ÜNİVERSİTEPARK Bülten | Bulletin

ISSN: 2147-351X | e-ISSN: 2564-8039 | www.unibulletin.com

ÜNİVERSİTEPARK Bülten | Bulletin • Volume 6 • Issue 2 • 2017

Nigerian Certificate in Education (NCE): An Exploration of Physics Students' Achievement

Aina, Jacob Kola and Philip, Yamma Joseph

To cite this article: Kola, A. J., & Joseph, P., Y. (2017). Nigerian Certificate in Education (NCE): An Exploration of Physics Students' Achievement. *Üniversitepark Bülten, 6*(2), 56-65.

To link to this article: http://dx.doi.org/10.22521/unibulletin.2017.62.4

Aina, Jacob Kola, College of Education (Technical) Lafiagi Kwara State, Nigeria.
(e-mail: physicseducation68@gmail.com)

Philip, Yamma Joseph, College of Education (Technical) Lafiagi Kwara State, Nigeria.

ÜNİVERSİTEPARK Bülten | Bulletin • Volume 6 • Issue 2 • 2017 • pp. 56–65.

Nigerian Certificate in Education (NCE): An Exploration of Physics Students' Achievement

AINA, JACOB KOLA and PHILIP, YAMMA JOSEPH

Abstract

Four colleges of education comprising three public and one private college were sampled for this study. The three years *of* Physics result*s* of 200 students of these colleges *were analyzed* using t-test and Analysis of Variance (ANOVA). *R*esult*s* indicates a difference in *the* academic achievement of students in theor*etical* and practical Physics. Additionally, there was a gap in the students*'* academic performance in the theor*etical* and practical courses based on gender. The implications of the findings for *P*hysics learning and gender representation in Physics education *ar*e highlighted.

Keywords: academic achievement, Nigerian certificate in education, national commission for colleges of education*,* gender gap, theor*etical* physics, practical physics.

DOI: 10.22521/unibulletin.2017.62.4

……

UNIBULLETIN • ISSN 2147-351X • e-ISSN 2564-8039

unibulletin.com

Introduction

The College of Education in Nigeria is the institution charged with the responsibility of awarding the Nigerian Certificate in Education (NCE) to students after satisfactorily completing three years of teacher training. Nigerian Colleges of Education are coordinated by the National Commission for Colleges of Education (NCCE). The NCCE prescribes many programs for the colleges of education, one of which is Physics education. Students are admitted to the college for three years leading towards the NCE. Students admitted to the Physics education program are required to combine Physics with any other science subject to make up two teaching subjects.

Many research studies have been conducted on the various academic programs of the colleges of education in Nigeria. The current study focuses on the Physics education program of the colleges of education due to the central position that the subject of Physics occupies in the technological advancement of the country. Additionally, NCCE's philosophy of the NCE posits that Physics students should have sound basic knowledge of Physics concepts and principles (NCCE, 2008, p. 103). Nevertheless, research studies still indicate that students' academic performance in Physics at Nigerian colleges of education is poor (Aina & Akintunde, 2013) and such poor academic performance in Physics is no longer considered exceptional in Nigerian schools; a fact established in the published literature (e.g., Eraikhuemen & Ogumogu, 2014; Olusola & Rotimi, 2012; Semola, 2010).

However, the problem of poor academic performance is not peculiar to Nigeria alone, but a global issue (Ramos, Dolipas, & Villamor, 2013). Ahtee and Johnston (2006) stated that as a topic, Physics was perceived as challenging and non-creative in both Finland and the UK. The pre-service teachers' Physics curriculum clearly demarcates between theory and practical (laboratory) Physics (NCCE, 2008). The NCE Physics curriculum is designed to make practical Physics compulsory for all students, and both laboratory Physics and Physics theory are integral parts of the course. Tiberghien, Vaelard, Marchal, and Buty (2001) affirmed that practical work is an integral part of teaching Physics in most countries. Thus, students apply the principles and laws learned in the theory courses for the understanding of the practical courses in Physics. Laboratory Physics was viewed as an organizational setting where Physics students observed and manipulated materials which demonstrate certain scientific concepts and principles (Tamir, Doran, & Chye, 1992).

The educational objectives that are often referred to in science are that of the Bloom Taxonomy, which highlights three educational learning objective domains of cognitive, affective, and psychomotor. The teaching and learning of Physics have concentrated on the cognitive and psychomotor domains with little reference to the affective domain. The Physics curriculum in Nigerian colleges of education demarcated between the cognitive and the psychomotor domain of learning (NCCE, 2008). This suggests the reasoning behind having both practical (laboratory) and theory courses in the NCE curriculum. Moreover, NCCE made all practical courses compulsory for students and drew practical courses from the theory. There are many questions that students, parents and some scholars might be asking about the NCE Physics. Does the cognitive domain have any influence on the psychomotor domain of learning in NCE Physics? Do we need a laboratory course since it is drawn from an already learned theory course? Could what the students learned in the theory course influence their performance in the laboratory course? Research question 1 of the current study attempts to address all these questions together.

The importance of the Physics practical course cannot be overemphasized in the Physics education program of Nigerian colleges of education. For any student to be outstanding in Physics education, they cannot afford to downplay this area of Physics. A course in practical Physics is prepared to give students the opportunity to acquire the necessary skills and techniques in the manipulation of apparatus. Vilaythong and Popov (2008) strongly shared the belief that practical activities enhance the understanding of Physics theory and phenomena. Bilesanmi-Awoderu (2003) stated that laboratory experiments offer students the opportunity to study along with their classmates the abstract concepts and generalizations through using real chemicals and other laboratory equipment under the guidance of their teacher.

According to the University of Cambridge (2005), students with solid practical experience are much more likely to perform well than those with limited practical skills. Kallats (2001) sees laboratory works as a means to verifying a scientific principle and/or theory already known by the students. Tamir et al. (1992) wrote that Physics laboratory work has been found to provide concrete and direct experience to students. Gambari, Folade, Fagbemi, and Idris (2012) underscored that practical Physics experience for students enables them to understand some abstracts concepts in Physics. According to Omosewo (2006), a deeper understanding of the science and technology process can be achieved through laboratory activities which encourage active participation and serve to develop critical thinking; they also provide real experiences to substantiate the theoretical aspect that has been taught.

According to the National Commission for Colleges of Education (NCCE, 2008), the integration of practical work with theory; having basic knowledge of the organizational concepts and techniques in practical Physics and laboratory management are essential to Physics teaching. To Onah and Ugwu (2010), laboratory experience in Physics is required to verify the concepts taught in the theory courses. Stephen and Mboto (2010) believed the integrating of laboratory work with the teaching of Physics theory enhance students' achievement. Musasia, Abacha, and Biyoyo (2012) believed that students' academic performance improved in any topic of Physics where they had meaningful practical work experience. The reason for the poor performance has been attributed to many factors, and one such reason is a lack of student interest, which is the affective domain in the Bloom Taxonomy mentioned earlier.

Agbaje and Alake (2014), in their study on "The student variables as a predictor of secondary school students' academic achievement in science subjects", concluded that students' interest is vital to learning. Agbaje and Alake concurred that students' interest and attitude are crucial to academic performance in Physics. Due to a lack of interest in Physics by many female students, they often display a negative attitude to the subject; resulting in the poor academic performance of the students (Thomas & Israel, 2013). Research studies show that males outperform females in all science subjects except for chemistry (Cox, Leder, & Forgasz, 2004). Many other studies in the literature have indicated that the gender variable influences student academic achievement in Physics.

Given the background outlined, the objective of the current study is to explore the differences between student academic achievement in practical and theory Physics courses. Specifically, the study investigates the differences in Physics academic achievement of students in (1) theory courses and laboratory courses, and (2) theory courses and laboratory courses based on gender.

Based on the purpose of the research, the following two research questions guide the current study:

RQ.01: Is there any difference in academic achievement of pre-service Physics teachers in theory and practical Physics courses?

RQ.02: Is there a gender gap in the pre-service Physics teachers' academic performance in theory and practical Physics courses?

Methodology

Data from three years academic achievement records of 200 pre-service teachers randomly selected from four colleges of education were analyzed (see Appendix A). Permission to make use of the data for the purposes of the current study was obtained from the relevant authority of each of the colleges. The researcher adhered strictly to the ethical rule of maintaining anonymity and confidentiality of the data collected. The pre-service teachers' three years academic results used had already been moderated by Physics Education experts and approved by the various institutions Academic Board Committee. Such committees are the highest academic body in Nigerian colleges of education, similar to the University Senate. Therefore, the data that formed the instrument of study required no further validation and was accepted as reliable. The data obtained were analyzed using both t-test and Analysis of Variance (ANOVA).

Results and Discussion

Table 1 indicates that the significant value of .000 is less than the probability value of .05, this implies that there is a significant difference between the theory and practical Physics courses. The outcome of the analysis shows that there is a significant difference between the students' achievement in the theory courses and the laboratory courses. The paired samples statistics shown in Table 2 reveals that the mean score of the practical courses is higher than that of the theory courses. The implication, therefore, is that students performed better in the practical courses than they did in the theory courses.

Table 1. Pair t-test of Difference between Theory and Practical

		Pair Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Dev.	Std. Error Mean	Lower	Upper	t	df	sig.(2-tailed)
Pair	Practical-theory	4.827	13.841	1.320	2.212	7.443	3.658	109	.000

Table 2. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Practical	53.85	110	11.485	1.095
	Theory	49.03	110	11.184	1.066

The results seen may be due to the opportunity the students had to first learn many of the Physics principles and concepts in theory courses before learning the laboratory work. What happens in laboratory Physics is in effect relearning of the principles and concepts. The concepts had been learned already, but in the laboratory setting, students are learning the concepts again and then verifying them. Supporting this, Kallats (2001) argued that the laboratory works as a means to check a scientific principle, and theory already known to the student. Onah and Ugwu (2010) reasoned along this direction, concurring that laboratory experience in Physics was designed to verify the concepts taught in theory. In the same vein, Omosewo (2006) said that laboratory work in Physics provides real experiences to substantiate the theoretical aspect taught.

The NCCE underscored the crucial role of laboratory Physics as a means of relearning of concepts and principles in Physics. Thus, they stipulated that experiments in laboratory Physics must be drawn from the Physics theory. For example, experiments from Physics practical code PHY 125 are taken from Thermal Physics I, Mechanics and Properties of Matter I, Electromagnetism I, Optics I, and Basic Electronics (NCCE, 2008). Another example, according to the NCCE, is PHY 215 that has selected experiments from Thermal Physics II, Electromagnetism II, and Mechanics and Properties of Matter II. Any student who had not attended the corresponding Physics theory classes were not expected to participate in the laboratory work of PHY 125 or PHY 215.

Therefore, the results seen should not be unexpected as students in the practical classes were in fact relearning already learnt Physics principles and concepts – as should be reflected in their performance as seen in Table 2.

Table 3. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	47464.418	1	47464.418	280.250	.000
Gender	1346.720	2	673.360	3.976	.022
Error	16428.360	97	169.365		

Table 3 reveals that the gender significant value of .022 is less than the probability value of .05. It is, therefore, inferred that there is a significant gender difference. The result contributes to the literature on gender disparities in Physics. Rodriguez, Potvin, and Kramer (2016) reported that women had been seen in some cases to perform lower than men, both before and after Physics instruction. This indicates the issue of the gender gap in Physics is not just new as seen in this study. The gender gap in attitudes, beliefs, and self-efficacy about Physics learning observed by Nissen and Shemwell (2016) might also have contributed to the gender difference in academic performance. Many reasons could be attributed to this result. However, the finding of Lock and Hazari (2016) is that there is a gender gap in Physics discussion during Physics instruction germane to the outcome of the current study. Males are known to be more active in the class than females for some courses, including Physics; thus, they interact more with the teacher. The current study also infers that males ask more questions than females in the Physics class because they have more of an interest in the course than females (Hoffmann, 2002). The gender difference recorded in the practical and theory courses of this study exists not only in Nigerian schools. The finding is consistent with the study of Madsen, McKagan, and Sayr (2013), who reported on a gender gap for two different mechanics concept inventories and two different electricity and magnetism concept inventories across institutions in the USA and the UK.

Day, Stang, Holmes, Kumar, and Bonn (2016), in their study on "gender gaps and gendered action in a first-year Physics laboratory," reported a gender gap in concise data processing assessment (CDPA). Day et al.'s observation also revealed differences in how female and male students spend their time in the laboratory. Their findings may not be that different from what happened in the current study.

Summary of the Major Findings

Given the results of the extensive analysis performed using the paired t-test and Analysis of Variance (ANOVA), testing for the assumptions before the use of the statistical tools was applied and non-violation established; thus, the following conclusion was reached:

- A difference exists in the academic achievement between the students of theory and practical Physics courses among the Nigerian colleges of education sampled.
- A difference exists in the academic achievement between the students in theory and practical courses among the Nigerian colleges of education sampled according to the variable of student gender.

The findings of the current study have implications for the teaching and learning of Physics at all levels of education, both in Nigeria and in other countries.

Implications of the Findings

The finding implies that the theory and practical courses should be separated and taught as stipulated by the NCCE. This is essential as some authors are advocating the two should not be separated during Physics instruction. The argument of Stephen and Mboto (2010) that both theory and practical courses should be instructed together at the same time in the classroom for any reason is deemed unacceptable by the researchers of the current study. Some teachers have turned practical Physics into ordinary laboratory demonstration, which is argued to be inappropriate and incorrect. Physics students should be given the opportunity to learn the principles and concepts in theory before attending laboratory experiment to verify said principles and concepts.

The gender issue has been a long-standing debate in Physics education research; hence the significance of the findings of the current study. The finding does not indicate which gender is better in terms of academic ability, nor in what aspect of Physics. Nonetheless, the empirical and anecdotal evidence reveals an underrepresentation of females in Physics, and also that males mostly perform better academically than females in Physics. As stated by Barthelemy, Dusen, and Henderson (2015), Physics is one field that has held a persistent low representation of women. The implication is that if nothing is done, these findings could further strengthen the underrepresentation.

Limprecht, Janko, and Gläser-Zikuda (2013) found that female students rate their abilities and performance on a lower level compared to their male counterparts. Wodzinski (2007) found that Physics teacher instruction is predominantly related to the learning demands of their male students, which probably resulted in female students feeling rather insecure in Physics lessons, and subsequently developed a fear of Physics as a subject. According to Limprecht et al. (2013), this may have impacted the female students to underestimate their potential learning achievement in Physics. Accordingly, female students have a tendency to underestimate their own competencies (Lupart, Cannon, & Telfer, 2004), and have lower academic confidence in themselves than male students (Day et al. 2015).

The study involved only four colleges of education in one state in Nigeria, which implies that the findings cannot be generalized. However, the outcome could be an instigator for further studies in other colleges and universities.

Notes

Corresponding author: AINA, JACOB KOLA

References

Agbaje, R. O., & Alake, E. M. (2014). Students' variables as predictor of secondary school students' academic achievement in science subjects. *International Journal of Scientific and Research 4*(9), 1-5.

Aina, J. K. & Akintunde, Z. T. (2013). Analysis of gender performance in physics in colleges of education, Nigeria. *Journal of Education and Practice, 4*(6), 1-5.

Ahtee, M., & Johnston, J. (2006). Primary student teachers' ideas about teaching a physics topic. *Scandinavian Journal of Educational Research, 50*(2), 207-219.

Barthelemy, S. S., Dusen, B. V., & Henderson, C. (2015). Physics education research: A research subfield of physics with gender parity. *Physical Review Physics Education Research, 11*(2), 020107, 1-10.

Bilesanmi-Awoderu, J. B. (2003). The status of biology practical skills acquisition among Nigeria secondary senior schools in Ogun state. *African Journal of Educational Research, 8*(1&2), 1-7.

Cox, J., Leder, G., & Forgasz, H. (2004). Victorian Certificate of Education: Mathematics, science and gender. *Australian Journal of Education, 48*(1), 27-46.

Day, J., Stang, J. B., Holmes, N. G., Kumar, D., & Bonn, D. A. (2016). Gender gaps and gendered action in a first-year physics laboratory. *Physical Review Physics Education Research, 12*(2), 020104, 1-14.

Eraikhuemen, L., & Ogumogu, A .E. (2014). An assessment of secondary school physics teachers conceptual understanding of force and motion in Edo South senatorial district. *Academic Research International, 5*(1), 253-262.

Gambari, A. I.; Falode, O. C.; Fagbemi, P. O.; & Idris, B. (2012). *Effect of virtual laboratory strategy on the achievement of secondary school students in physics practical in Minna, Nigeria*. In Proceedings NAEMT Conference. Retrieved from https://www.researchgate.net/publication/275518090.

Hoffmann, L. (2002). Promoting girls' interest and achievement in physics classes for beginners. *Learning and Instruction, 12,* 447-465.

Kallats, M. (2001). Strategies for effective science instruction in the 21st century: The Nigeria situation .Lafiagi Journal of Science Education. 3(1&2), 218-224.

Limprecht, S., Janko, T., & Gläser-Zikuda, M. (2013). Achievement emotions of boys and girls in physics instruction: Does a portfolio make a difference? *OrbisScholae, 7*(2), 43-66.

Lock, R.M., & Hazari, Z. (2016). Discussing underrepresentation as a means to facilitating female students' physics identity development. *Physical Review Physics Education Research, 12*(2), 020101, 1-16.

Lupart, J. L., Cannon, E., & Telfer, J. A. (2004). Gender differences in adolescent academic achievement, interests, values and life-role expectations. *High Ability Studies, 15*(1), 25-42.

Madsen, A., McKagan, S. B., & Sayr, E. C. (2013). Gender gap on concept inventories in Physics: What is consistent, what is inconsistent, and what factors influence the gap? *Physical Review Physics Education Research, 9*(2), 020121, 1-15.

Musasia, A. M, Abacha, O. A., & Biyoyo, M. E. (2012). Effect of practical work in physics on girls performance, attitude change and skills acquisition in the form two-form three secondary schools' transition in Kenya. *International Journal of Humanities and Social Sciences, 2*(23), 151-166.

NCCE. (2008). *National Commission for Colleges of Education minimum standard* (3rd ed.). Kaduna: Government Press.

Nissen, J. M., & Shemwell, J. T. (2016). Gender, experience, and self-efficacy in introductory Physics. *Physical Review Physics Education Research, 12*(2), 020105, 1-16.

Olusola, O. O., & Rotimi, C. O. (2012). Attitudes of students towards the study of physics in College of Education Ikere-Ekiti, Ekiti State, Nigeria. *American International Journal of Contemporary Research, 2*(12), 86-69.

Omosewo, E. O. (2006). Laboratory teaching method in science-based disciplines. *African Journal of Educational Studies, 4*(2), 65-73.

Onah, D. U., & Ugwu, E. I. (2010). Factors which predict performance in secondary school physics in Ebonyi North educational zone of Ebonyi state, Nigeria. *Advance in Applied Science Research, 1*(3), 255-258.

Ramos, J. L. S., Dolipas, B. B., & Villamor, B. B. (2013). Higher order thinking skills and academic performance in physics of college students: A regression analysis. *International Journal of Innovative Interdisciplinary Research, 4*, 48-60.

Rodriguez, I., Potvin, G., & Kramer, L. H. (2016). How gender and reformed introductory physics impacts student success in advanced Physics courses and continuation in the Physics major. *Physical Review Physics Education Research, 12*(2), 020118, 1-9.

Semola, T. (2010). Who is joining physics and why? Factors influencing the choice of physics among Ethiopian University students. *International Journal of Environmental and Science Education, 5*(3), 319-340.

Stephen, U., & Mboto, F. A. (2010). The effects of integrating laboratory work with theory on academic achievement in secondary school physics. *African Research Review, 4*(4), 412-419.

Tamir, P., Doran, R. L., & Chye, Y. O. (1992). Practical skills testing in science. *Studies in Educational Evaluation, 18*(3), 263-275.

Thomas, O. O., & Israel, O. O. (2013). Assessing the relative effectiveness of three teaching methods in the measurement of students ' achievement in physics. *International Journal of Materials, Methods and Technologies, 1*(8), 116-125.

Tiberghien, A., Vaelard, L., Marchal, J. F., & Buty, C. (2001). Analysis of laboratory work tasks used in science teaching at upper school and university level in several European countries. *Science Education, 85*(5), 483-508.

University of Cambridge. (2005). *Teaching A2 physics practical skills*. Cambridge, UK: University of Cambridge.

Vilaythong, T., & Popov, O. (2008). The Situation with Practical Work in Physics Education in Laos. In B. Cavas (Ed.), *Proceedings of the XIII. IOSTE Symposium: The use of science and technology education for peace and sustainable development* (pp. 559-565). Ankara, Turkey: Palme publications.

Wodzinski, R. (2007). Mädchenim Physikunterricht. In E. Kircher, R. Girwidz, & P. Häußler (Eds.), *Physikdidaktik Theorie und Praxis* (pp. 559-580). Berlin, Heidelberg: Springer.

Appendix

Three Years Students' Mean Scores in Physics

	Theory Courses (%)		Practical Courses (%)	
No	Male	Female	Male	Female
1	54	42	64	46
2	43	51	50	55
3	44	58	48	57
4	64	56	47	50
5	52	56	50	48
6	48	53	38	41
7	57	57	57	57
8	58	62	30	63
9	44	48	53	53
10	47	54	29	20
11	41	48	32	32
12	42	55	45	53
13	60	59	50	50
14	56	48	36	53
15	49	58	47	49
16	52	60	43	62
17	65	66	42	49
18	47	64	50	42
19	51	58	59	57
20	56	58	50	53
21	60	54	55	60
22	42	47	40	48
23	48	53	52	55
24	25	40	46	52
25	46	53	52	66
26	43	59	47	55
27	66	74	47	46
28	58	66	68	74
29	47	61	47	57
30	47	46	16	09
31	58	52	57	65

	Theory Courses (%)		Practical Courses (%)	
No	Male	Female	Male	Female
32	63	60	49	62
33	62	65	42	54
34	50	55	69	68
35	59	61	49	63
36	44	40	48	47
37	55	59	43	46
38	64	76	59	66
39	47	58	42	59
40	39	45	66	67
41	40	69	33	48
42	21	49	38	58
43	65	36	28	53
44	28	08	41	43
45	40	42	38	68
46	40	45	69	53
47	46	57	35	61
48	64	69	63	71
49	65	72	68	67
50	66	73	75	56