STUDENTS' PERCEPTION OF PHYSICS CONCEPTS IN INTEGRATED SCIENCE: A CASE STUDY OF COLLEGES OF EDUCATION IN KWARA STATE, NIGERIA

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Abstract

This study examined the perception of physics concepts among Integrated Science students in Colleges of Education in Kwara State, Nigeria. Three hundred students drawn from the Integrated Science Department in the seven Colleges of Education in Kwara State, Nigeria formed the sample for this study. The sample was drawn using multi-stage sampling technique. To elicit the relevant information, a researcher-structured students' perception of Physics concepts questionnaire (SPPCQ) was used. The SPPCQ comprised of three sections. Section A sought for demographic data relating to the students' sex, subject combination, name of school and school type. Section B contained fifteen physics concepts picked from the NCCE minimum standards for integrated science to which the students indicated their perception ratings, while section C also contained fifteen possible reasons that could determine the students' perception of physics concepts in Integrated Science. Five research questions and two hypotheses guided the study. The research questions were answered using mean and standard deviation while the hypotheses were tested using t-test at 0.05 level of significance. The results revealed that there is no statistically significant difference in students' perception of physics concepts in Integrated Science based on both gender and school type. It also revealed that three concepts were perceived as difficult by the students. It was recommended that further studies be carried out on a wider scale using more physics-related courses in Integrated Science so as to find out more concepts that are perceived as difficult by students with a view to devising means of teaching the concepts in simplified forms.

Key words: *perception, physics concepts, Integrated Science, gender, school type*

Introduction

As opposed to the old-fashioned compartmentalization of science into biology, chemistry and physics, integrated science places emphasis on the fundamental unity of science. It emerged as a result of researches into an approach to the teaching of science in lower schools that could sufficiently equip the products with relevant knowledge and skills to solve their personal and environmental problems. Hence, it addresses the inadequacies of the old science curricular in philosophy, principles, objectives, content and methodology of teaching. For example, the new course is relevant to the learners' needs and experiences, lays adequate foundation for subsequent

specialist studies, adds cultural dimension to science education and helps students to acquire relevant scientific and technological knowledge and skills to deal with personal, societal and national needs and aspirations (Duyilemi, 2008). Above all, the inquiry cum process approaches which are both activity and student-centered teaching methods are recommended for its instruction.

Although integrated science strives to de-compartmentalize science, its curriculum is made up of concepts drawn from biology, chemistry, physics, geography, mathematics and astronomy. However, by nature the physics component of the course consists of concepts that appear to be difficult to many teacher trainees in colleges of education. This feeling of difficulty often predisposes students to misconceptions about physics as a course of study, and by extension all physics-related courses. Akogun and Omosewo (2008) opined that the development of ideas, expectations and perception when students learn physics concepts are dependent upon their theoretical ideas about science as well as their experiences. These writers further submitted that if students hold on strongly to certain beliefs and misconceptions they may be unwilling to accept the conventional view of the concept taught by their teachers. For example, it is possible that a student may learn the recipe for correctly solving certain types of problems (such as Newton's second law of motion) but retain their misconceptions of the basic underlying concepts. Words like force, power, work and energy are good examples of concepts that have everyday usage that differ from their scientific meanings in physics.

Many of the problems experienced by students in learning science concepts are learner-dependent. Behar and Polat (2007) posited that the views of science held by students contribute to the difficulties they perceive about certain science concepts and topics, especially in physics. Nwona and Akogun (2013) also opined that learners experience learning difficulties that may be connected to their learning environment, background knowledge and study habits. They submitted that the cumulative effect of the factors listed above in addition to teacher and school environment factors could contribute immensely to the underperformance and low enrolment of students in many physics-related courses. The views above buttress the submissions of Olatoye (2002), Ajayi (2007) and Adedayo (2008) that the underperformance of students in physics in external examinations as well as poor enrolment into physics courses in tertiary institution may not be unconnected with the students' perceptions of the subject.

Logan and Skamp (2008) also found significant gender differences in attitude towards, and interest in science in favour of male students. They submitted that these gender differences were likely to be connected with a number of student variables including students' perception of science, subject combination of the students as well as the type of school they attended. The reference to students' perception of science concepts as a contributory factor to their poor achievement and low enrolment into the sciences calls for urgent attention. It is in this light that this work evaluates the students' perception of physics concepts in Integrated Science with a focus on the Colleges of Education in Kwara State, Nigeria.

Purpose of the study

The general purpose of this study is to find out students' perception of the physics concepts of Integrated Science in Colleges of Education in Kwara State. Specifically, this study tends to find out the:

i. physics concepts in Integrated science that are perceived as difficult by students in Colleges of Education in Kwara State, Nigeria
ii. reasons why integrated science students perceived physics concepts as difficult
iii. influence of students' gender on their perception of physics concepts in integrated science
iv. influence of students' subject combination on their perception of physics concepts in integrated science
v. influence of school type on students' perception of physics concepts in Integrated science

Research Questions

The following questions were raised to guide this study:

1. what are the physics concepts in Integrated science that are perceived as difficult by students in Colleges of Education in Kwara State, Nigeria?
2. what are the reasons for perceiving the physics concepts in Integrated Science as difficult by students in Colleges of Education in Kwara State, Nigeria?
3. what is the influence of gender on students' perception of physics concepts in Integrated Science?
4. what are the perceptions of physics concepts in Integrated Science based on the students' subject combinations?
5. what is the influence of school type on the students' perception of physics component of Integrated Science as difficult?

Research Hypotheses

The following hypotheses guided this study:

HO_1: There is no statistically significant difference in students' perception of physics concepts in Integrated Science based on their gender.

HO_2: There is no statistically significant difference in students' perception of physics concepts in Integrated Science based on school type.

Methodology

The population for this study comprised of all NCE II Integrated Science students drawn from seven Colleges of Education in Kwara State, Nigeria. The choice of NCE II students was necessitated by the fact that they have been exposed to a compulsory course in Integrated Science that is physics-oriented and from which the concepts were drawn. That is, "Man and Energy I" (ISC 122 for Double Major and ISC 123 for Single Major Students) using the 2012 edition of the NCE minimum standards for Integrated Science education. Although there are two of such compulsory physics-oriented courses for year one students, the second course (ISC 124: Fields and Waves) is offered by Integrated Science double major students only. Moreover, while the year one students were yet to complete the course from which the concepts were drawn (ISC 122/123) the year three students had already proceeded on a compulsory 6-month teaching practice exercise and could not be reached at the time of this study.

The sample for this study was drawn using a multi-stage sampling technique. Three hundred (300) students made up of one hundred and ten (110) male and one hundred and ninety

(190) female students constituted the sample for this study. Of this number, seventy-five (75) students offered Integrated Science/Biology, fifty (50) students offered Integrated Science/Chemistry, thirty (30) offered Integrated science/Physics, seventy (70) offered Integrated science/Computer Science, twenty-five (25) students offered Integrated Science/Mathematics and fifty (50) offered Integrated Science Double Major. Similarly, one hundred and twenty (120) of the students were selected from private colleges of education while one hundred and eighty (180) were selected from the public/government-owned schools (table 1).

A student's perception of Physics concepts questionnaire (*SPPCQ*) was used to collect data relevant to the study. It is a researcher-structured questionnaire that comprised of three sections. Section A sought the demographic information of the respondents while section B contained fifteen physics concepts to which the students responded according to their perceptions of the concepts. The students were to tick against the option that best represents their perception of the listed concepts using a 4-point scale (1 = Not Difficult, 2 = Moderately Difficult, 3 = Difficult and 4 = Very Difficult). To further guide the students in their responses, the following tips were explained to guide the students in their choices

i. ND (Not Difficult) – the concept is not difficult and can be understood with very little explanation
ii. D (Moderately Difficult) – concept be understood with a moderate amount of explanation
iii. D (Difficult) – concept can only be understood with lots of explanations
iv. VD (Very Difficult) – concept cannot be understood even after lots of explanations

Section C of the questionnaire suggested fifteen likely reasons why students may perceive particular physics concepts as difficult. The students were to tick according to their choices on a 4-point scale (1 = strongly disagree, 2 = disagree, 3 = agree and 4 = strongly agree).

To establish the reliability index for the instrument, it was administered on fifty (50) 200 level Integrated Science students of Federal College of Education, Okene. The internal consistency of the items in the instruments was computed using the Cronbach alpha reliability estimate. The internal consistency coefficient for the instrument was 0.831. This means that over eighty percent of the items truly measured the variables for which they were designed. This index, according to George and Mallery (2003) is acceptable. The research questions were answered using mean and standard deviation while the hypotheses were tested using t-test at 5% level of significance.

Results and discussion of findings

Table 1: Distribution of students according to gender, school type and subject combination

Variable	Group	Number	Total
1. Gender	Male	110	
	Female	190	300
2. School type	Private	120	
	Public (Government owned)	180	300
3. Subject Combination	ISC/BIO	75	
	ISC/CHE	50	
	ISC/CSC	70	
	ISC/DM	50	300

ISC/PHY	30
ISC/MAT	25

Research Question 1: what are the perceptions of integrated science students' about the physics concepts in the course?

Table 2: Students' perceptions of the physics concepts in Integrated Science

S/N	Concept	ND (1)	MD (2)	D (3)	VD (4)	Mean, $\bar{X}$	Std. Dev. (σ)	Decision
1	Force	246	40	14	0	1.23	0.301	N.D
2	Work	232	25	30	13	1.41	0.269	N.D.
3	Energy	196	59	35	10	1.53	0.248	N.D.
4	Power	240	42	14	4	1.27	0.294	N.D
5	Heat transfer	138	61	63	38	2.00	0.183	N.D
6	Temperature	189	72	29	10	1.53	0.248	N.D.
7	Reflection of light	144	75	51	30	1.89	0.196	N.D.
8	Sound waves	57	80	112	51	2.52	0.153	D
9	Shadows	124	59	67	50	2.14	0.169	N.D.
10	Eclipses	51	98	101	50	2.50	0.152	D
11	Thermometry	52	69	107	72	2.66	0.281	D
12	Refraction of light	100	106	64	30	2.08	0.174	N.D.
13	Dispersion of light	94	64	77	65	2.38	0.154	N.D.
14	Absorption/emission characteristics of matter	66	79	88	67	2.52	0.153	D.
15	Energy conversion & conservation	55	103	99	43	2.43	0.153	N.D.

Decision: Concept is perceived to be difficult if the mean, $\bar{X} \geq 2.50$ otherwise it is not difficult.

Table 2 above shows the mean responses of the students with regards to their perception of the sixteen concepts under study. From the table, the students perceived three concepts as difficult. The concepts are sound waves ($\bar{X}$ = 2.52, σ = 0.153), eclipses ($\bar{X}$ = 2.50, σ = 0.152), thermometry ($\bar{X}$ = 2.66, σ = 0.281) and emission/absorption characteristics of matter ($\bar{X}$ = 2.52, σ = 0.153). Other concepts were not perceived as difficult by the students.

Research Question 2: what are the reasons for perceiving the physics concepts in Integrated Science as difficult by students in Colleges of Education in Kwara State?

Table 3: Reasons for students' perception of physics concepts in Integrated Science as difficult

		Responses of students (N = 300)					
S/N	Reasons for perceiving Physics concepts as difficult	SD (1)	D (2)	A (3)	SA (4)	Mean, $\bar{X}$	Decision

1	I do not see the usefulness of physics in my daily life	177	92	29	2	1.52	Disagreed
2	Most of my friends are not in science departments	109	79	58	54	2.19	Disagreed
3	My friends often tell me that physics is a difficult subject	47	61	90	102	2.82	Agreed
4	Physics concepts are too abstract and/or idealized	19	36	105	140	3.22	Agreed
5	Most physics concepts are complex/made up of multiple parts	27	29	137	107	3.08	Agreed
6	Concepts are often taught as theories	39	58	103	100	2.88	Agreed
7	I do not have sufficient background knowledge of physics	122	97	60	21	1.93	Disagreed
8	There is insufficient allocation of time for teaching the concepts	138	90	50	22	1.85	Disagreed
9	Teachers do not use teaching aids to illustrate the concepts	123	74	63	40	2.07	Disagreed
10	Teachers do not use familiar examples to explain concepts	98	107	67	28	2.08	Disagreed
11	There is insufficient time for practical works	30	56	81	133	3.06	Agreed
12	Due to school workload, I do not have sufficient time for revisions after lessons	44	49	118	89	2.84	Agreed
13	The method(s) of teaching the concepts do not simplify the concepts	39	60	132	69	2.77	Agreed
14	I settled for Integrated science because I could not gain admission into other courses	89	73	102	36	2.28	Disagreed
15	There are to too many practical activities	142	94	42	22	1.81	Disagreed

Table 3 above shows the students' reasons for perceiving the physics concepts in Integrated Science as difficult. From the table it can be seen that the students agreed that they perceived the physics concepts in integrated science as difficult for seven reasons. The first reason arises from the influence of their peers. The students agreed that although they see physics as being useful in their daily lives and their friends were in the science departments, their friends often tell them that physics is a difficult subject ($\bar{X}$ = 2.82). This tends to suggest that the influence of peers contribute to students' perception of physics concepts.

The students perceived physics concepts in integrated science as difficult due to abstract nature of the concepts ($\bar{X}$ = 3.22) and the complexity of the concepts ($\bar{X}$ = 3.08). They also agreed that the

concepts are often taught as theories ($\overline{X}$ = 2.88) despite having sufficient time allocated for teaching the concepts in the school timetables. The students also agreed that practical activities were not given sufficient times ($\overline{X}$ = 3.06). This tends to corroborate the students' view that concepts are often presented in theoretical forms.

Other reasons given by the students for perceiving the physics concepts in integrated science as difficult is the teaching method ($\overline{X}$ = 2.77) adopted by teachers. In the students' views, the methods used by teachers do not simplify the concepts. Similarly, the students agreed that the school workload does not give them sufficient time for revision after the normal classroom lessons.

Research Question 3: what is the influence of gender on the students' perception of physics concepts in Integrated Science?

Table 4: Students' perception of physics concepts in Integrated Science based on gender

Variable	Group	N	Mean, $\overline{X}$	Std. Deviation
Perception of physics concepts	Male Students	110	2.47	0.177
	Female Students	190	2.51	0.204

Table 4 shows the students' perception of physics concepts in Integrated Science in Colleges of Education in Kwara State, Nigeria based on gender. From the table, the weighted mean response of the male students was 2.47 with a standard deviation of 0.177 while the female students had a weighted mean of 2.51 with standard deviation of 0.204.

HO_1: There is no statistically significant difference between the mean responses of male and female students with regards to their perception of physics concepts in Integrated Science.

Table 5: Two-tailed test of difference between mean responses of male and female students

Variable	Group	Mean	Std. Dev.	N	DF	t-cal	t-crit	Decision
Perception of physics concepts	Male	2.47	0.177	110	298	1.786	1.960	Accepted
	Female	2.51	0.204	190				

Decision Rule: Reject H_O1 if t-cal > t-crit otherwise accept H_O1

The calculated t-ratio is 1.786 while the t-critical or table value is 1.960. Since the calculated t-ratio is less than the critical or table value, the null hypothesis is accepted. It can therefore be concluded that there is no significant difference between the mean responses of male and female students with regards to their perception of physics concepts in Integrated Science at 0.05 level of significance.

Research Question 4: what is the students' perception of physics concepts in Integrated Science based on the students' subject combinations?

Table 6: Students' perception of the physics concepts in Integrated Science based on subject combinations

Variable	Group	N	Mean	Std. Dev	Decision
Perception of physics concepts in Integrated Science	ISC/BIO	75	2.68		Difficult
	ISC/CHE	50	2.33		Not Difficult
	ISC/CSC	70	2.77		Difficult
	ISC/DM	50	2.51		Difficult
	ISC/PHY	30	2.39		Not Difficult
	ISC/MAT	25	2.37		Not Difficult

Table 6 above shows the perception of physics concepts in Integrated Science based on the students' subject combinations. From the table, three combinations (ISC/BIO, ISC/CSC and ISC/DM students) perceived the physics concepts as difficult with mean responses of 2.68, 2.77 and 2.51 respectively. On the other hand students combining ISC/CHE, ISC/PHY and ISC/MAT perceived the concepts as not difficult with mean responses of 2.33, 2.39 and 2.37 respectively.

Research Question 5: what is the influence of school type on the students' perception of physics concepts of Integrated Science as difficult?

Table 7: students' perception of physics concepts in Integrated Science based on school type

Variable	Group	N	Mean, $\bar{X}$	Std. Deviation
Perception of physics concepts	Private colleges	120	2.87	0.191
	Public colleges	180	2.69	0.163

Table 7 shows the mean responses of Integrated Science students based on school type. From the table the mean response of students in private colleges of education is 2.87 with standard deviation of 0.191 while that of the public colleges is 2.69 with standard deviation of 0.163.

H_O2: There is no statistically significant difference in students' perception of physics concepts in Integrated Science based on school type.

Table 8: Two-tailed test of difference between mean responses of male and female students

Variable	Group	Mean	Std. Dev.	N	DF	t-cal	t-crit	Decision
Perception of physics concepts	Private	2.87	0.191	120	298	1.333	1.960	Accepted
	Public	2.69	0.163	180				

Decision Rule: Reject H_O1 if t-cal > t-crit otherwise accept H_O1

The calculated t-ratio is 1.333 while the t-critical or table value is 1.960. Since the calculated t-ratio is less than the critical or table value, the null hypothesis is accepted. It can therefore be concluded that there is no significant difference between the mean perceptions of physics concepts in integrated science with regards to school type at .05 level of significance.

Summary of findings

The results of this study revealed the following:

1. The students perceived the following concepts as difficult: sound waves, eclipses, thermometry and absorption/emission characteristics of matter.
2. The perception of physics concepts by integrated science students may not be unconnected with peer interaction as the respondents agreed that their friends often told them that physics is a difficult subject.
3. The respondents also linked their perception of physics concepts as difficult to the abstract nature of the concepts, complexity of physics concepts as well as the methods of teaching adopted by teachers. They agreed that the physics concepts were often taught as theories.
4. The respondents agreed that there was insufficient time to engage the students in practical activities while teaching the concepts.
5. The students also agreed that due to the school workload they had insufficient time for revisions after normal classroom lessons.
6. There is no statistically significant difference in students' perception of physics concepts in Integrated Science based on gender.
7. The perception of physics concepts in Integrated Science may not be linked to the students' course combinations. While the students combining Integrated science with biology, computer science and as double major perceived the concepts as difficult, their colleagues combining the course with chemistry, physics and mathematics held a contrary perception.
8. There is no statistically significant difference in perception of physics concepts in Integrated Science based on school type (private or public).

Educational Implication of findings

The perception of certain physics concept in integrated science as difficult by students has several implications for both teachers and students. First the performance of students on tests relating to such concepts will be low. This will not only affect the students' overall performances in Integrated Science as a course of study but also leave gaps in knowledge in the students who are training to be teachers. Consequently, upon completion of their teacher-training programmes and subsequent employment as teachers, they will either avoid such concepts in their course of actual teaching or teach the concepts poorly.

The students also agreed that among their reasons for perceiving the physics concepts in integrated science as difficult is that the school workload does not give them sufficient time for revisions. This tends to suggest that the science students in Colleges of Education are overloaded – a situation that will continue to limit the students' achievement in Integrated Science.

The theory dominated mode of teaching the physics concepts may not be unconnected with the perception of abstraction of the concepts by students. By design, integrated science is activity-based. Presenting the lessons as more of theories than activities negates the philosophy and objective of the course. Teacher-trainers therefore need to reconsider their teaching methods and tailor them towards engaging the students in practical activities that can familiarize the students with the concepts being taught to them.

Recommendations and conclusion

Based on the findings of this study and their implications for teaching and learning of Integrated Science, the researchers recommend as follows:

1. There is an urgent need to review the NCE curriculum for sciences by the National Commission for Colleges of Education (NCCE) with a view to ensuring that courses are not duplicated.
2. Science teachers must learn the art of utilizing both real objects and improvised ones in their classrooms. This will reduce to a great extent the abstraction of physics concepts often perceived by integrated science students.
3. Similar studies should be carried out on a wider scale to ascertain more concepts that are perceived as difficult by the students. This should also be done using a larger population in order to enhance the generalizability of the results.
4. Due to rising unemployment in Nigeria, it is commonplace to find unqualified personnel teaching science. The researchers recommend also that the employment of science teachers should be strictly based on merit. In this way competent teachers will be engaged in science teaching and they will in turn be able to demystify the physics concepts as well as change the students' perceptions of physics.

Conclusively, it is the hope of the researchers that the above measures will be adopted by the relevant authorities. This will go a long way in changing the perceptions of Integrated Science students about physics-related concepts in science.

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Appendix 1: Colleges of Education in Kwara State, Nigeria

S/N	NAME OF COLLEGE	SCHOOL TYPE
1.	College of Education (Tech.), Lafiagi	Public
2.	College of Education, Ilorin	Public
3.	College of Education, Oro	Public
4.	College of Education, Ilemona, Offa	Private
5.	Kinsley College of Education, Ilorin	Private
6.	Muhyideen College of Education, Ilorin	Private
7.	Nana Aishat College of Education, Ilorin	Private