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Exploring the Correlation between Academic Achievement in Science and Predictor Variables

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Abstract: Declining interest in science among high school students across the world is well documented although the extent of such disinterest varies by region and country. One indicator of dismal interest in science is below average academic achievement in the science subjects in standardized tests. Results from PISA, for example, provide insights into the achievement of participating countries and offers good feedback on science curricula in the same countries. This paper presents part of the findings from doctoral study on the effects of using multiple instructional approaches on secondary school students' learning outcomes in chemistry in Vihiga County, Kenya. The study employed a mixed methods approach using a sample of 550 students from intact classes. Five learning outcomes were studied, namely, academic achievement, science self-efficacy, motivation, science process skills and scientific literacy. Qualitative and quantitative data was collected and analyzed both descriptively and inferentially. Results indicate that academic achievement was positively, albeit weakly, correlated to all the constructs under study. The strongest correlation was found between scientific literacy and science self-efficacy. These findings have implications for science education practice.

Keywords: Science education, Correlations, Academic achievement, Science process skills, Scientific literacy, Science motivation, Science self-efficacy.

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I. INTRODUCTION

Perennial poor academic achievement by secondary school students in science subjects is a well documented global challenge that has been associated with the low uptake of Science, Technology, Engineering and Mathematics (STEM) courses at tertiary levels of education with the concomitant effect of declining capacity to take full advantage of advances in technology that drive modern economies. The situation is far more aggravated in the poor African countries. This sorry state of affairs has been attributed to inappropriate pedagogical approaches, inadequate instructional materials, low funding of science programs, lack of well-trained science teachers, students' low motivation to study science among a host of other factors. Today, many science educators, scholars and researchers advocate the use of inquiry-based approaches to classroom science instruction, particularly those that are interactive and technology-enhanced. Such approaches have been shown to not only align with the overarching goal of science education, namely to enhance scientific literacy but also promotes students academic achievement in science. Instructional approaches adopted for use in the classroom have been shown to impact a great deal on students' learning of science and the corresponding learning outcomes, including self-regulated learning [1] and academic achievement [2], [3], [4], [5] and [6]. In Kenya, science teachers use a variety of instructional strategies, often determined by such factors as the content under study, the grade level, curriculum demands, availability of instructional materials and the teacher's personal preferences. The strategies can be broadly classified as being either didactic or experiential. Traditional science instruction which emphasizes class text books, lectures, memorization of facts, tests and examinations is considered to be out of step with 21st Century science pedagogy [7] , [8]. Didactic instruction is widely used in Kenyan classrooms and is thought to be largely ineffective in enhancing students' science conceptual understanding, problem-solving ability and development of science process skills. Oftentimes it is the teacher's discretion on the approach to employ as there are no strict national standards to go by. However, the Kenya Institute of Curriculum Development (KICD) makes suggestions in the syllabus on what teaching-learning strategies the teacher should consider using [9]. But these suggestions are in no way binding. Government policy documents tacitly advocate for learner-centered instructional approaches but in reality the majority of teachers use a complex variety of methods that tend to lean more toward didactic strategies. Among the common instructional approaches in Kenya are lecture, teacher-demonstration, whole class experiments, small group experiments, group discussion, project work and field trips. [10] advocated for adoption and use of innovative pedagogy in science education in Kenya. This study sought to add to the existing corpus of knowledge on classroom practices in science education with particular focus on the correlation between students' science academic achievement and predictor variables, namely science self-efficacy, science motivation, scientific literacy and science process skills.

II. MATERIALS AND METHODS

This quasi-experimental pre-test, post-test control group study was carried out as part of a doctoral research done in Vihiga County, Kenya from September 2017 to November 2018. A total of 550 form four students aged between 16-18 years from intact classes participated in the study.

Multi-stage stratified sampling was used to select the study sample. Proportional stratification ensured equitable distribution of opportunity to participate in the study across all the five sub-counties in Vihiga County making the sample as representative as possible. Simple random sampling was used to select the participating schools which constituted the experimental and control groups. The Yamane [11] formula was used to scientifically determine the sample size that would properly measure the variables under study while at the same time avoiding finding significance because of inflated sample size.

Procedure methodology

Written informed consent was obtained from all respondents or their legal guardians by filling the Informed Consent Forms (ICFs). All students in the study were taught the topic 'salts' by their regular teachers for the prescribed period of time. The control group received instruction using the traditional method while the experimental group was taught using multiple interactive instructional approaches that included teacher demonstration, class experiment, 5-E and group discussion. Teachers and students using the interactive approaches followed an instructional protocol provided as a guide. Quantitative data was collected using the pre-test, post-test, SSES, SMS, SLAT and SPSAT for all of which validity and reliability was determined beforehand and found to be suitable. Qualitative data was collected using focus-group interviews. Tests were scored and rated by experienced examiners. Hard copy research instruments were collected, checked for completeness, sorted according to treatment groups, coded appropriately and entered in IBM SPSS version 20.0 for analysis.

Statistical analysis

Data was analyzed using IBM SPSS version 20.0. Initial analysis involved generation of descriptive statistics (frequencies, percentages, means and standard deviation) followed by Bivariate Pearson's correlation coefficient at $p < .05$ level which measures the degree and strength of correlation.

III. RESULTS

Analysis revealed that, on average, the experimental group outperformed their control counterparts in academic achievement and all the other variables under study. Table 1 presents the mean scores for the two groups and the corresponding standard deviations.

Table 1: Means, Standard Deviations and Sample Sizes by Treatment Group

	Experimental (n = 406)	Control (n = 144)	Total (n = 550)
Academic Achievement	19.33	17.47	18.85
	(1.306)	(1.030)	(1.487)
Science Motivation	89.07	68.22	83.61
	(8.178)	(11.421)	(12.942)
Scientific literacy	19.97	18.15	19.49
	(2.723)	(2.910)	(2.884)
Science Self-Efficacy	72.35	67.20	70.22
	(12.552)	(9.542)	(12.362)
Science Process Skills	14.33	13.89	14.21
	(.981)	(.983)	(.999)

Standard deviations in parentheses

The descriptive statistics displayed in Table 1 show that, on average, the experimental group scored higher in all the outcomes under study: academic achievement (M = 19,33, SD = 1.306), scientific literacy (M = 19.97, SD = 2.723), science self-efficacy (M = 72.35, SD = 12.552), science process skills (M = 14.33, SD = .981) and science motivation (M = 89.07, SD = 8.178) than the control group academic achievement (M = 17.47, *SD* = 1.030), scientific literacy (M = 18.15, SD = 2.910) science self-efficacy (M = 64.20, SD = 9.542) science process skills (M = 13.89, SD = .983) and science motivation (M = 68.22, SD = 11.421). The observed difference can be attributed to the use of the interactive instructional approach on the experimental group.

Bivariate Pearson's Product Moment correlation coefficients were also generated. The correlations were taken to be indicative of the relationship between the dependent and independent variables. They further showed both the magnitude and direction of the relationship between the variables [12], [13]. Correlation values range from +1.0 to -1.0 and the closer the value of the correlation coefficient is to an absolute value of 1.0, the larger the magnitude of the relationship is between the two variables. If the value of the correlation coefficient is zero, then there is no relationship between the variables. Table 14 shows the correlation analysis and the correlation coefficient values that were obtained.

Table 2: Inter-correlations for Academic Achievement (AA) and Predictor Variables (n=550)

Predictors	1	2	3	4	5
1. AA	1	.291**	.292**	.110**	.489**
		(.000)	(.000)	(.010)	(.000)
2. SL	-	1	.603**	.397**	.437**
			(.000)	(.000)	(.000)
3.SSE	-	-	1	.346**	.420**
				(.000)	(.000)
4. SPS	-	-	-	1	.216**
					(.000)
5. SM	-	-	-	-	1

Dependent variable: Academic Achievement (AA)

** p < .01 level (2-tailed)
p values in parentheses

Results from correlation analysis shown in Table 1 indicate significant, albeit weak to moderate, positive correlation between academic achievement and all predictors under study. It was observed that students' academic achievement is positively correlated with all the constructs under study: science motivation (r = .489, p < .001), scientific literacy(r = .291, p < .001), science self-efficacy (r = .292, p < .001) and science process skills (r = .110, p = .010). In addition, there is a moderate and significant positive correlation between scientific literacy and science self-efficacy (r = .603, p < .001), science process skills (r = .397, p < .001) and science motivation (r = .437, p < .001). Students science self-efficacy produced moderate but significant positive correlation with science process skills (r = .346, p < .001) and science motivation (r = .420, p < .001). However, the correlation between academic achievement and science process skills is weak though significant (r = .110, p = .010). The correlation between science process skills and science motivation (r = .216, p < .001) is positive and significant. According to [13] if the Pearson's Product Moment correlation is greater than .50 then there is a high correlation between the variables under study. In this regard, only the correlation between scientific literacy and science self-efficacy (r = .603, p < .001) could be considered to be high. Notably, all the positive correlations were significant at p < .001 meaning that there was only 0.1% probability of such correlations occurring by sheer chance

IV. DISCUSSION

Findings show that there is a positive correlation between academic achievement and all the predictor variables except science motivation. Such positive and significant correlations suggest that students with high levels of scientific literacy, science self-efficacy and science process skills would be expected to show high levels of academic achievement. This finding, particularly with respect to self-efficacy, is consistent with findings from other studies found in literature [1], [14], [15] . Together, self-efficacy and scientific literacy can be postulated to positively correlate to influence academic achievement. It is reasonable to expect students' with high self-efficacy and those who also have high levels of scientific literacy to exhibit superior academic achievement. Such findings have been reported in literature [16] ,[17], [18]. These findings are also consistent with findings by [19] who investigated the relationship between science self-efficacy beliefs, gender and academic achievement among high school students in Kenya. The study used a sample of 2,139 form four students of biology and found students' self-efficacy to be highly correlated to academic achievement. [20] investigated the interaction of gender and self-efficacy on the academic achievement of students in third grade using a sample of 200 students from Shiraz school in Iran found and that students with high self-efficacy posted superior academic achievement. A study in Albania by [21] that used a sample of 180 students found a significant relationship between their self-efficacy and academic performance. The correlations between the predictors (scientific literacy and self-efficacy) and the dependent variable (academic achievement) were all significant and positive albeit weak. Some studies e.g. [21] and [22] have reported negative or no significant relationship between academic self-efficacy and academic achievement.

V. CONCLUSION

Students' academic achievement in science correlates positively, though weakly, with all the predictor variables under study, namely science motivation, science self-efficacy, and scientific literacy and science process skills. Science motivation produced the strongest correlation. Teachers of science ought to consider ways of enhancing students' science motivation, self-efficacy, scientific literacy and science process skills for better academic achievement. More rigorous empirical research ought to be conducted on the aforementioned variables to inform policy and science pedagogy.

REFERENCES

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

[2]. Mutisya, S. M., Rotich, S.K. & Rotich, P.K. Conceptual understanding of Science Process Skills and Gender Stereotyping: A Critical Component of Inquiry Teaching of Science in Kenya's Primary Schools. *Asian Journal of Social Sciences & Humanities(AJSSH)* , (2013); 2(3), 359-364.

[3]. Odundo, P.A., & Gunga, S.O. Effects of Application of Instructional Methods on Learner Achievement in Busines Studies in Secondary Schools in Kenya. *International Journal of Education and Research,* (2013); 1(5), 1-22.

[4]. Ongowo, R.O., & Indoshi, F.C. Science Process Skills in the Kenya Cerificate of Secondary Education Biology Practical Examinations. *Creative Education* , (2013); 713-717.

[5]. Oyoo, S. Science teacher Effectiveness as a Condition for Successful Science Education in Africa: A focus on Kenya. *The International Journal of Learning* , (2010); 17(9), 469-484.

[6]. Wachanga, S.W., & Mwangi, J.G. Effects of Co-operative Class Experiment teaching Method on Secondary School Students' Chemistry Achievement in Kenya's Nakuru District. International Educational Journal, (2004); 5(1), 26-36.

[7]. Capps, D.K., Crawford, B.A., & Constas, M.A. A Review of Empirical Literature on Inquiry Professional Development: Alignment with Best Practices and a Critique of the Findings. *Journal of Science Teacher Education* , (2012); 23(3), 291-318.

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

[9]. Kenya Institute of Curriculum Development (KICD). *Secondary Education Syllabus.* Nairobi: Kenya Literature Bureau, (2002).

[10]. Khatete, D. Innovative Pedagogy in Science Education*. A paper presented at a workshop "Towards Effective Pedagogy in Science Education", 17th to 19th June 2010, CEMASTEA*, (2010); Nairobi, Kenya.

[11]. Yamane, T. Statistics: An Introductory Analysis, 2nd Edition. (1967); New York: Haper and Row.

[12]. LeBreton, J.M., Ployhart, R.E., & Ladd, R.T. A Monte Carlo Comparison of Relative Importance of Methodologies. *Organizational Research Methods*, (2004); 7(3), 258-282. Doi.10.1177/1094428104266017

[13]. Tabachnick, B.G., & Fidell, L.S. Using Multiple Statistics, 6th ed. (2013); Boston, Pearson.

[14]. Pajares, F. & Usher, E.L. Self-efficacy, Motivation and Achievement in School from the Perspective of Reciprocal Determinism. Social Psychology Perspectives: Advances in Motivation and Achievement , (2008); 15, 391-423.

[15]. Motlagh, S.E., Amrai, K., Yazdani, M.J., Abderahim, H.A, & Souri, H. The Relationship between Self-Efficacy and Academic Achievement. *Procedia Social and Behavioural Sciences* , (2011); 15, 756-768.

[16]. Aurah, C. *The Influence of Self-Efficacy Beliefs and Metacognitive Prompting in Genetics Problem Solving Ability Among High School Students in Kenya.* (2013b); Muncie, Indiana: Unpublished Doctoral Dissertation, Ball State University.

[17]. Motswiri, M.J. *Supporting Chemistry Teachers in Implementing Formative Assessment of Investigative Practical Work in Botswana*. Thesis, (2004); University of Twente, Enschede. Retrived from http://doc.utwente.nl/4824/1thesis-motswiri.pdf

[18]. Lunetta, V. The school science laboratory: historical perspectives and context for contemporary teaching. In B. &. Fraser, *International handbook of science education*. (1998); (pp. 249-264). Dordrecht: Kluwer.

[19]. Aurah, C. Investigating the Relationship between Science Self-Efficacy Beliefs, Gender and Academic Achievement among High Students in Kenya. *Journal of Education and Practice,* (2017); 8(8), 146-153.

[20]. Nejad, E.H & Khani, S.S. Studying the interaction of gender and self-efficacy [high and low] on the academic achievement of students in third grade. Bulletin of Environment, Pharmacology and Life Sciences, (2014), 3(II), 67-72.

[21]. Shkullaku, R. The Relationship between Self - efficacy and Academic Performance in the Context of Gender among Albanian Students. European Academic Research, (2013), 1,(4). 467-478

[22]. Baanu, T.F., Oyelekan, O.S., & Olorundane, A.S. Self-Efficacy and Chemistry Students' Academic Achievement in Senior Secondary Schools in North Central Nigeria. *The Malaysian Online Journal of Educational Science* , (2016) ; 4(1), 43-52.

[23]. Vancouver, J.B., Tischner, E.C., & Putka, D.J. Two Studies examining the negative effects of self-efficacy on performance. Journal of Applied Psychology , (2002); 87(3), 506-516.

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