British Journal of Education, Society & Behavioural Science
3(1): 18-32, 2013

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A Path Analytic Study of Student and School Performance Indicators as Determinants of Student Midwives' Performance in Anatomy and Physiology

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Authors' contributions

This work was carried out in collaboration between both authors. Author EAE, wrote the protocol, manage the literature searches and wrote the final draft. Author GOA designed the study, performed the statistical analysis and managed the analysis of the data. Both authors read and approved the final manuscript.

Research Article

Received 21st October 2012
Accepted 11th January 2013
Published 25th January 2013

ABSTRACT

Aims: The study constructed and tested a seven variable model for providing a causal explanation of student midwives' achievement in Anatomy and Physiology in terms of student performance indicators of entry qualifications, academic self-concept and academic support seeking and school performance indicators of teacher quality, school type and teacher-student ratio.
Study Design: The study adopted a survey research.
Place and Duration of Study: Schools of Midwifery in Lagos zone of Nigeria, between January 2009 and January 2010.
Methodology: The population was made up of 559 student midwives and 73 midwife educators in Nigeria. The four sets of instruments used were Teacher Quality Questionnaire, r = 0.8; Student Midwives' Academic self concept Questionnaire r = 0.84; Teachers Perception of Student Midwives' Academic Support-Seeking Questionnaire, r = 0.74; and Achievement Test in Anatomy and Physiology,
r = 0.79.Data were analysed using multiple regression and path-analysis.
Results: The result showed that only three (3) variables namely: School Type, Teacher

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Quality and Academic Self Concept had direct causal influence and were significant in determining student midwives' achievement in Anatomy and Physiology(x7).
Conclusion: Recommendations were made based on the findings.

Keywords: Student midwives; student performance indicators; school performance indicators anatomy and physiology.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

***Term**: Definition for the term*
***School Performance Indicators:** These are school characteristics (i.e. school type, teacher quality, teacher student ratio,) which could exert a causal influence on the students' performance in Anatomy and Physiology.*
***Academic Support Seeking:** It is learning assistance requested for by the learner either from the peers or classmates or from the tutors in the School.*
***School Type:** It is the type of programme that each school runs. It could be basic or post basic midwifery programme.*
***Basic Midwifery Programme:** This is a three year training programme in Midwifery for Senior Secondary School leavers.*
***Post Basic Midwifery Programme:** It is an eighteen month training programme for those that have undergone the three year General Nursing programme.*
***Academic Self Concept:** It refers to one's perception about self ability as regards academic achievement in Anatomy and Physiology,*
***Student Performance Indicators:** These are student factors or characteristics (such as entry qualification, self concept, academic support seeking) that influence student' performance in Anatomy and Physiology.*
***Entry Qualification:** This refers to the grades the students obtained in the subjects taken at the Senior Secondary School Certificate Examination and the Registered Nurse Certificate*
***Teacher Quality:** This is teacher characteristic in terms of teacher qualification, teaching experience, clinical experience, and teaching strategies used by the teacher to assist students in learning activities.*

1. INTRODUCTION

The role of the midwives in recent midwifery practice is to take care of normal pregnancy, labour and post delivery. The midwives provide high proportion of the intra-partum care for women with pregnancy complication whose care is directly managed by an obstetrician. It is essential that the care provided by midwives reflect an understanding of the risks involved as well as the knowledge and the experience needed to manage the risks. Skills required in managing clients are taught during a midwife's training. The skills are based on the students' knowledge of Anatomy and Physiology and the midwife is expected to apply or translate that knowledge into practice, hence the link between theory and practice needs to be established.

In school programme, performance indicator is any statistics that casts light on the condition and performance of schools. They can be either good or bad predictors of students' academic achievement at any level of learning, Lashway [1]. The quality of schooling is important to the quality of skills and schools are under demand for graduates with more cognitive skills as opined by Taylor [2]. Performance indicators do not only satisfy the

demands of accountability, but also serve as a tool for school improvement. For schools to better interpret the statistics that comes from test scores and other outcome measures, indicators such as student entry qualification, student academic support seeking, academic self concept, teacher student ratio, teacher qualifications and school type need be focused on.

In Nigeria, entry into midwifery profession is either by a pre service post-basic training of eighteen calendar months meant for registered nurses, or three years of basic midwifery programme targeting candidates that have just completed the Senior Secondary School Certificate. The two programmes aim at producing skilled attendants at every birth as recommended by the World Health Organisation and International Confederation of Midwives. The entry qualification into Schools of Midwifery in Nigeria is five credit passes in English Language, Mathematics, Physics, Chemistry and Biology at not more than two sittings. Ofori and Charlton [3] found that good entry qualification is not necessarily a good indicator of performance, but Ismail and Othman [4] and Campbell [5] found it to be a good significant and positive predictor of academic performance.

Academic support seeking, a variable in the study, which refers to consultation of others, is a legitimate learning strategy associated with wisdom and experience to deal with challenges of goal attainment in educational set up as viewed by Oetingen, Stephens, Mayer and Birkinmann [6]. This variable was found by Ofori and Charlton [3] to be a good predictor of academic achievement.

The cluster of ideas and attitudes an individual holds about self, as well as the description and evaluation of self is self concept. O' Mara, Marsh, Graven and Debus [7]; Valentine, Dubois and Cooper [8] uphold the view that academic self concept is student self perception of academic ability which is formed through individual experiences and interaction with the environment. According to Rosen, Glennis, Dalton, Lenon and Borzik [9], a positive academic self concept should lead to gain in academic achievement.

Another factor which significantly affects performance is teacher –student ratio, measured by the number of teachers to students in a school. Mitchell [10] is of the view that lowered pupil teacher ratio lead to higher achievement. Similarly, Suryadarma, Suryahadi, Sumarto and Rogers [11] found that student- teacher ratio is significant in determining student academic achievement.

In line with the view of Mizala and Romaguera [12], the performance of the different school types is an extremely important issue, as the main educational problem is not one of coverage but rather of quality, In most studies, school type is considered as either boys, girls or mixed schools while some such as those of Erbas [13], Obong [14], Washanga and Nwangi [15] consider it as public, private or mission schools. Obong [14] found that school type has significant effect on student achievement. Analysis of students' academic performance in Anatomy and Physiology between the different school types is necessary because in a schooling system based on choice, it is important to have alternatives that offer education of at least the same quality for midwifery as a profession.

Teachers play an important role in education and as opined by Fergusson [16], Goldhaber [17], Goldhaber and Anthony [18], Goldhaber, Brewer and Anderson [19], Hanushek, Kain and Rivkin [20,21], teacher quality is the most important schooling factor in explaining student achievement.

Anatomy and Physiology is a core Midwifery Course. The structure and physiological indices of how the body functions are used to explain pathological processes that may occur. Anatomy and Physiology is a foundation, a pre requisite and a compulsory course in Midwifery because the role of the midwife in the identification of anatomical landmarks in the mechanism of child birth is important. This course is also the foundation for other core Midwifery courses such as Normal Midwifery and Complicated Midwifery. The researchers observed that many studies have examined the causes of maternal mortality and morbidity as well as students' achievement in other Nursing and Midwifery programmes without recourse to the student midwives' achievement in Anatomy and Physiology. The study therefore examined critically the performance indicators of student midwives' achievements in Anatomy and Physiology by constructing and testing a seven variable model for providing an explanation of student midwives' achievement in Anatomy and Physiology.

1.1 Research Questions

1. What is the most meaningful causal model for providing an explanation of the performance of students in Anatomy and Physiology?
2. What are the (i) directions (ii) estimates of the strengths of causation (path coefficients) of the variables in the model?
3. What are the (i) direct (ii) indirect effects on the students' achievement in Anatomy and Physiology?
4. What proportion (%) of the total effects is: (i) Direct? (ii) Indirect?

2. METHODOLOGY

This is a non-experimental research which considered the variables of school type and teacher quality as exogenous variables on its path analytic attempt of factors that determine student midwives' performance in Anatomy and Physiology. The endogenous variables considered are teacher - student ratio, students' entry qualification, academic self concept and academic support seeking.

2.1 Population, Sampling Technique and Sample

All final year student midwives in the schools of midwifery in Nigeria were chosen because of their broad knowledge in the subject of focus. These students along with their teachers constitute the population for the study. The sample for the study was drawn from the Lagos zone, the zone with the largest number of constituent states (11states) and the largest number of schools of Midwifery that are either owned by the Federal Government, State Government, Missions or individual. The schools run either basic or post basic type of Midwifery programme. From among the eleven (11) constituent states of the zone, eight (8) were purposively sampled. Eighteen schools were selected. Only one school in Ondo State was not included because the students were not preparing for the final qualifying examination. The sampled schools and the states where they are domiciled are shown in Table 1

Table 1. Sampled Schools for the Study

States	No of Schools in Each states	School Type	Chosen Schools	Type of Midwifery Programme	No of Schools Chosen
Lagos	3	2federal, 1 state	2 Federal	PBM	2
Oyo	5	1federal, 1 state, 3 mission	All	PBM	5
Osun	2	1 federal,1state.	Both	PBM	2
Ogun	2	2 state	1 state	PBM	1
Edo	5	1 federal,1 state, 2missions,1 private	1 private,1 state,2missions	BM	4
Delta	2	2 state	2 state	PBM	2
Ekiti	1	1 state	1 state	PBM	1
Kwara	1	1 state	1 state	PBM	1
8 states	21 schools	5 federal, 10 state, 5 mission 1 private	4 federal 8 state 5 mission 1 private	4 PBM 1BM& 7PBM 2BM&3PBM 1BM	18

Key: *PBM-------- Post Basic Midwifery, BM--------- Basic Midwifery.*

2.2 Instrumentation

The instruments for the collection of data are: Teachers' Perception of Student Midwives Academic Support-Seeking Questionnaire (TPSMASSQ**),** Student Midwives Academic Self Concept of Anatomy and Physiology **(**SMASCAP**)**, Teacher Quality Questionnaire on Anatomy and Physiology (TQQAP) and Achievement Test in Anatomy and Physiology (ATAP). The Cronbach Alpha coefficients for TPSMASSQ, SMASCAP and TQQAP, were:0.74, 0.84 and 0.80 respectively; while the KR 20 coefficient for the Achievement Test in Anatomy and Physiology using was 0.79.

2.3 School Records

Analysis of records in the school on students' grades in SSSCE, school type, number of students in the school, number of lecturers (including guest lecturers) was obtained from available records in the schools.

2.4 Data Collection Procedure

The research instruments were administered directly on the students and the teachers in the 18 selected schools after obtaining their consent to participate in the study. Data collection lasted six weeks.

2.5 Data Analysis

The data collected were analyzed using multiple regressions and path analysis. A total of six (6) backward regression analyses were run using SPSS computer programme to obtain the path coefficients of the hypothesized model. The researchers' decision for ordering the

variables are based on some of the parameters listed by Mertlar and Vannatta [22] which include research literature, formal and informal theories, personal observations, experiences with the phenomenon of interest, expert opinions, common sense and logic.

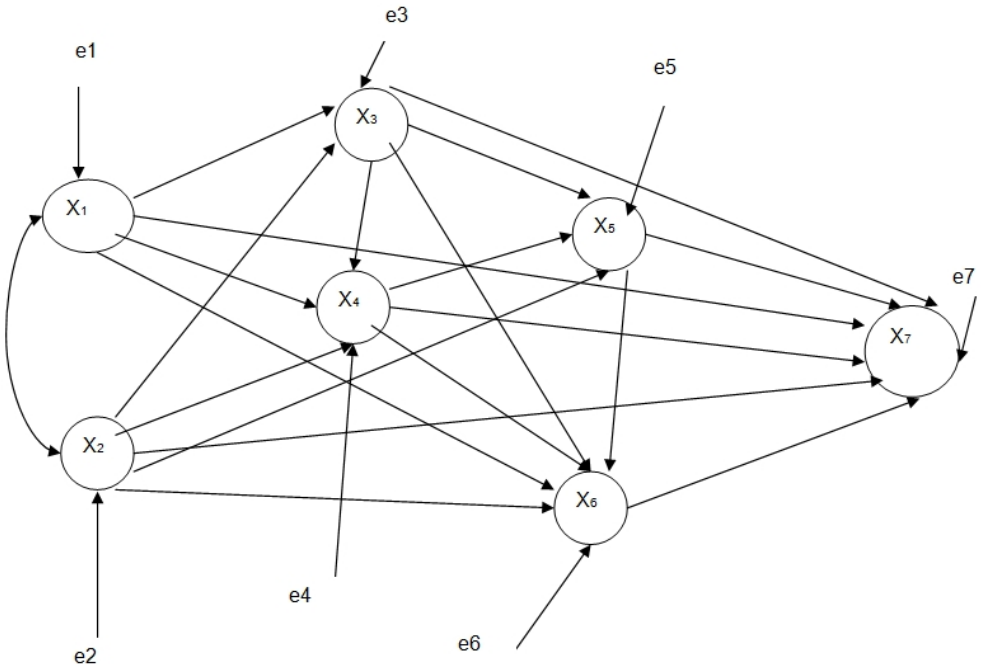

Fig. 1. Hypothesized Causal Model of the Seven Variable Systems.

X1=School type *X2= Teacher quality*
X3=Entry qualification *X4= Teacher student ratio*
X5= Academic self concept *X6= Academic support seeking*
X7=Achievement in Anatomy and Physiology.

3. RESULTS

Research Question 1:

What is the most meaningful causal model for providing an explanation of the performance of student midwives in Anatomy and Physiology?

The most meaningful causal model that involves student variables, school variables and students' achievement in Anatomy and Physiology is shown in Fig. 2 which was derived from trimming the hypothesized model in Fig. 1 based on statistical significance and meaningfulness at 0.05 as recommended by Land [23]. In verifying the efficacy of causality among variables (Fig. 2) the original correlations were reproduced using path coefficient on the parsimonious model as shown in Table 2.The discrepancies between original and reproduced correlations are considered minimal (discrepancies< 0.05). The pattern of correlations in the data is considered tenable with the parsimonious model (Fig. 2). Fig. 2 is therefore considered to be the most meaningful causal model in explaining student midwives' achievement in Anatomy and Physiology.

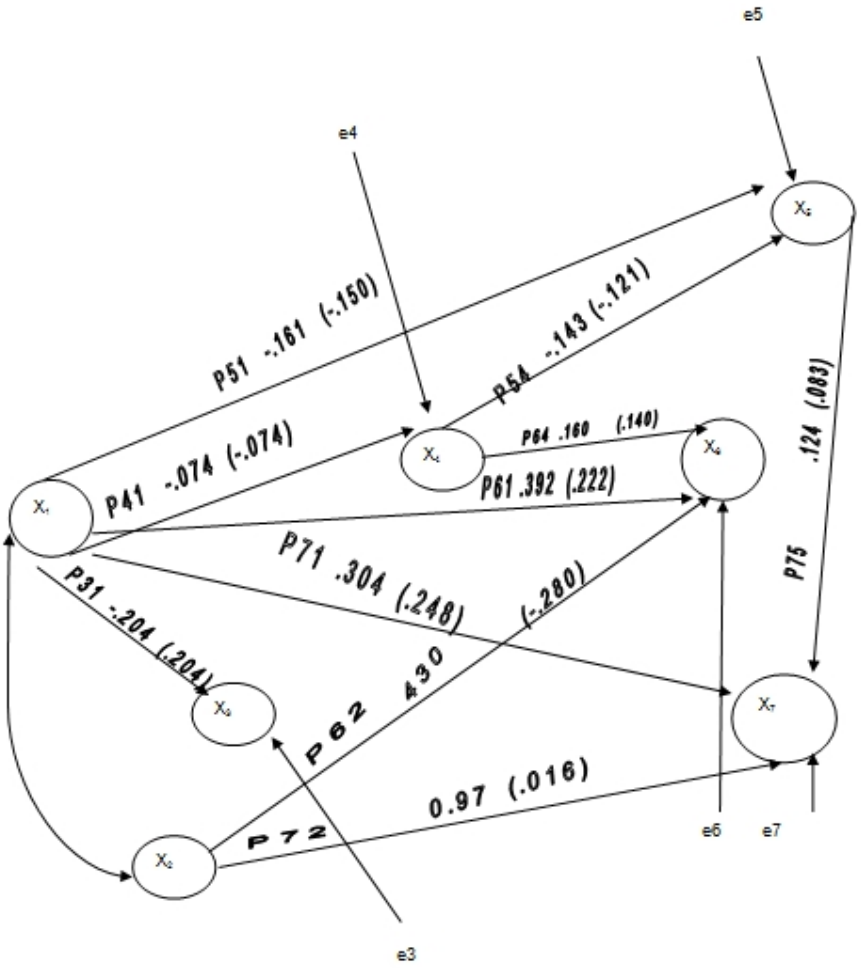

Fig. 2. The new path model showing path coefficients and zero order correlation coefficients in parentheses.

X_1 = School Type X_6=Academic Support Seeking
X_2 =Teacher Quality X_7=Achievement in Anatomy and Physiology.
X_3 = Entry Qualification X_4 =Teacher-Student Ratio
X_5 =Academic Self Concept

Research Question 2:

What are the directions as well as the estimate strengths of causation (path coefficients) of the variables in the model?

The directions of the causal paths of the variables in the model are shown in the pathways which are (i) Significant (ii) meaningful and (iii) have a link with the criterion variable. The paths are shown in Table 2:

Table 2. Original and reproduced correlation matrix for variables 1, 2, 3, 4, 5, 6 and 7

Variables	School Type	Teacher Quality	Entry Qualification	Teacher Student Ratio	Academic Self Concept	Academic Support Seeking	Achievement in Anatomy & Physiology
School Type		.367	-.204	-.074	-.150	.222	.248
Teacher Quality	.367		-.135	-.002	-.025	-.287	-016
Entry Qualification	-.204	-.074		.034	-.025	-.287	.027
Teacher-Student Ratio	-.074	-.027	.015		-.121	.140	-.074
Academic Self Concept	-.152	-.056	.031	-.122		-.086	.080
Academic Support Seeking	.223	-.076	-.046	.150	.039		.031
Achievement in Anatomy & Physiology.	.251	.008	-.052	-.035	.083	.097	

N.B. Entries above the diagonal are the original correlation coefficients.
Entries below the diagonal are the reproduced correlation coefficients.

Table 3. Analysis of significant pathways in anatomy and physiology
Pathways through which xi (1-6) caused variations in the dependent variable x7 at p < 0.05

Normal Equation	Direct Path	Indirect Paths
R13`		1: p31
R14		1:p41
R15		3: e.g p51,p54 r14
R16		5:e.g p61.p62,r12,p64r14
R17	P17	7: e.g p71,p72r12, p75r15
R23		1:e.g.p31r21
R24		1:e.g.p41r21
R25		4:e.g.p51r21,p54r24
R26		5:e.g.p61r21,p62,p62r24
R27	P27	7:e.g.p71r21, p72,p75r25
R34		2:e.g.p41r31
R35		4:e.g.p51r31,p54r34
R36		9:e.g.p61r31, p62r32,p64r34
R37		12:e.g.p71r31, p72r32,p75r35
R45		2:e.g.p51r41,p54
R46		5:e.g.p61r41, p62r42,p64
R47		7:e.g.p71r41, p72r42, p75r45
R56		10:e.g.p61r51, p62r52, p64r54
R57	P57	10:e.g.p71r51,p72r52.p75
R67		28:e.g.p71r61,p72r62,p75r65
Total	3	134

The variables that have direct significant paths to achievement in Anatomy and Physiology were regarded as having direct effect. Also, an indirect path (compound path) is considered significant and meaningful, if the constituent single paths are significant and meaningful. Out of these pathways, only three were direct while the remaining 134 were indirect. The result shows that out of the three variables that have direct effect on students' achievement in Anatomy and Physiology, school type (var 1) contributed most (β =.304) followed by academic self concept (var.5, β= .124) and teacher quality (var. 2, β .096). Their respective contributions are significant and meaningful.

Research Question 3:

What are the direct and indirect effects on the students' achievement in Anatomy and Physiology as predicted by the causal model?

The total effects (direct and indirect) of all six (6) predictor variables consisting of students and school indicators) and criterion (student achievement in Anatomy and Physiology) are shown in Table 4. The total effects of all the predictor variables on the criterion variable (students' achievement in Anatomy and Physiology) obtained from regression analysis of the data collected from this study is 0.328. This was decomposed into direct and indirect components and is presented in Table 4. Therefore, the direct effect is 0.649 and indirect effect is -.321.

Table 4. Effects of the Predictor (Variables 1- 6) on Achievement in Anatomy and Physiology

Predictor Variables	Total Effect (TE) a	% B	Direct Effect(DE) c	% D	Total Indirect Effect(TIE) a-c= e	% F
School type	.248	75.61	.304	46.84	-.056	-17.45
Teacher Quality	.016	4.88	.096	14.79	-.080	-24.92
Entry Qualification	.027	8.23	.071	10.94	-.044	-13.71
Teacher student ratio	-.074	-22.56	-.013	-2.0	-.061	-19.00
Academic Self concept	.080	24.39	.124	19.11	-.044	-13.71
Academic Support Seeking.	.031	9.45	.067	10.32	-.036	-11.21
Absolute Total	0.328	_	0.649	_	-.321	_
% of proportions	_	100	197% = 66.9%	100	-97%= 33.1%	100

- *Total Effect =Original correlation coefficient*
- *Direct Effect = Path coefficient*
- *Total Indirect Effect =Total Effect – Direct Effect*

Research Question 4:

What proportion (%) of the total effect is: (i) Direct? (ii) Indirect? Proportion of the total effect of Direct to Indirect was calculated from Table 4 which shows the proportion of the total effects (100%). The direct effect is 66.9% while the indirect effect is 33.1%.

4. DISCUSSION

The result of the study showed that out of the hypothesized causal links to achievement in Anatomy and Physiology (Fig. 2 refers), only ten significant pathways survived trimming in relation to the hypothesized linkages. The pathways were derived from 6 structural equations for producing the most meaningful causal model (Fig. 2) involving student and school indicators as determinants of achievement in Anatomy and Physiology (a core midwifery course). The efficacy of the new model which was verified by reproducing the original correlation matrix of the variables shows that the original correlation data is consistent with the new model. Hence, the new model is retained.

It was found that, an exogenous variable (variable 1, school type) contributes 75.6% of the total effect on students' achievement while an endogenous variable, teacher-student ratio, has the least contribution of -22.56% total effects on students' achievement in Anatomy and Physiology. The results of students' achievement in Anatomy and Physiology shows that out of the 3 school indicators, only 2 of the hypothesized school indicators (school type and teacher quality) and the only student indicator (academic self concept) significantly determine students' achievement in anatomy and physiology directly and indirectly.

Furthermore Table 4 shows that out of the total variation in the criteria measure that is accounted for by the 2 exogenous and 4 endogenous variables (when taken together) direct and indirect components accounted for 66.9% and; 33.1% respectively. Again, since the magnitude of the beta weight is taken to be directly proportional to the degree of effect of the influencing variables, it could be seen (from Table 3) that only 3 variables namely school type (var1), teacher quality (var2),and students' academic self concept (var5) have direct causal influence on students' achievement in Anatomy and Physiology.

In considering school performance indicators, school type which made the highest direct contribution to student midwives' achievement in Anatomy and Physiology accounted for 75.6% of the total effect of the three school indicator variables and 17.44% of variability in the criterion measures in students' achievement in Anatomy and Physiology.

There are many studies on school type and its effect on students' achievement. Obong [14] found that school type has a significant direct influence on academic achievement in Anatomy and Physiology. Obong [14] considered school type in terms of ownership, i.e., federal, state and mission and found that federal schools performed better than the state or mission owned schools. In this study school type is considered as either basic or post basic types of midwifery schools. It was found in this study that post basic schools performed better than the basic schools. This finding may be so because students in the post basic schools had earlier training in nursing, i.e. they are registered nurses. This shows that previous knowledge or higher entry qualification for post basic midwifery programme has influence on the academic achievement of students in that they are not just out of secondary schools. It could therefore be concluded that school type has significant effect on students' achievement.

Teacher quality (var2) has direct influence on students' achievement in Anatomy and Physiology with a path coefficient of -.097 at .05 level while its direct effect is 14.79% of the total effect of the variable on achievement in Anatomy and Physiology. The indirect effect accounts for 24.92% of the total effect. It was found that this variable is the most significant of all the variables in the study. An understanding of the indices of teacher quality, namely, teacher's teaching experience, teachers clinical experience buttress the importance of teacher quality as an indicator of students' achievement in Anatomy and Physiology. This result of this study is supported by Goldhaber [17], Goldhaber and Anthony [18] who found that teacher quality is a determinant of students' achievement. The result is also corroborated by the studies of Goe [24] and Clotfelter et al. [25].

In this study, teacher - student ratio accounts for 22.56% of the total effect of the six variables on students' achievement in Anatomy and Physiology, and its direct effect accounts for 2.0% while the indirect effect is 19.0% of the total effect. Numerous sources (such as Hanuchek [26], Hruz [27], Becker [28] argue that lower student-teacher ratios augur better when teaching students complex subjects such as physics, mathematics and chemistry. There are many arguments and controversies on student-teacher ratios and these have been the basis for a multitude of studies and debates. (e.g. Harris and Plank [29], Becker [28] In this study, teacher-student ratio is significant but has no direct linkage with the predictor variable, but has direct linkage with academic self concept and academic support seeking. It is known that teachers assist students to reflect on past events, analyze present perceptions and shape future experiences. Following logically from the aforementioned, if the teacher student ratio is low, the teacher would be able to identify students who need help in developing positive self concept which in turn would assist

student to achieve academically. Thus, it is not surprising as found in this study that teacher –student ratio could affect academic achievement indirectly.

Students Entry Qualification has a direct effect of 10.99% and indirect effect of 13.7%. This has no direct causal link with the criterion variables of Anatomy and Physiology. The findings in this study supports the findings of Jeffery [30], Merriel-Hutton [31] and Ofori [32] that student nurses' entry qualifications are not the most useful predictors of academic performance and that they should not be relied upon for selecting potential nurses. Also, from this study entry qualifications did not appear as significant predictors of academic achievement.

Student academic self concept has a total effect of 24.39%, direct effect of 19.1% and indirect effect of 13.70%. It was found in this study that academic self concept (var5) is significant and has direct effect on the students' achievement in Anatomy and Physiology. Students with positive self concept often evaluate their own performance positively and are likely to be more successful than students with negative self concept. This finding corroborates the findings of Rhonda and Craven [33] which states that academic self concept is crucial concepts for understanding students' academic achievement. Self concept of students plays important role in the success or failure of a student in the learning process. Several studies (e.g Marsh) [34] indicate that the major factors in determining whether a student passes or fails are self concept, motivation and willingness to engage in the range of learning activities provided for them. It can therefore be concluded that academic self concept is relevant in determining student midwives' achievement in Anatomy and Physiology.

The sixth variable is student academic support seeking. It has a total effect of 9.45%, direct effect of 10.3% and indirect effect of 11.21%. (Table 4). Academic Support Seeking according to Ofori [32], Ofori and Charlton [3], is a good determinant of student nurses' achievement in a psychology course. This variable appears not to be a good predictor of student midwives' achievement in Anatomy and Physiology although there are direct linkages to this variable from other variables in the study. Kraus, Hartley, James and McInnis [35] found that while mature students might be new to a course of study, they generally have a clear purpose motivating their study and are more likely to seek assistance from tutors. Students who attend schools in which more students engage in supporting activities will also be more likely to have higher achievement (see Ma and Klinger [36], Williams [37].

5. RECOMMENDATIONS

The two school types (by basic and post-basic midwifery programmes) are adequate within the context of this study, thus, they are to be sustained in order to have skilled attendant at every birth.

Teacher quality in terms of qualification, certification, clinical experiences, methods of teaching as stipulated by Nursing and Midwifery Council of Nigeria are to be adhered to.
Entry qualification of credit passes in the sciences is not a good predictor of achievement in Anatomy and Physiology, therefore it should be reviewed and not to be singly used in selecting students for pre-service midwifery education.

The stipulation of the Nursing and Midwifery Council of Nigeria on Teacher -Student-Ratio of one teacher to six students (1:6) in the classroom and clinical settings must be strictly adhered to in order to measure its significance on Anatomy and Physiology.

A positive academic self concept of student midwives should be promoted to enhance student academic achievement in Anatomy and Physiology.

Students and teachers are to be encouraged to see the importance and effect of academic support seeking as it has been found in other studies that it positively enhances academic achievement.

Other extraneous variables, like teacher expectation, student maturity and previous knowledge are to be considered in further studies.

6. CONCLUSION

Out of the 3 variables of school indicators and 3 variables of student indicators for achievement in Anatomy and Physiology only 2 school variables: school type and teacher quality, and a student variable (academic self concept) have direct significant causal influence on the core course of Anatomy and Physiology. The school variable of teacher student ratio and student variables of entry qualification and academic support seeking exert influence on students' achievement indirectly.

CONSENT

Explanation was given on the purpose of the study and participant support was solicited. Few students declined to participate and they were allowed not to be part of the study. All the teachers that were present at the time of data collection willingly participated in the study.

ACKNOWLEDGEMENTS

We express our gratitude to the authorities of the selected schools for granting us the permission to collect data for the study. To all participants (teachers and students) in this study, we appreciate this privilege.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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