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PHYSICIST ENTREPRENEURIAL DEVELOPMENT: ASCERTAINING STUDENT'S LEVEL OF SKILLS ACQUISITION, READINESS AND IMPLICATIONS FOR NATIONAL DEVELOPMENT

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Abstract

This paper investigated the level of entrepreneurship development among Physics students with regards to their theoretical and practical acquisition of entrepreneurship skills as well as their level of readiness or preparedness for engaging in small to medium scale enterprise. The population for this study comprised all the physics students in NCE and Degree programme in 2015/2016 academic session at Federal College of Education (Technical) Omoku, River State. A total of twenty students were used for the study. The descriptive survey research design was adopted in carrying out the study. Five research questions and five hypotheses guided the study. The instrument used to obtain data was a 4-point Likert scale questionnaire called, "Physics Entrepreneurship Skills, Readiness and Implications questionnaires (PESRIQ)", which had twenty-items. Data was analyzed using descriptive statistics. Differences in mean were tested using T test statistic. The results revealed that Physics students had high skills level and were prepared to venture into the business world and also develop themselves further (mean>2.5; p<0.05). They all agreed that Physics entrepreneurship development enhances national development due to creation of wealth and job opportunities, which will among other things enhance the well-being of the individuals and people connected to them. It was therefore recommended that a formal Physics Entrepreneurship program at all levels of educational institutions should be introduced to provide training and empowerment for physicists as entrepreneurs.

Key words: *Entrepreneurship, theoretical and practical acquisition, skill, statistics.*

Introduction

Some people have referred to the 21st century as the "entrepreneurial age". This is because nations are being controlled by entrepreneurs, men, women and youth who have taken their destinies in their own hands by risking their resources (time, money and energy) to establish and run their own businesses. Entrepreneurship development is regarded as a means of stimulating economic growth through the creation of job opportunities, the development of local technological base and conservation of foreign exchange earnings (Ibitoye, 2014; Shamalin, 2016).The high rate of youth unemployment in the country, the low standard of living and the hope of technological transfer which is tending towards a mirage have led to a renewed interest in entrepreneurship development in Nigeria. Although, several attempts have been made at encouraging entrepreneurial activities in Nigerian in the past, there is no gain saying the fact that these initiatives failed to produce the desired results. Poor implementation, inadequate and inefficient infrastructural facilities and over bearing bureaucracy have been identified

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as the constraints to entrepreneurship development. One vehicle through which entrepreneurial development is achieved is science and technology education. Scientific entrepreneurs employ science process skills and attitude and transform scientific principles and theories into goods and services. One of such field of scientific endeavour involves physics. Physics, according to Miriam-Webster Dictionary is a science that deals with matter and energy and their interactions in the fields of mechanics, acoustics, optics, heat, electricity, magnetism, radiation, atomic structure, and nuclear phenomena. Physics is the science that attempts to describe how nature works using the language of mathematics. It is often considered the most fundamental of all the natural sciences and its theories attempt to describe the behavior of the smallest building blocks of matter, light, the Universe and everything in between. Physics is the study of your world and the world and universe around you (Holmer, 2006). The importance of physics to society today is most easily represented by the percentage of reliability on technology. Many of the technologies that are continually changing the world we live in can be directly traced back to important physics research. Physics is a driver of innovation, the results of which can be seen in all areas of industry. Technologies such as the laser, found in numerous industrial and commercial sectors, have their roots in physics research and development. Cutting-edge research – based in the developed countries has produced new materials like graphene, which is now being used in corporate research and Development laboratories around the world, and physics-trained people are at the heart of a diverse range of sectors, from communications and transport to film and computer games. Entrepreneurship education provides students with excellent analytical, problem solving and quantitative skills (Arion, 2015; Modini, 2017) .A successful Physicist entrepreneurship programme will most likely to make the average Nigerian youth discover the entrepreneurial talents in him/her and therefore be guided to take the risk of starting a business, impact the requisite skills and knowledge needed to successfully launch and grow a business and promise information on where and how to get both financial and technical assistance when the need arises. In general, a physics degree teaches skills that are extremely valuable to anyone contemplating to start a business, quantitative skills and an instinct to see the world in terms of things that can be measured, the ability to model complex systems with simple models that provide insight, and an instinct to test hypotheses by conducting experiments. The last of these is particularly important for start-ups. Areas in which cognitive knowledge and practical skills can be applied include optics, mechanics, thermodynamics, sound, electricity and magnetisms. Skills such as measurement using precision instruments, calculation, designing, construction, and analysis are to be mastered for entrepreneurial initiatives. Entrepreneurship skills acquired in the process include critical thinking, problem solving, analysis etc. In view of the mandatory entrepreneurship education programme for undergraduate students of tertiary institutions in Nigeria, this study therefore investigated on the level at which physics students in Federal college of Education (Technical) Omoku have acquired theoretical and practical knowledge and their readiness to use the same to initiate entrepreneurial activities through establishment of small scale business in order to create goods and services, generate capital, create jobs and contribute meaningfully to community development.

Concept of Entrepreneurship and Entrepreneur

The word, entrepreneurship is derived from the French word "entreprendre" meaning to undertake" (Cunningham & Lischeron, 1991). Thus entrepreneurship is commonly defined as the process of creating a business (Shanae & Venkataraman, 2000). An entrepreneur therefore is defined as one that creates a business. The characteristics of seeking opportunities, taking risks beyond security and having the tenacity to push an idea through to reality combine into special perspectives that permeate

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entrepreneurs. To capture the above perspective, several authors have attempted a comprehensive definition of an entrepreneur. Introducing new products and services, expanding into new markets, inventing new processes and acquiring raw materials in a new way are the scopes of entrepreneurship (Wennekers et al., 2002). An entrepreneur is someone who creates a business out of nothing. In other words, someone who understands either implicitly or explicitly that wealth is not a conserved quantity (Shmailan, 2016) .

Entrepreneurship and Physics linkages

In the developed countries, the knowledge of physics has helped the gone beyond intimidation and great achievement in all aspect of the economic, for instance in the lunching of a war rocket, piloting of jet plane and a lot of calculation metrological science, laser jet, determine time and space measurement and so on (Arion, 2013, Crowder, 2014; Utibe & Agah, 2014, Alsi et al., 2015). Studying physics should be all encompassing in all tertiary or high school of learning and it citizen should be encourage to study and regards be given to it, just as someone studying medical, law, engineering and banking courses. (Usman, 2012) stated that the technological potentials of any nation can be gauged by the quality of its physics education, since the technological culture of her citizens is firmly rooted in Physics. A physicist is a scientist who specializes in physics research study a wide range of physical phenomena in many branches of physics spanning all length scales: from sub atomic particles of which all ordinary matter is made (particle physics) to the behavior of the material universe as a whole (AIS Statistical Research centre, 2006). They utilize scientific methods to formulate and test hypotheses that are based on observation of the natural world. The aim of physics in this regard is to use the results of these experiments to formulate scientific laws, which can then be used to predict other phenomena.

Physics and entrepreneurial development potentials

Several opportunities abound for physicists in entrepreneurial development, few of which include; transportation, aviation, medicine, industry, warfare, peace, entertainment and electrification as well as institutional teachers that offers to teach curriculum subjects to students (Onwioduokit, 2013). Physicists are primarily interested in things that can be measured and modelled, and when faced with an unfamiliar kind of quantity, their first question is “how many orders of magnitude is it?”(Crowder, 2014). People with a business background worry about targets and objectives and incremental improvements. Physicists are concerned with the underlying model here and how they can increase efficiency or performance by an order of magnitude?” In short, physicists think big. They understand scale. And they are ideally placed to spearhead innovations that disrupt entire industries. Physicists are highly quantitative and hence are comfortable with number. Physicists can model. It turns out that this is an art only few master (Zurbuchen, 2012)

Among the recent employer of physic entrepreurer are find in the medical industries, government institutions like educational sector, banking industries as a result of their mathematical knowledge and so on. (AIP Statistical Research Centre, 2006). Furthermore, physic entrepreurer are concerned with number measurement, modelling and things that make up life instruction as describe by vector and scalar quantities or of determinative orders of magnitude. This has earned them the entrepreneurial inventions of most appliance both for the good and the bad today in the society. Examples include Larry Page, the founder of Google and Android mobile operating system, Elon Musk, the CEO of SpaceX, a company that designs, manufactures and launches advanced rockets and spacecraft, and also Tesla, a company making electric cars, and Geordie Rose the founder of D-Wave company that built the world’s first commercial quantum computer (Crowder, 2014).

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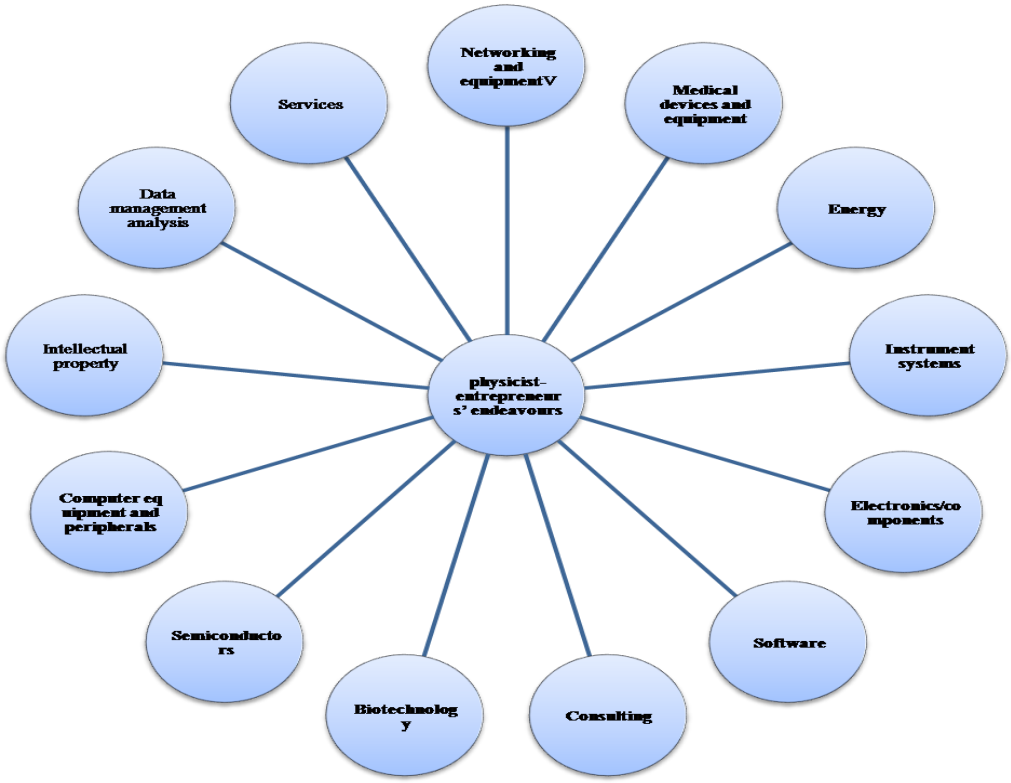

Figure 1. Fields of physicist-entrepreneurs' endeavours
Adapted from: http://physicstoday.scitation.org/doi/full/10.1063/PT.3.1821

Challenges of entrepreneurial physicist in Nigeria

Nigeria as a nation with developing economy has suffered appreciably from high rate of unemployment, inconsistent power supply, inadequate food and water supply, poor medical care, as well as high corruption cases coupled with un-conducive working and living environment which is due to low level of scientific and entrepreneurial development (Anyakoha, 2006). Concerted efforts made at tackling some of these menace was channeled to producing scientists at various levels; especially in physics for national and entrepreneurial development. For instance, the Federal Government of Nigeria through the Federal Ministry of Education in 2008 reviewed the physics curriculum physics in line with the MDGs and NEEDS (Utibe & Agah, 2014).

Despite the above effort Nigerian government is still seen as the sole provider of employment to the teeming population of over 160 million people. The truth about this can be seen in the number of people who present themselves for public/government employment. According to Oteje (2013), studies by the National Institute for Social Research and the World Bank revealed that more than 55 per cent of Nigerians of working age are unemployed, representing one in every five adults.

Research Questions

1. To what extent have Physics students acquired enough theoretical knowledge of physics to enable them engage in small scale entrepreneurial ventures in their community?
2. To what extent have Physics students acquired enough practical and entrepreneurship skills?
3. What is the extent of Physics students' readiness to engage in entrepreneurship ventures?

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4. What is the readiness of Physics students for self-development on their chosen entrepreneurship ventures?
5. What are the perceived implications of entrepreneurship in the area of Physics on national development?

Research Hypotheses

H_{01}: Physics students have not acquired enough theoretical knowledge of physics to enable them engage in small scale entrepreneurial ventures in their community

H_{02}: Physics students have not acquired enough practical skills in physics to enable them engage in entrepreneurial ventures in the community

H_{03}: Physics students have not acquired enough theoretical and practical skills in physics to enable them engage in entrepreneurial ventures in the community

H_{04}: Physics students have not acquired enough theoretical and practical skills in physics to motivate them engaging in entrepreneurial ventures in the community

H_{05}: Physics entrepreneurship will not have implications for national development.

Methodology

The study adopted descriptive survey design.The population of study comprises students of the school of Science Education- physics department in Federal College of Education (Tech) Omoku. Rivers state, Nigeria. The study sample consisted of twenty respondents, comprising female and male students in Physics department from 2013/14 to 2016/2017 sessions. The respondents were purposely sampled using their mark and attendance list. The instrument was a Physics Entrepreneurship Skills, Readiness and Implications questionnaires (PESRIQ). It had twenty-items based on four point Likert scale of mixed structured rated as very high level, high level, very low level and low level/strongly agree/agree, disagree and strongly disagree, rated 4, 3, 2 and 1 respectively. Face and content validity of test instrument was performed by experts in the field.

Data Analysis

The responses obtained from the respondents constituted the data for the study. It was arranged into frequency distribution tables and analyzed using statistical mean. Significant differences in mean responses were determined by paired T test at 95% confidence limit at degree of freedom 7. A decision Rule was set as follows: Mean score of 2.5 and above was judged accepted as a factor in positive response, while an item with mean below 2.5 was rejected

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Results

Research Question One

Table 1. Responses on the rate of Physics theoretical skills acquired

S/No	Items	Very* High level (4)	High* level (3)	Low* Level (2)	Very* Low level (1)	Total (fx/N)	Mean	Remark
1	Understanding of the theories behind the major concepts in physics (mechanics, optics, electromagnetism, heat, quantum, electricity etc).	12	39	2	3	56	2.80	Accepted
2	Understanding that principle of physics which are in relationship to handling of equipment / instruments	20	27	4	4	55	2.75	Accepted
3	Relating the knowledge acquired in the theoretical physics to real life practical application	20	21	10	3	54	2.70	Accepted
4	Principles of physics can be applies to everyday life situation	44	18	4	1	67	3.35	Accepted

* (fx=Product frequency and Likert point); N=20

From table 1, above it was observed that the Mean score of the student ranges from $2.8 \geq 3.35$, shows the level of physics student in their theoretical knowledge is very high and is accepted as a factor in positive response, against the assume mean below 2.5 was rejection.

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Research Question Two:

Table 2. Responses on the rate of Practical and Physics Entrepreneurship skills acquired

S/No	Items	Very* High level (4)	High* level (3)	Low* Level (2)	Very* Low level (1)	Total (fx/N)	Mean	Remark
5	Demonstration of measuring skills	24	33	4	1	62	3.10	Accepted
6	Ability to design and construction	32	21	8	1	62	3.10	Accepted
7	I can showcase my initiative/ entrepreneur skills	16	30	6	3	55	2.75	Accepted
8	I can manipulate my calculative skill	12	30	8	3	53	2.65	Accepted

* (fx=Product frequency and Likert point); N=20

From table 2, above it was observed that the Mean score of the student ranges from $2.65 \geq 3.10 < 2.5$, which implies that the level of acquisition of practical and entrepreneurship skills in physics is accepted as high.

Research Question Three

Table 3. Responses on the level of readiness to start up small –medium scale business using skills gained in Physics

S/No	Items	Very* High level (4)	High* level (3)	Low* Level (2)	Very* Low level (1)	Total (fx/N)	Mean	Remark
9	To what extent can your community depends on your practical skill to for SMES development?	24	21	6	4	55	2.75	Accepted
10	How would you rate your application of practical skill for enhancement to meet the need of the SMES to encourage local production?	12	36	2	4	54	2.70	Accepted

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11	Your level of skill acquisition gain be adequate enough to support SMES establishment.	28	15	8	4	55	2.75	Accepted
12	Ability to source for and use locally available material to construct product, employing the skills acquired from physics.	28	21	8	2	59	2.95	Accepted

* (fx=Product frequency and Likert point); N=20. From table 3, above it was observed that the Mean score of the student ranges from 2.70 ≥ 2.95, shows the level of application of practical skills for establishment of small and medium business is high and is accepted as a factor in positive response, against the assume mean below 2.5 .

Research Question Four

Table 4. Responses on the level of readiness to start up small –medium scale business using skills gained in Physics

S/No	Questionnaire items	Very* High level (4)	High* level (3)	Low* Level (2)	Very* Low level (1)	Total (fx/N)	Mean	Remark
13	Level of willingness for further self-development on the skill acquired in the educational sector	40	24	2	1	67	3.35	Accepted
14	Rate your level of preparedness to pay a sacrifice for further self-development training on your learned skill via the education sector.	44	18	2	2	66	3.30	Accepted
15	How would you rate your level of self-development, even if it amount to descending below your educational status	44	21	2	1	68	3.40	Accepted
16	Rate the level of recommendation for higher intuitions student to be involved on the job training/ attachment to technician on the job	32	27	4	1	64	3.20	Accepted

* (fx=Product frequency and Likert point); N=20

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From table 4, it was observed that the Mean score of the student ranges from 3.20. ≥ 3.40, shows the level of physics student preparedness for self-development is very high and is accepted as a factor in positive response, against the assume mean below 2.5 was rejection.

Research Question Five

Table 5: Responses on the perceived implications of entrepreneurship in the area of Physics on national development?

S/No	Questionnaire items	Very* High level (4)	High* level (3)	Low* Level (2)	Very* Low level (1)	Total (fx/N)	Mean	Remark
17	Enables self-employment as the skills acquired is used to establish small scale entrepreneur	48	18	2	1	69	3.45	Accepted
18	Stimulate wealth creation and alleviate poverty	24	33	4	1	62	3.10	Accepted
19	Provides job and avenues for training of other persons(apprentice)	48	15	2	2	67	3.35	Accepted
20	Ability to earn a living, reduce crimes and promote the general well-being of the entrepreneur and	56	12	2	1	71	3.55	Accepted

* (fx=Product frequency and Likert point); N=20

From table 5, above it was observed that the Mean score of the student ranges from 3.10 ≥ 3.45, shows a strong determination of physics student in using the skills in entrepreneurial training in propelling national development is very high and is accepted as a factor in positive response, against the assume mean below 2.5 was rejection.

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Hypotheses Testing

Paired samples tests results for hypotheses H_{o1}-H_{o5} conducted at degree of freedom 7 and alpha level of 95% are shown in table 6 below:

Table 6. t-Test analysis of paired samples

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1 (Physics Theoretical Knowledge)	High level - Low level	21.250	11.222	3.968	11.868	30.632	5.356	7	.001
Pair 2 (Physics Practical Skills)	High level - Low level	20.500	9.350	3.306	12.683	28.317	6.201	7	.000
Pair 3 Readiness for SMEs applications	High level - Low level	18.375	6.739	2.383	12.741	24.009	7.712	7	.000
Pair 4 (Readiness for Self development)	High level - Low level	29.375	10.099	3.570	20.932	37.818	8.227	7	.000
Pair 5 (Implications on Community dev)	Positive – Negative	29.875	16.949	5.992	15.705	44.045	4.986	7	.002

From Table 6, all paired responses (pairs 1-5),results show that Physics students had gained high level of theoretical and practical cum entrepreneurship skills were significant for T-test ($p<0.05$), Null hypotheses were rejected, which implied that in the subject and are ready to open small scale businesses in their local community as well as increase their knowledge and capacity to ensure that their entrepreneurial competence is adequate to create money and jobs.

Discussion

Tables 1 and 2 indicates Physics students in FCE (T) Omoku have high level of theoretical knowledge and practical and entrepreneurship skills that can be transformed into or enable startup of small-medium scale enterprise (mean>2.5). As also shown in result of T test, which was significant ($p<0.05$) (table 6). Theoreticals well as practical skills in physics entrepreneurship programme are the perfect bridge between the core physics curriculum known and the practical skills needed in the real world (Hilborn et al., 2003; Alasi et al., 2015). Entrepreneurial skills and attitudes can be brought into the academic environment through several methods. Zurbuchen (2012) opines that a physics student usually have excellent analytical, quantitative and problem solving skills, with the ability to synthesize and analyze large quantities of data and present their analysis in an easily understandable form. When

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faced with a particular problem they are taught to systematically identify all factors contributing to the problem and work out how those factors interact in order to solve the problem. More so, the greatest skill a physics student develops is a sense of wonder about how things work. Physics teaches us a method of systematic thinking and also the theories necessary to allow us to understand how the things we rely on (technology) actually work. These are valuable skills that can be applied in a range of careers.From tables 3 and 4, Physics students readiness to engage in small scale entrepreneurial schemes and self-development respectively were rated high (mean >2.5). Significant difference was observed in the t-test statistics ($p<0.05$) (table 6). The inclination of students towards entrepreneurship initiatives was positive. According to Pittaway and Jason (2007)and Uduak and Aniefiok (2011)entrepreneurship education have encouraged self-employment and career intention of undergraduate students after graduation to do business. In a related study, Ehirheme and Ekpeyong, (2014) reported that all respondents agreed that entrepreneurship education provides adequate preparation for their post-graduation employment and self-employment creation. Alasi et al., (2015) also reported the potential of entrepreneurship in career development .Table 5 indicates that students agreed that physics entrepreneurship programme was significantly linked to national development($^{x} = 3.10, 3.45; p < 0.05$)Physicists are old hands at entrepreneurship. They played an important role in the first generation of technology-developing companies. Physicists are involved in startups either as founders or employees. They work at startup companies to create and improve marketable technologies. According to Wennekers et al., (2002), people may own a business simply to generate a living for their families. Ibitoye (2014) sees entrepreneurship as an antidote to unemployment.

Conclusion

Nigeria is a country blessed with diverse source of natural resources in every nook and cranny of it environment, which ranges from human talent to mineral deposit. The inability to harness this natural gift on the environment has brought the unending poverty on it citizenship. Most devastating of it all, the leadership has not foreseen the need to focus on proper human capacity training and development that will in turn lead to the scientific collaboration for the know how in utilizing of the natural resources through effective entrepreneurships training of it student in our various institutions.

Recommendations

In view of this research, proper planned entrepreneurships scheme with implementation facilitator in Nigeria will lead to a step forward in the development of the state of the nation in all aspect of it economy

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