between extrinsic motivation and academic achievement.

When asked why they struggle to pass chemistry, one student reckoned:

I want to be the best student in chemistry in this school. Those people who emerge the best in this subject are respected and teachers know such students will pursue prestigious science courses in the university, I feel good being the best in this subject, and I must pass chemistry (Student, 9).

The excerpts of student 9 is a clear manifestation of a leaner who works hard in order to get a higher grade that can make him/her acquire a most prestigious career in the university. This is a strong indicator for seeking approval from others and competition with other students who pursue medicine course in the university must pass highly in chemistry. In terms of motivation, this is extrinsic motivation

at play. The external reward of passing in order to be the best student in the subject and secure a good course makes the students to work extra hard and therefore such learners perform highly. The finding was in agreement with Meltem (2012) study that reported a positive relationship between extrinsic motivation and academic achievement. However, the finding was in disagreement with Becker et al. (2010) study in Germany reported a negative relationship between extrinsic motivation and reading literacy.

It is also worth to note that from qualitative data that students who experience extrinsic motivation belief do not generally perform so well in chemistry exam. When asked on how they felt about undertaking science based causes that chemistry was a core subject, the respondents had this to say:

From form one I had high hopes of becoming a doctor in future, I am struggling to pass chemistry, I am sure I will do well but getting an A grade might not be easy, Maybe I can be sure of at least a C+ . I may not do so well. However, I don't want to give up now in chemistry (student 8)

We reward our students who do well in chemistry by giving them a chemistry revision text book every end of term exam. However, they keep on declining and most of them who get rewards are not always consistent. They perform well in one term and in another term you find they have perform poorly or below expectations. Some of them by the time they do final examination, they seem to have given up and no longer think of science career courses they used to dream of doing to their performance in Chemistry (G & CT 7).

From the excerpt of student 8, it is an indication that as much as the student is extrinsically motivated to learn chemistry by having hopes of pursuing science courses, the students may not do well eventually. This is also support by the statement from guidance and counseling teacher 7 who asserts that there are usually inconsistencies in performance even if rewards are given to learners. This is an indicator that there is a weak relationship or negative relationship between extrinsic motivation and chemistry academic achievement. The quantitative findings indicate a weak positive correlation between extrinsic motivation belief and chemistry academic achievement.

4. Conclusions

The study concluded that there was statistically significant, though weak, positive correlation ($r = .274$, $n = 308$, $p < .05$) between extrinsic motivation and Chemistry academic achievement among secondary school students in Rachuonyo South Sub-County Kenya. The findings was further supported by the qualitative data that showed that students who expect to perform better due to reward like just attaining good grade for better course in the university or just to beat their classmates may end up performing well in Chemistry tests. It is worth noting that the most conspicuous

form of extrinsic motivation noted in this study that made students to work hard in chemistry was that most of them wished to get a good grade in order to get good courses in the university. The themes that emerged were: External reward, approval from others and Competition.

The null hypothesis stated:

‘There is no statistically significant relationship between extrinsic motivation and student achievement in Chemistry in Rachuonyo South Sub-County, Kenya’. It was rejected and this meant accepting the alternative hypothesis. The study concluded that extrinsic motivation beliefs significantly influenced chemistry academic achievement among secondary school students.

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