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Thinking through Ethnoscientific Scenarios for Physics Teaching: Implication for Curriculum Implementation

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ABSTRACT

The study was focused on Physics teachers' perception on the use of ethnoscience learning experiences for the teaching of secondary school Physics and its implication for curriculum implementation. Six research questions and six hypotheses were posited for the study. The cross sectional survey research design was employed for the study. 243 secondary school Physics teachers in three Urban Local Government Areas (Port Harcourt, Obio-Akpor and Eleme) and four rural Local Government Areas (Ikwerre, Khana, Ahoada East and Ahoada West) in Rivers State, Nigeria were selected using the non-proportional stratified random sampling technique. Data collecting instrument was titled "Ethnoscience Learning Experience for Physics Teaching Questionnaire" with a coefficient reliability index of 0.86 was used to elicit response from the respondents. Data was analyzed using frequency count, mean, and inferential statics of t-test at 0.05 level of significance. The findings of the study revealed that the following themes (Interaction of Matter, Space and Time, Conservative Principle, Waves: Motion without material transfer and Fields at rest and in motion can be taught using ethnoscience learning experiences while themes such as Energy quantization and duality of matter and Physics in technology cannot be taught using ethnoscience learning experiences. Based on the findings of the study, it was recommended that stakeholders and planners of the secondary school Physics curriculum should consider the integration of ethnoscience learning experiences in the Physics curriculum in order to clarify those abstract concepts in learning of Physics.

KEYWORDS: *Ethnoscience, Learning, Experience, Physics, Curriculum, Teachers*

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INTRODUCTION

The world is a store house of inexhaustible knowledge which is open for humans to harness in ensuring quality life sustainability. The process of harnessing natures' knowledge is continuous leading to unlimited expansion, exploration and innovation. In understanding nature, the study of science plays a fundamental role. Science is a body of knowledge, a means of investigation or system of thinking towards the realization of understanding nature. Science strengthens commitments of man to free enquiry and search for truth as its highest beauty and obligation of nature. Bell and Linn (2000) posited that apart from science being body of knowledge, it is also a means of knowing. An important underlying feature for knowledge structure in science is the understanding of the intrinsic interacting elements in nature which is a platform for its description, explanation and prediction. Science is purely reliant on the dynamics of natural phenomena and their fundamental states which are achieved through the observation of cause-effect relationships and data generated based on empirical and quantitative measurement.

Next Generation Science (2016) explained that natural phenomenon are observable and real and they exist in our world and it is the scientific knowledge that can be employed for their prediction and explanation. Natural occurrences that form the body of knowledge domiciled in nature for science teaching and learning are quite enormous. Understanding the concept of floatation that was built from the Archimedes' principle, to Isaac Newton's gravitational law that emanates from the downwards force exerted by earth, to the formation of rainbow which is explained from the concept of dispersion of light, the focus of science educators has always been on ways students can develop the construction and understanding of scientific knowledge through the study of natural events. Arokoyu and Aderonmu (2018) asserted that understanding science from the naturalistic perspectives makes one a better science practitioner. Despite the centrality of the knowledge component of nature in science, the teaching of science has obviously neglected those fundamental components that enrich the contents of science. The consequence have been the inability for students to apply scientific knowledge obtained from the class to a real world context.

The direction of science learning has swung from the initial idea of just learning the scientific concept to an in-depth understanding or figuring out the "how and why" something happens in nature. It is not enough for science teachers to define and possibly explain Archimedes principle to students but importantly engage them in a more evidence–based discovery form of learning. Reflecting on this, Physics teachers plays important roles in the dissemination of knowledge to their students. What happen during the teaching and learning of Physics is critical because teachers controls what is taught, how is taught and have direct contact with their students. It therefore implies that Physics teachers' knowledge, skills and disposition is a function of students' achievement in the study of Physics.

It is important to state that Physics teachers cannot teach in isolation because they rely on the science curriculum which acts as a guide during the journey of knowledge transmission. The science curriculum is one key component that is essential for the development of scientific knowledge of students. Curriculum is set of actions or activities that are geared towards achieving desired goals and objectives through a formal system of education. Ndioho and Aderonmu (2014) pointed out that the Physics curriculum in its totality is the platform and means towards ensuring functional and quality Physics learning. Learning experiences that are associated with the curriculum should be cumulative in the development of the learners' views about Physics and ways of understanding scientific ideas through natural phenomenon. Physics is a science that studies the concepts of matter and energy and their interactions. In Nigeria, Physics is studied at the senior secondary school for 3 years, it is a fundamental science subject that prepares the foundation for further studies in sciences, engineering, environmental sciences etc. The focus of Physics instructions is guiding students to effectively understand Physics concepts and be able to apply the knowledge in other situations. The objectives of Physics learning as stipulated in the Physics curriculum (FRN, 2014) are to:

1. provide basic literacy in physics for functional living in the society
2. acquire basic concepts and principles of physics as a preparation for further studies
3. acquire essential scientific skills and attitude as a preparation for the technological application of physics
4. stimulate and enhance creativity

The essence of designing and implementing curriculum is to guide the teachers and students towards the achievement of set goals at the end of the programme.The NERDC Physics curriculum currently in use for teaching and learning of Physics in senior secondary schools is structured on the thematic approach in compliance to national and global issues. The thematic approach to curriculum implementation consists of a learning structure that is unified and reliant on ideally guided essential questions. Resor (2018) stated that the thematic curriculum approach provide a wide range of learning experience to learners such that learners begin to see relationships and connections across time, place, and disciplines. Also recommended was the guided discovery method as the teaching strategy to be employed in physics teaching. The guided discovery method de-emphasizes memorization, regurgitation of facts, and encourages experimentation. Six themes where highlighted for the physics curriculum which are;

1. interaction of matter, space and time
2. conservative principle
3. waves: motion without material transfer
4. fields at rest and in motion
5. energy quantization and duality of matter
6. physics in technology

In Nigeria, research has revealed the abysmal failure of Physics students at the external examinations can be attributed to defects in the Physics curriculum (Adolphus, Torunarigha & Aderonmu, 2007). It is quite unfortunate that science teaching in our secondary schools is still dominated by European worldview. Analogies, examples and language that produces our secondary school graduates are enshrined with western-oriented ideas. In this era that requires urgent solutions to the ever changing issues in the society, overwhelming calls have been made for the refurbishing of the secondary school Physics curriculum based on the content selection and learning experiences that will be relevant and be of interest to Nigerian students. It is therefore imperative that an ethnoscience culturally typified curriculum that accumulates its content and learning experience from the immediate local environment is essential for Physics teaching and learning. Ethnoscience also known as indigenous knowledge is that type of knowledge that are derived locally and relevant for the explanation of science. It is a knowledge structure that employs local content and practice in solving scientific task from our natural environment.

For instance, teaching Archimede's principles of flotation using locally carved boats from wood, use of mud/clay (poor conductors of heat) for building huts and water preservation, thatch with poor absorption of water and also poor conductor of heat as roofs in buildings, local clean agents, balancing pot on the head during traditional festivals (center of gravity), aiming a bird using catapult (elastic properties of solids and projectiles), vibration of the skin of the talking drum when hit (vibratory motion and sound wave), backward jerking of hunters when firing of their gun (Recoil velocity) among others are obviously domiciled in our environments.Novika and Fajar(2016) stated that ethnoscience consist of a system of knowledge which provides explanation of the natural world with practical applications emanating for a cultural context. They further highlighted specific principles towards the integration of ethnoscience learning experience in the study of physics as;

- Knowledge of the history, methods, principles and development of learning physics.
- Mastering of competencies, principles and basic concepts of learning physics.
- Having the capability of pedagogy in the teaching of physics confidence that knowledge taught is valid.
- Paying attention to the diversity of the human, material and technique or source of education.
- Avoiding the dominant, dogmatic and moral elements.

In a study carried out by Fasasi (2017) on the effect of ethnoscience instruction on learners' attitude and performance in science, it was revealed that ethnoscience instruction enhanced learners' performance and promoted their attitude towards the learning of science. It was further suggested that the use of ethnoscience for educational content and learning experiences should be maximally exploited. Davidson and Miller (1998) had proposed the use of ethnoscience approach in developing curriculum because it makes the curriculum relevant to the students in interest and provides a structure for the curriculum that systematically builds on the students embedded background knowledge. An ethnoscience curriculum approach will encourage teachers generate information from their immediate environment in teaching complex scientific concepts. Abonyi, Achimugu and Adibe (2014) commented that ethnoscience based learning is the development of a model template that balance both local knowledge and western science through the pedagogical processes.

Aim and objectives of the study

The aim of the study is to investigate Physics teachers' perspective on use of ethnoscientific learning experience for physics teaching. Specifically, the objectives of the study are to ascertain if the themes in the Nigeria secondary school Physics curriculum can be taught using ethnoscience learning experiences.

Research questions

1. Which of the following topics in the themes **"Interaction of Matter, Space and Time"** can be taught using ethnoscience learning experiences in the Physics curriculum?
2. Which of the following topics in the themes **"Conservation Principle"** can be taught using ethnoscience learning experiences in the Physics curriculum?
3. Which of the following topics in the themes **"Waves: Motion without materials transfer"** can be taught using ethnoscience learning experiences in the Physics curriculum?
4. Which of the following topics in the themes **"Field at rest and in motion"** can be taught using ethnoscience learning experiences in the Physics curriculum?
5. Which of the following topics in the themes **"Energy Quantization and Duality of Matter"** can be taught using ethnoscience learning experiences in the Physics curriculum?
6. Which of the following topics in the themes **"Physics in Technology"** can be taught using ethnoscience learning experiences in the Physics curriculum?

Hypotheses

H_{01}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Interaction of Matter, Space and Time"** that can be taught using ethnoscience learning experience.

H_{02}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes**"Conservation Principle"** that can be taught using ethnoscience learning experience.

H_{03}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes "**Waves: Motion without materials transfer"** that can be taught using ethnoscience learning experience.

H_{04}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Field at rest and in motion"** that can be taught using ethnoscience learning experience.

H_{05}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Energy Quantization and Duality of Matter"** that can be taught using ethnoscience learning experience.

H_{06}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Physics in Technology"** that can be taught using ethnoscience learning experience.

Methodology

The study adopted thecross sectional survey research design. This type of research design is significant when describing fundamental characteristics that exist in a population without the manipulation of any variable. The study was conducted in urban and rural areas of Rivers State, Nigeria. Rivers State lies on 4°44'59.06" N, 6°49'39.58" E and is bounded by Imo State on the north, Abia and Akwa Ibom States on the east, BayelsaState on the west and the Atlantic Ocean at the south. Rivers State comprises of 23 local government areas with three major urban areas namely Port Harcourt, Obio-Akpor and Eleme Local Government Areas based on high population density of human settlement, infrastructural and built-up areas, while others are classified as rural arears. The population of the study consisted of 559 secondary school Physics teachers in teaching in schools located in both Urban and Rural areas of Rivers State, Nigeria. Using the non-proportional stratified random sampling technique, two strata were identified which were Port Harcourt, Obio-Akpor and Eleme local government areas as the urban areas with a total number of 381 Physics teachers while Ikwerre, Khana, Ahoada East and Ahoada West were categorized as rural areas with a total number of 178 Physics teachers. The teachers were randomly selected from each group a total of 243 physics teachers consisting of 138 teachers in the urban areas while 105 Physics teachers are in the rural areas in both public and private secondary schools.

The instrument for data collection was titled "Ethnoscience Learning Experience for Physics Teaching Questionnaire" (ELEPTQ). ELEPTQ was developed to elicit Physics teachers' response on the need to include to include ethnoscience learning experience in the Physics curriculum. The questionnaire was divided into two sections A and B. section A was designed to obtain demographical information about the respondents for the study while section B was categorized into six sub-sections in accordance to the six themes of the Nigerian Physics curriculum. All the topics in each of the themes were identified from the three years of study programme and merged. Physics teachers response were categorized as Strongly Agreed (SA) = 4 points, Agreed (A) = 3 points, Disagreed (D) and Strongly Disagreed (SD) = 1 point. The questionnaire was validated two Physics curriculum experts and two experienced secondary school Physics teachers.

A pilot study was conducted to also establish the reliability of the instrument using 40 Physics teachers in both locations but were not part of the study. Test-retest method of an interval of one week was administered to the teachers used for pilot study. Data obtained from them were collected and analyzed using the Pearson Product Moment Correlation Statistics and a reliability coefficient index of 0.86 was obtained making the instrument 86% reliable to be used for the study. Data collected from the main study was analyzed using frequency count, mean, standard deviation and inferential statics of t-test at 0.05 level of significance.

Result

Research question 1: Which of the following topics in the themes "Interaction of Matter, Space and Time" can be taught using ethnoscience learning experiences in the Physics curriculum?

Table 1: Analysis of Physics teachers' response on the theme "Interaction of Matter, Space and Time"

s/n	Interaction of matter, space and time	Teachers in Urban Schools N = 138		Teachers in Rural Schools N = 138	
		Mean	Decision	Mean	Decision
1	Fundamental and derived qualities and units	4.12	Accepted	4.05	Accepted
2	Position, Distance and Displacement	3.27	Accepted	3.78	Accepted
3	Time	2.55	Accepted	3.03	Accepted
4	Speed and Velocity	3.10	Accepted	3.60	Accepted
5	Rectilinear acceleration	2.43	Accepted	3.32	Accepted
6	Scalars and Vectors	2.16	Rejected	2.11	Rejected
7	Motion and equations of Uniform Accelerated Motion	2.24	Rejected	2.75	Accepted
8	Projectiles	2.57	Accepted	4.22	Accepted
9	Equilibrium of forces	3.12	Accepted	3.90	Accepted
10	Simple Harmonic Motion	3.24	Accepted	3.88	Accepted
Aggregate calculated mean		**2.88**	**Accepted**	**3.46**	**Accepted**

Source: Researchers' field work, 2020.

Table 1 showed the analyzed response of Physics teachers on the topics that can be taught using ethnoscience learning experiences for the theme "Interaction of matter, space and time" in the Physics curriculum. Physics teachers in Urban and Rural schools both accepted that "Scalers and Vector" [Urban x = 2.16; Rural x = 2.11] do not have means of using ethnoscience learning experiences to teaching the topic. The study also indicated that while Physics teachers in Urban settlement rejected that the topic "Motion and equations of Uniform Accelerated Motion" cannot be taught using ethnoscience learning experience [Urban x = 2.24], the Physics teachers in Rural settlement accepted that the topic can be taught using ethnoscience learning experience [Rural x = 2.77]. The aggregate calculated mean response for both Urban and Rural Physics teachers indicated [x = 2.88] and [x = 3.46] respectively. The findings of the study therefore revealed that the theme "Interaction of Matter, Space and Time" can be taught using ethnoscience learning experiences.

H_{01}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Interaction of Matter, Space and Time"** that can be taught using ethnoscience learning experience.

Table 2: t-test computation on the theme "Interaction of Matter, Space and Time "based on Physics teachers mean response in urban and rural schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	.024	.877	3.108	241	.082	1.94493	.62576	.71227	3.17759
	Equal variances not assumed			3.118	226.517	.087	1.94493	.62383	.71567	3.17419

Table 2 showed the t-test inferential statistics between urban and rural Physics teachers mean values on their response on the topics that can be taught using ethnoscience learning experiences for the theme "Interaction of matter, space and time" in the Physics curriculum. The calculated t value is obtained as 0.082 at a degree of freedom of 241 at 0.05 level of significance. Therefore, the hypothesis implies that there is no significant difference between Physics teachers mean response on topics in the themes "interaction of matter, space and time" that can be taught using ethnoscience learning experience.

Research Question 2: Which of the following topics in the themes **"Conservation Principle"** can be taught using ethnoscience learning experiences in the Physics curriculum?

Table 3: Analysis of Physics teachers' response on the theme "Conservation Principle"

s/n	Conservative Principle	Teachers in Urban Schools N = 138		Teachers in Rural Schools N = 138	
		Mean	Decision	Mean	Decision
1	Work, Energy and Power	2.73	Accepted	2.59	Accepted
2	Heat Energy	3.31	Accepted	2.64	Accepted
3	Electric Charges	2.34	Rejected	2.20	Rejected
4	Linear Momentum	2.72	Accepted	2.55	Accepted
5	Mechanical Energy	2.66	Accepted	2.54	Accepted
Aggregate calculated mean		**2.75**	**Accepted**	**2.50**	**Accepted**

Source: Researchers' field work, 2020.

The analyzed data in Table 3 indicated that among the topics that is in the theme "Conversation Principle". Physics teachers in urban [x = 2.34] and rural [x = 2.20] schools expressed that the topic electric charges cannot be taught through ethnoscience learning experiences. Based on the aggregate calculated mean, the findings of the study revealed that both urban and rural teachers accepted that the theme "Conservative Principle" can be taught using ethnoscience learning experiences with mean [x = 2.75] and [x = 2.50] respectively.

H_{O2}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Conservation Principle"** that can be taught using ethnoscience learning experience.

Table 4: t-test computation on the theme "Conservation Principle"based on Physics teachers mean response in urban and rural schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Score	Equal variances assumed	8.800	.463	2.641	241	.074	.88364	.33458	.22458	1.54271
	Equal variances not assumed			2.520	177.196	.083	.88364	.35061	.19173	1.57556

The t-test inferential statistics shown in Table 4 is the analysis of urban and rural Physics teachers mean values on their response on the topics that can be taught using ethnoscience learning experiences for the theme "Interaction of matter, space and time" in the Physics curriculum. The calculated t value is obtained as 0.074 at a degree of freedom of 241 at 0.05 level of significance. Therefore, the hypothesis implies that there is no significant difference between Physics teachers mean response on topics in the themes "interaction of matter, space and time" that can be taught using ethnoscience learning experience.

Research Question 3: Which of the following topics in the theme **"Wave: Motion without transfer"** can be taught using ethnoscience learning experiences?

Table 5: Analysis of Physics teachers' response on the theme Wave: Motion without transfer

s/n	Wave: Motion without transfer	Teachers in Urban Schools N = 138		Teachers in Rural Schools N = 138	
		Mean	Decision	Mean	Decision
1	Production and Propagation of Waves	4.21	Accepted	3.33	Accepted
2	Types of Wave	2.77	Accepted	2.54	Accepted
3	Properties of Waves	2.94	Rejected	2.51	Accepted
4	Light Waves	2.63	Accepted	2.57	Accepted
5	Sound Waves	2.81	Accepted	2.55	Accepted
6	Applications of Light and Sound Waves	2.72	Accepted	2.51	Accepted
7	Electromagnetic Waves	2.31	Rejected	2.37	Rejected
Aggregate calculated mean		**2.91**	**Accepted**	**2.63**	**Accepted**

Source: Researchers' field work, 2020.

Analysis on Table 5 indicated Physics teachers' response on the topics in the theme "Wave: Motion without transfer". It was shown that the teachers in urban and rural schools mentioned that the topic electromagnetic waves cannot be taught through ethnoscience learning experiences. The findings of the study revealed that Physics teachers in urban [x = 2.91] and rural [x = 2.63] schools accepted that the theme "Wave: Motion without transfer" can be taught using ethnoscience learning experiences.

H_{03}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes "**Waves: Motion without materials transfer**" that can be taught using ethnoscience learning experience.

Table 6: t-test computation on the theme "Waves: Motion without materials transfer" based on Physics teachers mean response in urban and rural schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	6.296	.256	1.710	241	.089	.93623	.54766	.14257	2.01504
	Equal variances not assumed			1.702	220.337	.090	.93623	.55000	.14770	2.02017

Table 6 shows the t-test computation on the theme "Waves: Motion without materials transfer" based on Physics teachers mean response in urban and rural schools. The calculated t value is obtained as 0.890 at a degree of freedom of 241 at 0.05 level of significance. Therefore, the hypothesis implies that there is no significant difference between Physics teachers mean response on topics in the themes "Waves: Motion without materials transfer" that can be taught using ethnoscience learning experience.

Research Question 4: Which of the following topics in the theme "Field at rest and in motion" can be taught using ethnoscience learning experiences?

Table 7: Analysis of Physics teachers' response on the theme "field at rest and in motion"

s/n	Field at rest and in motion	Teachers in Urban Schools N = 138		Teachers in Rural Schools N = 138	
		Mean	Decision	Mean	Decision
1	Description and properties of fields	2.62	Accepted	2.57	Accepted
2	Gravitational Fields	2.94	Accepted	2.91	Accepted
3	Electric fields	2.93	Accepted	2.95	Accepted
4	Magnetic fields	2.74	Accepted	2.63	Accepted
5	Electromagnetic field	1.74	Rejected	1.57	Rejected
6	Simple A.C Circuit	2.33	Rejected	2.26	Rejected
	Aggregate calculated mean	**2.55**	**Accepted**	**2.50**	**Accepted**

Source: Researchers' field work, 2020.

Table 7 showed the analysis of Physics teachers' response if ethnoscience learning experiences can be used to teach topics in the theme field at rest and in motion. The study indicated that Physics teachers in urban and rural schools mentioned that topics like electromagnetic field [urban x = 1.74; rural x = 1.57] and simple A.C circuit [urban x = 2.33; rural x = 2.26] cannot be taught using ethnoscience learning experiences. Based on the Aggregate calculated mean for both urban [x = 2.55] and rural [x = 2.50] school Physics teachers, the findings of the study revealed that they accepted that the theme "Field at rest and in motion" can be taught using ethnoscience learning experiences.

H_{04}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Field at rest and in motion"** that can be taught using ethnoscience learning experience.

Table 8: t-test computation on the theme "Field at rest and in motion" based on Physics teachers mean response in urban and rural schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	4-.010	.922	1.972	241	.072	.91346	.46324	.00095	1.82597
	Equal variances not assumed			1.978	226.404	.049	.91346	.46188	.00333	1.82358

Table 8 showed the analysis of urban and rural Physics teachers mean values response on the topics that can be taught using ethnoscience learning experiences for the theme "Field at rest and in motion"in the Physics curriculum. The calculated t value is obtained as 0.072 at a degree of freedom of 241 at 0.05 level of significance. Therefore, the hypothesis implies that there is no significant difference between Physics teachers mean response on topics in the themes "Field at rest and in motion" that can be taught using ethnoscience learning experience.

Research Question 5: Which of the following topics in the theme "Energy Quantization and Duality of Matter" can be taught using ethnoscience learning experiences?

Table 9: Analysis of Physics teachers' response on the theme energy quantization and duality of matter

s/n	Energy Quantization and Duality of Matter	Teachers in Urban Schools N = 138		Teachers in Rural Schools N = 138	
		Mean	Decision	Mean	Decision
1	Particulate nature of matter	2.22	Accepted	2.07	Accepted
2	Elastic properties of solids	3.31	Accepted	3.24	Accepted
3	Crystal structure	2.94	Accepted	2.63	Accepted
4	Fluids at rest and in motion	3.22	Accepted	3.14	Accepted
5	Molecular theory of matter	2.13	Rejected	2.01	Rejected
6	Models of the atom	2.05	Rejected	1.94	Rejected
7	Nucleus	2.20	Rejected	2.02	Rejected
8	Energy quantization	1.97	Rejected	1.87	Rejected
9	Waves particle paradox	1.78	Rejected	1.80	Rejected
	Aggregate calculated mean	**2.42**	**Rejected**	**2.30**	**Rejected**

Source: Researchers' field work, 2020.

The analyzed data in Table 9 indicated that among the topics that is in the theme energy quantization and duality, Physics teachers in urban and rural located schools accepted that topics such as Particulate nature of matter [urban x = 2.22; rural x = 2.07], Elastic properties of solids[urban x = 3.31; rural x = 3.24], Crystal structure [urban x = 2.94; rural x = 2.63] and Fluids at rest and in motion [urban x = 3.22; rural x = 3.14] can be taught using ethnoscience learning experiences. However, other topics such as Molecular theory of matter, Models of the atom, Nucleus, Energy quantization and Waves particle paradox were rejected indicating that they cannot be taught using ethnoscience learning experiences. Based on the aggregate calculated mean [urban x = 2.42] and [rural x =2.30], the findings of the study revealed that the theme energy quantization and duality cannot be taught using ethnoscience learning experiences.

H_{05}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Energy Quantization and Duality of Matter"** that can be taught using ethnoscience learning experience.

Table 10: t-test computation on the theme "Field at rest and in motion" based on Physics teachers mean response in urban and rural schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	4.760	.030	1.791	241	.075	1.32547	.74001	.13224	2.78317
	Equal variances not assumed			1.848	240.601	.066	1.32547	.71721	.08735	2.73829

Table 10 showed the t-test computation between urban and rural Physics teachers mean values on their response on the topics that can be taught using ethnoscience learning experiences for the theme "Field at rest and in motion"in the Physics curriculum. The calculated t value is obtained as 0.075 at a degree of freedom of 241 at 0.05 level of significance. Therefore, the hypothesis implies that there is no significant difference between Physics teachers mean response on topics in the themes "Field at rest and in motion"that can be taught using ethnoscience learning experience.

Research Question 6: Which of the following topics in the theme "Physics in technology" can be taught using ethnoscience learning experiences?

Table 11: Analysis of Physics teachers' response on the theme "Physics in technology"

s/n	Energy Quantization and Duality of Matter	Teachers in Urban Schools N = 138		Teachers in Rural Schools N = 138	
		Mean	Decision	Mean	Decision
1	Battery and Electroplating	2.14	Rejected	2.11	Accepted
2	Electrical continuity testing	2.08	Rejected	1.96	Accepted
3	Solar collector	1.90	Rejected	1.70	Accepted
4	Solar energy panel	2.00	Rejected	1.80	Accepted
	Aggregate calculated mean	**2.03**	**Rejected**	**1.89**	**Rejected**

Source: Researchers' field work, 2020.

Table 11 showed the analyzed response of Physics teachers on the topics that can be taught using ethnoscience learning experiences for the theme "Physics in technology" in the Physics curriculum. The findings of the study revealed that Physics teachers both in urban [x = 2.03] and rural [x = 1.89] schools opined that all topics in the theme Physics in technology cannot be taught using ethnoscience learning experiences.

H_{06}: There is no significant difference between mean responses of Physics teachers in Urban and Rural schools on topics in the themes **"Physics in Technology"** that can be taught using ethnoscience learning experience.

Table 10: t-test computation on the theme "Physics in Technology" based on Physics teachers mean response in urban and rural schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	.283	.595	1.816	241	.415	1.53292	.65278	.51881	.75297
	Equal variances not assumed			1.906	182.883	.366	1.53292	.58837	.49378	.62795

Table 12 showed the analysis of urban and rural Physics teachers mean values response on the topics that can be taught using ethnoscience learning experiences for the theme "Physics in technology" in the Physics curriculum. The calculated t value is obtained as 0.072 at a degree of freedom of 241 at 0.05 level of significance. Therefore, the hypothesis implies that there is no significant difference between Physics teachers mean response on topics in the themes "Field at rest and in motion" that can be taught using ethnoscience learning experience.

Discussion of findings

Quality education that is geared towards enhanced human capital development that avails an egalitarian society is vastly hinged on the curriculum structure of that is employed for training in that society. This is obvious because the education curriculum is a tool that translate the learning objectives into societal reality. The study was concerned with extracting ethnoscientific learning experiences for Physics teaching with the aim for curriculum implementation. The findings of the study therefore revealed that the theme [Interaction of Matter, Space and Time], [Conservative Principle], [Waves: Motion without material transfer] and [Fields at rest and in motion] can be taught using ethnoscience learning experiences as stated by Physics teachers both in urban and rural schools. Also the study indicated that themes [Energy quantization and duality of matter] and [Physics in technology] cannot be taught using ethnoscience learning experiences.

The findings of the study carried out by Rahmawati, Subali and Sarwi (2019) substantiates with the outcome of this study were it was indicated that the use of ethnoscience based module have significant impact on students' learning by promoting active participation and independency towards the learning of science. Understanding of Physics concepts requires students to acquire details that are simple and concrete which are related to their environment. When learning is derived from the immediate environment blended with local wisdom and systematic programme through a module students' achievement is increased (Sudarim, Nuswowati&Sumarni, 2017). Other research findings also such as the one revealed by Ajayi, Achor and Agogo (2017) that teaching students the concept of separation techniques in chemistry using ethnochemistry approach enhances their performance significantly. Also Okwara and Upu (2017) showed that there is a significant difference in the mean achievement and interest scores of students taught using Ethnoscience Instructional Approach and their counterparts taught using Demonstration Teaching Method (DTM). Importantly, developing ethnoscience curriculum package for teaching Physics will help students understand the core of science and the connection between cultural and social domain by exploring scientific knowledge from the environment.

Conclusion

The teachers are seen as the curriculum implementers, which implies that they are major stakeholders considered during the curriculum development and implementation process. From the findings of the study, it was concluded that Physics teachers both in urban and rural schools accepted that themes in the Physics curriculum such as Interaction of Matter, Space and Time, Conservative Principle, Waves: Motion without material transfer and Fields at rest and in motion can be taught using ethnoscience learning experiences. Teaching with Physics through the ethnoscience learning package with the linking of indigenous scientific knowledge augments students' motivation towards and subsequent understanding of Physics concepts.

Recommendation

In light of the above findings, the study therefore recommended that Physics curriculum stakeholders and planners should consider the integration of ethnoscience learning experiences in the Physics curriculum so that the abstract nature of Physics learning will be eliminated.

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