ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 09, Issue, 10, pp. 30216-30220, October, 2019

RESEARCH ARTICLE

OPEN ACCESS

MOTIVATION AS A PREDICTOR OF SCIENCE ACADEMIC ACHIEVEMENT AMONG SECONDARY SCHOOL CHEMISTRY STUDENTS' IN VIHIGA COUNTY, KENYA

***Mulavu W. Garanja and Dr. Aurah Catherine**

Masinde Muliro University of Science and Technology, Kenya

ARTICLE INFO

Article History:
Received 03rd July, 2019
Received in revised form
11th August, 2019
Accepted 06th September, 2019
Published online 16th October, 2019

Key Words:
Motivation,
Science Academic Achievement.

ABSTRACT

Motivation is a multifaceted construct whose application in educational settings has been extensively studied. In learning environments, it has been shown to influence grade achievement, effort expended on a task, task performance and completion, choice of track as well as career choice among others. This paper is part of a doctoral research that used a Mixed methods research design to examine the extent to which science motivation, alongside three other constructs, namely science self-efficacy, scientific literacy and science process skills, can predict science academic achievement among secondary school chemistry students in Vihiga County, Kenya. Multi-stage proportionate stratified sampling was used to select 11 participating schools followed by simple random sampling to select 550 form four students from intact classes to participate in the study. Achievement tests and a motivation scale were used to collect quantitative data while focus group interviews were used to collect qualitative data. The data was analyzed using the Standard Multiple Linear Regression (SMLR) at $\alpha = .05$. The main finding was that two of the four constructs under study – science motivation and science self-efficacy - individually predicted academic achievement significantly but science motivation was the strongest predictor while science self-efficacy was the least. Science self-efficacy, scientific literacy and science process skills were found to moderate the effects of science motivation on academic achievement.

Citation: Mulavu W. Garanja and Dr. Aurah Catherine. 2019. "Motivation as a predictor of Science Academic achievement among Secondary School Chemistry Students' in Vihiga County, Kenya", *International Journal of Development Research*, 09, (10), 30216-30220.

INTRODUCTION

Motivation is a complex and multifaceted construct that has been defined in various ways by researchers and scholars (Taasoobshirazi and Sinatra, 2011). According to Schunk, Pintrich and Meece (2008), motivation is the process by which goal-oriented activity is instigated, directed and sustained. As applied in education, it can be considered as the disposition of students to find academic activities relevant and worthwhile and to try to derive the intended academic benefits from them (Brophy, 2004; Glyn,Taasoobshirazi and Brickman, 2009). Motivation involves both physical and mental activities whose outcomes may not be directly observed but are instead inferrred from actions. During their time in school, students typically work toward achieving certain academic and non-academic goals (Yamit, Miri and Yael, 2014) and efforts expended towards such goals are influenced by motivation. Motivated students tend to pay more attention, sustain interest, show willingness to learn, put in more effort, don't give up and often end up with superior achievement. When applied to educational settings, motivation to learn refers to the disposition of students to find academic activities relevant and worthwhile and to try to derive from them the intended benefits (Feinstein, 2011). Cavas (2011) considers motivation to learn science as an internal state that arouses, directs ans sustains science-learning behaviour while Bolat (2007) defines it as a desire of science learning. Motivated students tend to achieve academically by strategically engaging in behaviours that buttress their academics such as class attendance, class participation, asking questions, advice seeking, studying and participating in study groups (Bryan, Glynn and Kittleson, 2011; Pajares, 2001). Learning of science is influenced by many factors which, however, can be placed into two broad categories: cognitive and affective. The cognitive factors include information processing, reasoning ability and academic achevement (Lawson, 2004; Lawson, Banks and Logvin 2006; Schunk, 2000 as cited in Chan and Norlizah, 2017). On the other hand, the affective factors include attitude,

****Corresponding author:*** **Mulavu W. Garanja**
Masinde Muliro University of Science and Technology

self-efficacy, anxiety and motivation (Glyn and Koballa, 2007; Mallow, 2006, Osborne, Simon and Collins, 2003 as cited in Chan and Norlizah, 2017). Koballa and Glyn (2007) aver that motivation is an important construct in science education and it has received considerable research attention recently. Tuan, Cin and Shieh (2005) assert that student' motivation toward science learning can be influenced by self-efficacy, active learning strategies, science learning value, performance goal, achievement goal and learning environment stimulation. Students' motivation to learn chemistry is critical for effective classroom instruction because without it learners tend to lack the necessary impetus to engage in activities that enhance learning of the subject. Indeed, actual or perceived relevance of science to students' education and career interests is a major motivator for them. Motivation is associated with " why students strive to learn science, what emotions they feel as they strive, how intensively they strive and how long they can strive" (Bryan, Glynn and Kittleson, 2011. p.2). Therefore, students' motivational responses can be used to improve classroom instruction. According to Glynn, Taasoobshirazi and Brickman, (2009), students consider their motivation to learn science in terms of five dimensions (1) intrinsic motivation and personal relevance (2) self-efficacy and assessment (3) self determination (4) career motivation and (5) grade motivation.

From the mid-1980s to the late-1990s, much attention in science education research focused on cognitive aspects, particularly concept development with little being done on motivation but in recent years much focus has gone into motivational aspects of science education. Kempa and Diaz (1990) found a strong relationship between students' motivational traits and instructional preferences and proceeded to classify students into three categories as (1) conscientious – those who preferred more formal learning environments laden with curiosity and having open-ended situations such as in inquiry laboratory activities (2) sociable – those who preferred group discussions and (3) achievers – those who preferred more individualized or whole class instructional situations. According to Daniel, Douglas and Roy (1999), learners must be sufficiently motivated in order for them to be meaningfully engaged in inquiry learning partly because it is often of an extended nature compared to traditional instruction. Indeed, Soloway, Guzdial and Hay (1994) argue that motivation is one of the three primary challenges for Learner-Centered Design. Although some studies discredit the motivational aspects of practical activities in science instruction (e.g Harlem, 1999), research evidence suggests that doing practical science activities has a considerable motivating effect on students (Hodson,1993) apart from improving conceptual understanding (Beatty and Woolnough 1982), helping develop essential science process skills (Kerr, 1963), providing useful insights into the scientific method and developing a positive scientific attitude which, in turn, is closely associated with motivation to learn science. Students' learning outcomes in science have been shown to improve and their performance on learning tasks enhanced when they exhibit high levels of motivation to learn science and when teachers provide a rich and stimulating learning environment that encourages inquiry (Bandura and Locke, 2002). Some research suggests that motivation becomes increasingly differentiated both within and across subjects with age. Eccles and Wigfield (2002), for example, note that children attach more value to activities at which they excel over time suggesting that they get increasingly more motivated to learn in subjects in which they experience success. Giving students autonomy has been shown to increase their motivation (Pintrich, 2003; Schunk *et al.,* 2008). Another strategy for strengthening student motivation is using collaborative or cooperative learning approaches. Some studies have demonstrated that motivation is a good predictor of academic achievement in science(e.g. Pajares and Usher, 2008; Pintrich and Schunk, 2002) . Research has further shown a relatively consistent relationship between motivation and achievement in reading and maths (Broussard and Garrison, 2004). Lange and Adler (1997) found that motivation contributes to the prediction of achievement over and above the effects of ability. Typically, researchers have used such findings to support the idea that motivation leads to achievement. Additionally, motivation has been shown to be related to a number of other academic factors including several 21st century skills such as critical thinking, making inferences (Willingham, 2007), evaluating (Case, 2003) and problem solving (Willingham, 2007). The aforementioned are widely recognized as desirable learning outcomes. Pintrich (2003) holds that cognition and motivation affect one another, and that both affect academic achievement but the two are, in turn, affected by the social context of learning (Linnenbrink and Pintrich, 2002; Pintrich, 2003). In this study, the relationship between science motivation and academic achievement in chemistry was explored.

As a multidimensional construct, motivation has an influence on students' achievement and it is also a crucial component of educational and instructional processes. Vrtacnik, Jurisevic and Savec (2010) studied 361 Slovenian high school students' motivational profiles and chemistry achievement and found that the motivational profiles were very important for their academic achievement. Students from good quality motivational groups had greater achievement in chemistry than their counterparts from bad quality motivation groups. In another study, Devetak and Glazer (2010) investigated the relationship between students' intrinsic motivation for learning chemistry, formal reasoning abilities and chemical knowledge among 386 secondary school students in Slovenia and found a moderate but statistically significant correlation between students' intrinsic motivation, formal reasoning and academic achievement at the sub-microscopic level. A study done by Kadioğlu and Uzuntiryaki (2008) in Turkey involving 359 10th grade secondary school students found that 11% of the variance in chemistry achievement was accounted for by three variables which are intrinsic motivation, self-efficacy for learning and performance, and test anxiety. These three variables were found to be significant predictors of students' chemistry achievement in gases and chemical reacions. Kim (2005) reported that constructivist instruction was more effective than traditional instruction in terms of academic achievement and motivation. Chan and Norlizah (2017) used a sample of 165 students randomly selected from 10 secondary school in Pahang, Malysia in a study and found that the students were moderately motivated towards science learning and achieved mid-low achievement in their science subjects. The research found that students' motivation towards science learning had a significant correlation with students' science achievement. Sharma and Sharma (2018) studied the relationship between motivation, self-concept and academic achievement among secondary school students in India and found a significant correlation between self-concept, motivation and academic achievement. In cross-sectional study in Iran involving 252 Tehran University students, Amrai, Motladh, Zalani and Parhon (2011) found positive and significant correlation between academic motivation and academic achievement. The study concluded that students' academic achievement required co-ordination and interaction between different aspects of motivation. Sikhwari (2014) used cross-sectional survey to investigate the relationship between motivation, self-concept and academic achievement among 193 second year University of Venda students in South Africa and found significant correlations between self-concept, motivation and academic achievement

The Present Study: This study was part of a doctoral research whose focus was to study the efffects of multiple instructional approaches on secondary school students' learning outcomes in chemistry in Vihiga County, Kenya. The study was quasi-experimental and it employed a Mixed- methods design. Multi-stage proportionate stratified sampling was used to select 11 participating schools followed by simple random sampling to select 550 form four (grade 12) students from intact classes. Students' science motivation was one of the constructs studied. The others were scientific literacy, science process skills ans science self-efficacy. A segment of the study sought to find out how the aforementioned factors predicted students' academic achievement. Quantitative data was collected using six instruments: a pre-test, a post-test, a science self-efficacy scale (SSES), a scientific literacy assessment test (SLAT), a science process skills achievement test (SPSAT) and a science motivation scale (SMS). Quantitative data was collected using focus group interviews. The SMS was prepared using guidelines from the Motivated Strategies for Learnig Questionnaire (MSLQ) by Pintrich *et al.,* (1991), the ARCS model developed by Keller and Suzuki (2004) and another motivation instrument by Glynn *et al.,* (2009). Data was analysed using the Standard Multiple Linear Regression (SMLR).

MATERIALS AND METHODS

This was a quasi-experimental study with non-random assignment of non-equivalent experimental and control groups. The study employed a mixed methods research design, which is a combination of quantitative and qualitative approaches with the latter component involving semi-structured focus-group interviews. The quasi-experimental design was used largely because the adoption of intact classes in this study rendered random assignment of participants' impossible (Best and Kahn, 2003; Borg and Gall 1989; Kirk, 1982). Additionally, a qualitative approach offers the benefit of obtaining deeper, clearer and more detailed insights into the 'why' and 'how' of a phenomenon as well as an opportunity to interrogate the wider and broader perspectives of issues under study (Denzil and Lincoln, 2008; Creswell, 2003;Creswell and Plano-Clark, 2007). The mixed methods approach is considered advantageous because data from one method complements data from the other method leading to a better, deeper and more complete understanding of the constructs under study than would otherwise be achieved by one method alone (Creswell, 2003; Creswell and Plano-Clark, 2007; Johnson and Onwuegbuzie, 2004). Data collection occurred over a period of 4 months from 02/01/2018 to 30/04/2018.

Study sample: The target population was the form 4 (grade 12) students in secondary schools in Vihiga County, Kenya. These were students who were about to sit their national KCSE examination in November, 2018. Multi-stage proportionate stratified random sampling by sub-County was used to select that would participate in the study while quota random sampling was used to select respondents in intact classes to form either the experimental or control group. The Yamane (1967) formula was used to scientifically determine the sample size. In total 550 students participated in the study.

FINDINGS

A Standard Multiple Linear Regression (SMLR) was conducted to establish the predictive power of science motivation. In conducting SMLR analysis, the order of entering the predictor variables in the model is important. Field (2009) avers that predictors should be entered into the model based on past research "that has utilized a good methodology" (p. 160). In the absence of the aforementioned, the 'enter' option was used by which all the variables under study were 'forced' into the regression model. The results are presented in Table 1. Results presented as Model summary in Table 1 reveal a coefficient of determination (adjusted R^2) of .246 - which indicates the proportion of variance in the dependent variable that can be explained by the independent variable(s) – and it translates to 24.6% prediction of the variance in academic achievement. The model summary further demonstrates that science motivation, scientific literacy, science self-efficacy and science process skills are statistically significant predictors of levels of academic achievement, (F (4, 545) = 45.749, $p < .001$). In subsequent analysis, the variable with the least coefficient of determination was eliminated from the model, one at a time, and in all four regression models

Table 1. Model Summary (n = 550)

Model	R	R^2	Adjusted R^2	R^2 Change	F Change	Sig. (2-tailed)	Durbin-Watson
1	.501	.251	.246	.251	45.749	.000	1.396

Dependent Variable: Academic Achievement (AA)
Predictors: (constant), SM, SSE, SL, SPS

Table 2. SMLR Analysis Predicting Academic Achievement from Students' Science Motivation, Science Self-Efficacy, Scientific Literacy and Science Process Skills (n= 550)

	Model 1		Model 2		Model 3		Model 4	
Predictor(s)	R^2	β	R^2	β	R^2	β	R^2	β
SPS	-	-.038	-	-	-	-	-	-
SL	-	.067	-	.056	-	-	-	-
SSE	-	.083	-	.077	-	.105**	-	-
SM	-	.433**	-	.432**	-	.445**	-	.489**
Adjusted R^2	.246		.246		.246		.238	
Total ΔR^2	.251**		-.001		-.002		-.009**	
Constant	14.120		13.481		13.683		14.148	

Dependent Variable: Academic Achievement (AA)
** significant at $p < .001$

were generated as presented in Table 2. In Model 1 which was obtained by "forcing" all the predictors into the regression analysis, science motivation turned out to be the only significant predictor of academic achievement (β = .433, $p <$ .001) with science self-efficacy (β = .083, p = .085), scientific literacy (β = .067, p = .176) and science process skills (β = -.038, p = .348) producing non-significant standardized regression coefficients. In Model 3 both science motivation (β = .445, $p <$ .001) and science self-efficacy (β = .105, p = .010) produced statistically significant coefficients. In the fourth and last regression model science motivation was the only predictor (β = .489, $p <$ .001). Consequently, four regression equations were postulated: Model 1: $Y = 14.120 + .433\chi_1 + .083\chi_2 + .067\chi_3 -.038\chi_4 + \varepsilon$. Where: Y = Predicted Academic Achievement, χ_1 = Science Motivation, χ_2 = Science Self-Efficacy, χ_3 = Scientific Literacy χ_4 = Science process skills and ε = Error term. Model 2: $Y= 13.481 +.432\chi_1 +.077\chi_2 +.056\chi_3 + \varepsilon$. Model 3: $Y= 13.683 +.445\chi_1 +.105\chi_2 +\varepsilon$. Results from the third regression analysis confirm that the most important and significant predictors of academic achievement are science motivation levels (β = .445, $p <$ .001) and levels of science self-efficacy (β = .105, p = .010). According to this model, science motivation and science self-efficacy predict 44.5% and 10.5% of variance in academic achievement respectively. It is notable that the predictive power of science motivation levels and science self-efficacy increase by 2.3% and 4.9% respectively from Model 2 upon removing scientific literacy from the regression model. This suggests that scientific literacy could be a negatively moderating variable for both science motivation and science self-efficacy in predicting academic achievement. In Model 3 both science motivation (β = .445, $p <$ .001) and science self-efficacy (β = .105, p = .010) produced statistically significant coefficients. In the last regression model with science motivation as the only predictor (β = .489, $p <$ .001), the latter predicted nearly a half (48.9%) of all academic achievement and the prediction was statistically significant. When focus group interviews were conducted to collect qualitative data, students expressed a variety of opinions about how they were learning the topic under study. Samples of their opinions are:

Patricia: *"I used tobelike…nervousabout chemistry…especially in form two… but I got over it. I now like the subject very much. I wouldn't choose how to be taught…I guess the teacher decides that….but practical work is the best".*

Moses: *"The way we have been taught recently has been different and very interesting. I wish it could be that way ever day…I mean….if it continues this way, I am confident of doing very well in the exams".*

Alex: *"I did not have a good background in chemistry from form one and I really try to do well but it is not easy. When the teacher gives us questions to try, I learn a lot from my friends through group discussions".*

Philip: *"I am nervous when studying chemistry. I really fear the chemicals in particular. You know, they can burn you if they pour on you especially the acids. I don't need to pass chemistry….we cannot all be scientists… (laughs)…".*

DISCUSSION

Regression analysis indicates that science motivation and science self-efficacy were the two most important predictors of academic achievement. The fourth regression model shows that science motivation was the most important predictor of academic achievement, predicting up to 48.9% of all academic achievement. Thus, the last model was be postulated to be:

Model 4: $Y= 13.683 +.489\chi_1 +\varepsilon$

Where: Y = Predicted Academic Achievement, χ_1 = Science Motivation and ε = Error term

These findings suggest that science self-efficacy could have moderating effects on the prediction of science motivation on academic achievement. A review of literature found mixed findings on the effect of the variables under study on academic achievement. No study was found that had examined all of the variables together while using the same methodology. However, Zimmerman (2000) and Aurah (2013a) have reported that self-efficacy was a significant predictor of motivation and meta-cognition and forms of academic achievement respectively.

Conclusion

Based on the totality of the research findings presented, it can be concluded that students' science motivation is a critically important factor in their science academic achievement. In addition, academic achievement in science can be promoted by enhancing their science motivation as the latter was shown to be the most important predictor of academic achievement. Indeed, with other factors kept constant, improving science motivation would be expected to elevate academic achievement by nearly 49%. However, the other constructs that influence science achievement should not be ignored. Indeed, science self-efficacy was found to predict as much as 10.5% of academic achievement. This is a fertile area for more rigorous research.

REFERENCES

Aurah, C. 2013a. The Effects of Self-efficacy Beliefs and Metacognition on Academic Performance: A Mixed method Study. *American Journal of Educational Research,* 1(8), 334-343.

Bandura, A. and Locke, E.A. 2002. Negative Self-Efficacy and Goal Effects Revisited. *Journal of Applied Psychology*, 88(1), 87-99.

Beatty, J.W. and Woolnough, B.E. 1982. Practical work in Grade 11-13 Science. *British Educational Research Journal*, (8): 23-30.

Britner, S.L. and Pajares, F. 2001. Self-Efficacy Beliefs, Motivation, Race and Gender in Middle School Science. *Journal of Women and Minorities in Science and Engineering*, 7, 271-285.

Broussard, S.C. and Garrison, M.E.R. 2004. The relationship between classroom motivation and academic achievement in elementary school-aged children. *Family and Consumer Sciences research Journal*, 33(2), 106-120.

Bryan, R.R., Glynn, S.M. and Kittleson, J.M. 2011. Motivation, Achievement and Academic Placement Intent of High School Students Learning Science. *Science Education*, 95, 1049-1065.

Case, R. 2003. Moving Critical Thinking to the Main Stage. *Education Canada*, 45(2), 45-49.

Chan, Y.L. and Norlizah, C.H. 2017. Students' Motivation towards Science Learning and Students' Science Achievement. *International Journal of Academic*

Research in Progressive Education and Development, 6(4), 174-189.

Creswell, J. 2003. *Research Design: Qualitative and Mixed Methods Approaches (2nd Ed.).* Thousand Oaks, CA: Sage Publications.

Creswell, J.W. and Plano-Clark, V.L. 2007. *Designing and Conducting Mixed Methods Research (1st Ed.).* Thousand Oaks, CA: Sage Publications.

Daniel, C.E., Douglas, N.G. and Roy, D.P. 1999. Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design. *The Journal of thr Learning Sciences*, 8(3-4), 390-450.

Duschl, R. A. and Grandy, R.E. 2013. Two ways about explicitly teaching nature of science. *Science and Education*, 22(9), 2109-2139.

Duschl, R.A., Schweingruber, H.A. and Shouse, A.W. (eds.) 2007. *Taking Science to School: Learning and Teaching Science in grades K-8*. Washington, DC. National Academies Press.

Eccles, J.S., and Wigfield, A. (2002). Motivational Beliefs, Values and Goals. *Annual Review of Psychology*, 53, 109-132.

Feinstein, N. 2011. Salvaging Science Literacy. *Science Education*, 95, 186-185.

Field, A. 2009. *Discovering Statistics Using SPSS* (3rd ed.). California. Sage Publications Inc.

Field, A. 2013. *Discovering Statistics Using IBM SPSS* (4th ed.). London. Sage Publications Inc.

Glesne, C. 1999. *Becoming Qualitative Researchers: An Introduction.* New York, NY: Longman.

Glynn, S.M., Taasoobshirazi, G. and Brickman, P. 2009. Science Motivation Questionnaire: Construct Validation with Non-Science Majors. *Journal of Research in Teaching*, 46, 127-146.

Johnson, R.B. and Onwuegbuzie, A.J. 2004. Mixed Methods Research: A research Paradigm whose time has come. *Educational Researcher*, 35(7), 362-381.

Keller, J.M. and Suzuki, K. 2004. Learner Motivation and E-Learning design: A Multinationally Validated Process. *Journal of Educational Media*, 29(3), 229-239.

Kempa, R, F. and Diaz, M. 1990. Motivational Traits and Preferences for Different Instructional Modes in Science. *International Journal of Science Education*, 12, 195-203.

Kirk, R. 1982. *Experimental Design.* PacificGrove, CA: Brook/Cole Publishing.

Koballa, T.R.J. and Glynn, S.M. 2007. Attitudinal and Motivational Constructs in Science Learning. In S.K. Abell and N.G. Lederman (Eds.), *Handbook of Research on Science Education,* (pp.75-102). Mahwah, New Jersey and London: Lawrence Erlbaum Associates Publishers.

Kothari, C. 1990. *Research Methodology: Methods and Techniques. (2nd Edition).* New Delhi: New Age International Publishers.

Koul, L. 1992. *Methodology of Educational Research (2nd Edition).* New Delhi: Vikas Publishing House Development Ltd.

Lange, G.W. and Adler, F. 1997. *Motivation and Achievement in Elementary Children: A paper presented at the biennial meeting of the Society for Research in Child development.* Washington, D.C.: SRCD.

Linnenbrink, E.A. and Pintrich, P.R. 2002. Motivation as an Enabler for Academic Success. *School Psychology Review,* 31(3), 313-327.

Mugenda, O. and. Mugenda, A.G. 2003. *Research Methods: Quantitative and Qualitative Approaches.* Nairobi: ACTS Press.

Mutai, K. 2001. *How to write a Quality Research Proposal.* Mysore: Mysore.

Pintrich, P. 2003. A motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts. *Journal of Educational Psychology*, 95, 667-686.

Pintrich, P., Smith, D., Garcia, T. and McKeachie, W. 1991. *A Manual for the use of the Motivated Strategies for Leaning Questionnaire (MSLQ).* Ann Arbor: University of Michigan.

Pintrich,P., and Schunk, D. 2002. Motivation in Education: Theory, Research and Application (2nd ed.). N.J: Prentice Hall.

Schunk, D.H., Pintrich, P.R. and Meece, J.L. 2008. *Motivation in Education: Theory, research and application.* Upper Saddle River, New Jersey and Colombus, Ohio: Pearson.

Soloway, E., Guzdial, M.,and Hay, K.E. 1994. Learner-Centered Design: The Challenge for HCT in the 21st Century. *Interactions*, 1, 36-47.

Taasoobshirazi, G. and Sinatra, G. M. 2011. A Structural Equation Model of Conceptual Change in Physics. *Journal of Research in Science Teaching, 48(8): 901-918.*

Tabachnick, B.G. and Fidell, L.S. 2013. *Using Multiple Statistics*, 6th ed. Boston, Pearson.

Yamane, T. 1967. *Statistics: An Introductory Analysis, 2nd Edition.* New York: Haper and Row.

Yamit, S., Miri, K. and Yael, S. 2014. Enhancing Students' Motivation to Learn Chemistry. *Sisyphus Journal of Education*, 2(2), 100-123.

Zimmerman, B.J. 2000. Self-Regulated Learning and Academic Achievement: An Overview. *Educational Psychologists*, 25, 3-17.

Zimmerman, B.J., Bandura, A. and Martinez-Pons, M. 1992. Self-motivation for academic achievement: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal*, 29, 663-676.

****