Evaluation of Entrepreneurial Skill Development in Physics Education: Implications from Secondary School Teachers' and Students' in Anambra State.

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Abstract
This study evaluated secondary school teachers' and students' experiences in entrepreneurial skills in Physics in Anambra State. The study adopted a descriptive survey design. 6,745 physics students and 27 Physics teachers in 21 public secondary schools in Onitsha North and Oyi local government areas formed the population of the study. A census of 27 Physics teachers were used for the study while a simple random sampling technique was used to sample 673 physics students for the study. Five research questions were posed to guide the study. The instrument used in data collection was titled "Physics and Entrepreneurial Skills: Evaluation of Teachers' and Students' Experiences in Secondary Schools Questionnaire". Face and content validity of the instrument were carried out by experts in Physics education and measurement and evaluation. Test-retest and Cronbach Alpha methods of reliability were employed to test the stability and internal consistency of the items. A reliability coefficient obtained forthe selected Physics teachers were 0.81 and the sampled Physics students were 0.78 respectively. The research questions were answered using descriptive statistics of mean and standard deviation. Results from the study revealed that simple a.c circuit, heat energy measurement, electrical continuity testing, battery, electromagnetic fluid, principles of fluctuation, potential energy, electric field, fluid at rest and in motion, solar collector are topics in physics that could expose students to entrepreneurial skills. The study also revealed that students acquired entrepreneurial skills such as electric installations and wiring, load calculations, repair of generators and household appliances, installation and maintenance of solar panels. It was recommended that students should be engaged in student-centered and active process of learning such as discoveries, hands-on and minds-on activities as to enable students discover and create entrepreneurial skills themselves as well galvanizing students' intentions to become economically empowered.

Keywords*: Entrepreneurial Skills, Teachers and students experiences, Physics.*

Introduction

Education is seen as a vital instrument for human capital development. The synergy between education and society is such that the needs of the society are reflected in the national philosophy and objectives of education. Therefore the school curricular at various levels of education reflects the national ethos. Science and technology are recognized as powerful instruments for national development. Realizing that, Okeke &Nwoye, (2019) opined that Nigeria had to adjust her education system and diversify her curriculum to integrate academic knowledge with technical and vocational skills in order to empower students with relevant knowledge and skills. The aim is to make students self-reliant and useful members of the society (Federal Republic of Nigeria, 2004). The National Policy on Education widened the scope of secondary school curriculum to integrate technical and vocational studies intending to empower students for self-employment upon graduation. In a bid to ensure that the young

school leavers from Nigeria's educational system acquire appropriate vocational, technical and entrepreneurial skills for economic empowerment and national development, different systems of education (6-5-4, 6-3-3-3 and at present 9-6-4) have been adopted at different times (Okeke&Nwoye, 2019). Additionally, global changes in science curriculum as a result of knowledge explosion and new wave in science and technological development demand for qualitative science teaching.

Science teaching and particularly physics education aims at equipping the students with appropriate scientific knowledge and skills which will enable them to explore their surrounding and become more creative and self-reliant. Physics which is the study of matter, energy and their interactions is an international enterprise which plays a key role in the future progress of humankind (Jones, 2008). According to the Nigerian Educational Research and Development Council (NERDC 2007), physics is crucial for effective living in the modern age of science and technology and the best way of achieving this is through acquisition of entrepreneurial skills embodied in the science curriculum for the secondary and tertiary levels of education. These skills implicit in secondary schools physics curriculum includes amongst others ability to construct and use simple electrical continuity tester, solar collector installation, maintenance of simple machines, vulcanizing and repair of generators (Okeke & Nwoye, 2019). Similarly, Okoli and Onwuchu in Okeke & Nwoye, (2019) noted that exposing physics students to scientific skills through practical lessons could expose them to acquisition of skills in energy measurement, electrical continuity testing, energy conversion, simple A. C. circuit, amongst others.

Teaching and learning resources is expected to aid students in the acquisition of entrepreneurial skills. Duncan, (2020) recommends availability of Information and Communication Technology resources, entrepreneurship manuals, workshop areas amongst others as resources required for teaching and learning of entrepreneurial skills. These resources according to Duncan, (2020) is intended to equip students with knowledge, skills and attitudes necessary for starting, operating and managing personal or group business enterprises effectively. The role of learning resources in entrepreneurship education directly affects the teaching methods and success of entrepreneurship education (Esmi, Marzoughi & Torkzadeh, 2015). Wibowo, Saptino & Suparno, (2018) opined that quality and adequate resources improve the creativity and quality of entrepreneurship teaching and learning and foster acquisition of entrepreneurial skills among students. Learning resources directly affect the teaching methods and success of entrepreneurship education. Mkala & Wanjau, (2013) posit that inadequate resources translate into ineffective teaching which invariably affects student's self-efficacy, hence the need for institutions to devise sustainable strategic financial resources to supplement government allocation. Bwisa, (2017) emphasized the need for institutions to provide resources such as business incubators that can stimulate acquisition of entrepreneurial skills. Other critical resources required according to Wibowo, Saptino & Suparno (2018) are the course facilities and equipment, professional entrepreneurship tutors, internet networks, literature materials and financial budget. The demographic profiles of teachers are known to relate to the teaching methods affecting student's performance (Tshering, Gembo & Cox, 2017). Researchers have pointed out that a particular feature of teaching skill is their interactive nature. Educational institutions are moving towards more of knowledge-sharing role where class discussion and quest speakers are becoming more popular (Solomon in Saranza, Bueno, Andrin & Ninal, 2022). Neck & Greene, (2011) opined that engagement in a classroom discussion is different from a case study discussion. Therefore, the active role learners should be applied and built in the learning process of entrepreneurship education pedagogy, same as the methods on non-traditional teaching (Gibb, 2011).

Skill acquisition has been recognized as a source of wealth creation that helps to improve the minds of youth towards entrepreneurial development in an environment that is competitive and business oriented like Nigeria (Ombugus&Umaru, 2017). In view of this, government has implemented a number of skill acquisition initiatives such as the addition of entrepreneurship subject and the creation of vocational and skill acquisition centers in institutions across the states. Such programmes are aimed to influence student's abilities, attitudes, aspirations, competencies and particularly creativity (Muhd in Eze, Akam&Okeke, 2022). The development of entrepreneurial skills however depends on how students are ready to unearth and galvanize this latent potential in them. Entrepreneurial skills refer to transversal competencies critical to all spheres of life such as job market, personal development and the society (Bacigalupo, Kampylis, Punie& Van den Brande, 2016). Entrepreneurial skills can either be applied in creation of new ventures or in existing organizations to create new subsidiary or launch new products or service line, technologies, administrative procedures strategies and competitive tactics that eventually create value. Acquisition of entrepreneurial skills is a process that entails student's learning particular skill or type of behavior related to entrepreneurship through training and education (Ekpe, Razak, Ismail & Abdullah, 2015). It appears that the traditional approach of offering entrepreneurship education programme in schools raises concerns about their effectiveness. Therefore, it is crucial to evaluate the efficiency of the entrepreneurial education programmes offered in schools such evaluation correlate with the notion of Morselli, (2018) who stated that entrepreneurship education in any institution of learning should be evaluated on a regular basis to determine how well it enables students to develop competencies such as work-ready skills, innovative attitudes and knowledge applicable to the diverse vocations for the advancement of individuals' social and economic well-being.

The entrepreneurial skills competence of teachers is related to the way they manage their classrooms through the use of effective teaching strategies. The more teachers are engaged in the process of learning in a specific lesson, the better they can connect their students in the process of learning that field. Bird, (2002) opined that teachers are mainly interested in industrial-level competency in helping students become more skilled and motivated to start and succeed in the new endeavor. Therefore, a common concern among academic institutions is to encourage students to become more business-inclined and more innovative. To achieve this goal, development of entrepreneurial skills to better prepare for an entrepreneurial life ought to be instilled in students. Lonappan in Saranza, Bueno, Andrin&Ninal, (2022) categorized teaching strategies into: action learning, case study, group discussion, group project, quest speakers, individual presentation, individual written report, seminars, video recording and web-based learning. In addition, Solomon (2007) opined that the most common teaching strategies in entrepreneurship education are creation and development of business plans, case studies and lectures. In the same vein, Hytti& O'Gorman in Fatoki, (2014) noted that offering entrepreneurship education depends on its objectives. They stated that if it targets the expansion of comprehension of what entrepreneurship is about, the most ideal strategy is to give data through open channels such as lectures, seminars and use of media. If the goal is to furnish people with entrepreneurial skills to apply for legitimate work, the most ideal path is to give specialized instruction that empower them to straightforwardly engage in entrepreneurial process.

Acquisition of entrepreneurial skills exposes students to prior experience which leads to preparedness for entrepreneurial activity and reduction in business failure, increasing chances of employment and increasing chances for self-employment (Shane in Duncan, 2020). It is believed that entrepreneurial skills are critical

drivers of job creation, either through self-employment or as suppliers to corporate sectors. A skill is referred to as an ability which can be developed not necessarily inborn, but can be manifested in performance not merely in potential. Nwanaka&Amaehule, (2011) opined that it is only with skilled men that materials can be harnessed, manipulated and transformed into product. Entrepreneurial skill could be viewed as business skills which one acquires to function effectively in the turbulent business world as a self-employed or employed person in order to improve one's economic status and in extension the society (Allison,Naade&Adolphus, 2023).

The three stages in entrepreneurial skills acquisition according to Nwanaka&Amaechule, (2011) are theoretical, practical and exposure to challenges. An important factor in skills acquisition process is exposure to practical situations where these skills are displayed and utilized. Entrepreneurial skills in physics curriculum according to Okeke & Nwoye, (2019) includes ability to construct and use simple electrical continuity tester, solar collector, telescope, compound microscope, simple transmission system amongst others. The knowledge and skills which physics students acquire could be of value by helping them develop entrepreneurial skills for wealth creation. It is therefore necessary that students be exposed to the required practical skills which they need to cope with emerging challenges of the modern world. In order to expose students to real work situations, they are mandated to go for trainings. According to Comfort & Bonaventure, (2012), one of the major ways students can gain the right offices with the right equipment and facilities is by being monitored closely and supervised effectively by both the institutions and industries-based supervisors. To develop entrepreneurial skills in students, they need to be attached to workplaces for practical orientations. Araba, (2013) emphasized that it is important to involve stakeholders inside and outside institutions in entrepreneurial skill training. Araba, (2013) therefore recommends that if students are to enter the business world and entrepreneurship, it is necessary to involve business people and entrepreneurs in the academic process.

Every entrepreneurship is expected to start from the generation of entrepreneurship intention which has good predictive effect on entrepreneurship behavior. Thompson, (2009) defined entrepreneurial intentions as the belief that entrepreneurs intend to start a business. In order words, entrepreneurial intention is a psychological state that guides our attention toward specific business goals in order to achieve entrepreneurial results. Lie, Pei &Kunpeng, (2011) believed that people with entrepreneurial intentions may not really be able to start new businesses because of personal characteristics and surrounding environment. In order words, although entrepreneurship intention is a necessary condition for the occurrence of entrepreneurship, not all potential entrepreneurs can take action even if they want to start a business.

Students are an important part of mass entrepreneurship. Compared with others such as the new generation of migrant workers, students have a more solid theoretical knowledge and advanced entrepreneurial concept with active thinking and the spirit of adventure that they have and with the gradual promotion of entrepreneurship education in schools, students have a more comprehensive and profound understanding of entrepreneurship. Physics education is expected to equip students with relevant skills that will enable them to be self-employed on leaving school. Unfortunately most students who studied physics at the secondary school level seem to fail to acquire relevant practical skills that will enable them to become entrepreneurs. This development may negate the objectives of secondary school education in Nigeria which is to prepare the students for useful living.

Entrepreneurial skills in physics are crucial for students in secondary schools as they enable students to apply physics concepts in the practical and entrepreneurial manner. However there is

limited research on the evaluation of teachers and students experiences in teaching and learning entrepreneurial skills in physics in secondary schools in Anambra State. Prior to the reviewed National Policy on Education in 2004, unemployment, poverty level, violence, school dropout amongst others seems to be on the increase despite the fact that there are entrepreneurial skills implicit in the physics curriculum. The question then is what are the experience of teachers and students in entrepreneurial skills in secondary schools in Anambra State? In a bid to answer this question amongst others prompted a study of this nature.

Research questions.

The following research questions guided the study.

1. What are the topics in physics curriculum that could expose students to entrepreneurial skills?
2. How adequate are the teaching and learning resources that could enable students acquire entrepreneurial skills?
3. What are the teaching strategies employed by teachers for topics with entrepreneurial skills?
4. What are the entrepreneurial skills acquired by students?
5. What are the entrepreneurial intentions of physics students?

Method

The study adopted a descriptive survey design. The population of the study comprised of 6,745 physics students and 27 physics teachers in senior secondary schools in Onitsha North and Oyi Local Government Areas in Anambra State. A census of 27 Physics teachers were used for the study while a simple random sampling technique was used to sample 673 physics students for the study. The instrument used in data collection was a structured questionnaire titled "Physics and Entrepreneurial Skills: Evaluation of Teachers' and Students' Experiences in Secondary Schools Questionnaire". Face and content validity of the instrument were carried out by experts in physics education and measurement and evaluation. Test retest and Cronbach Alpha methods of reliability were employed to test the stability and internal consistency of the items. A reliability coefficient obtained forthe selected Physics teachers were 0.81 and the sampled Physics students were 0.78 respectively. The instrument was on a four point rating scale of agreement: Strongly Agreed (4), Agreed (3), Disagreed (2) and Strongly Disagreed (1) were used to elicit responses from the respondents in questions 1, 3, 4 and 5 while Very Adequate (4), Adequate (3), Not Adequate (2) and Not Very Adequate (1) was used to elicit responses in question 2. A total of 700 copies of the instruments administered were retrieved and used for the study. The research questions were answered using Mean and Standard Deviation as decisions were made based on the criterion Mean of 2.50. The implication was that Mean value of 2.50 was rated accepted and otherwise rejected.

Results

The results for this study were presented according to each research question posed in the study as thus:

Research question 1

What are the topics in physics curriculum that could expose students to entrepreneurial skills in Anambra State?

Table 1

Mean and standard deviation on the topics in physics curriculum that could expose students to entrepreneurial skills

S/N	Items	Students (N=673) X	SD	Remark	Teachers(N=27) X	SD	Remark
1.	Simple A.C circuit	2.78	0.97	A	2.84	0.93	A
2.	Thermal energy measurement	2.56	1.18	A	2.61	1.17	A
3.	Electrical Continuity testing	2.69	0.98	A	2.74	0.95	A
4.	Battery	2.77	1.39	A	2.83	1.37	A
5.	Electromagnetic field	3.06	0.73	SA	3.00	0.78	SA
6.	Principle of floatation	2.93	1.04	A	2.96	0.99	A
7.	Potential energy	2.88	1.12	A	3.03	0.99	SA
8.	Electric field	2.90	1.30	A	3.28	0.47	SA
9.	Fluid at rest and in motion	3.24	1.02	SA	3.34	0.73	SA
10	Solar Collector	2.82	1.02	A	2.71	1.05	A
11.	Application of lens and plane mirror	2.59	0.94	A	2.63	0.92	A
	Grand Mean	**2.83**	**1.06**	**SA**	**2.90**	**0.94**	**SA**

The results from table 1 showed the topics in physics curriculum that could expose students to

entrepreneurial skills in Anambra State. The findings revealed that simple A. C. circuit had (2.78 & 2.84), thermal energy measurement (2.56 & 2.61), electrical continuity testing (2.69 & 2.74), battery (2.77 & 2.83), electromagnetic field (3.06 & 3.00) principles of floatation (2.93 & 2.96) potential energy (2.88 & 3.03) electric field (2.90 & 3.28) fluid at rest and in motion (3.24 & 3.24), solar collector (2.82 & 2.71) and application of lens and plane mirror (2.59 & 2.63). Table 1 equally revealed a grand mean of 2.83 and 2.90 and a grand standard deviation of 1.06 and 0.94 respectively which also indicated that the above listed are topics in physics curriculum that could expose students to entrepreneurial skills in secondary schools in Anambra State.

Research question 2

How adequate are the teaching and learning resources that could enable students acquire entrepreneurial skills?

Table 2

Mean and standard deviation on the adequacy of teaching and learning resources that could enable students acquire entrepreneurial Skills.

S/N	Items	X	Students (N=673) SD	Remark	X	Teachers (N=27) SD	Remark
1.	Information & Communication Technology	2.38	1.01	NA	2.45	1.23	NA
2.	Entrepreneurship manuals	2.73	0.99	VA	2.67	1.11	VA
3.	Workshop areas	2.41	1.17	NA	2.14	0.52	NA
4.	Facilities	2.47	1.00	NA	2.40	1.18	NA
5.	Equipment	2.56	1.18	A	2.63	0.92	A
6.	Professional entrepreneurship tutors	2.78	0.97	VA	2.77	1.39	VA
7.	Literature manuals	2.66	0.98	VA	2.72	0.95	VA
	Grand Mean	**2.80**	**1.05**	**VA**	**2.71**	**1.16**	**SA**

The results from table 2 showed the adequacy of teaching and learning resources that could enable students acquire entrepreneurial skills in Anambra State. The findings revealed that Information and Communication Technology resources had (2.38 & 2.45), entrepreneurship manuals (2.73 & 2.67), workshop areas (2.41 & 2.14), facilities (2.47 & 2.40), equipment (2.56 & 2.63), professional entrepreneurship tutors (2.78 & 2.77) literature manuals (2.66 & 2.72). From the findings ICT workshop areas and facilities were not available while entrepreneurship manuals, equipment, professional entrepreneurship tutors and literature manuals are available. Table 2 equally revealed a grand mean of 2.80 and 2.71 and a grand standard deviation of 1.05 and 1.16 respectively which also indicated that teaching and learning resources are adequate for student's entrepreneurial skills acquisition in secondary schools in Anambra State.

Research question 3

What are the teaching strategies employed by teachers for topics with entrepreneurial skills?

Table 3

Mean and standard deviation on the teaching strategies employed by teachers for topics with entrepreneurial skills.

S/N	Items	X	Teachers (N=27)SD	Remark
1.	Action learning	2.87	1.32	SA
2.	Case study	2.53	1.10	A
3.	Group discussion	3.02	0.93	SA
4.	Group project	2.89	0.95	SA
5.	Individual presentation	2.67	1.20	SA
6.	Seminars	2.84	1.34	SA
7.	Web based presentation	2.72	0.95	SA
	Grand Mean	**2.79**	**1.11**	**SA**

The results from Table 3 showed the teaching strategies deployed by teachers in teaching topics with entrepreneurial skills. The findings revealed that action learning had (2.87), case study (2.53), group discussion (3.02), group project (2.89), individual presentation (2.67), seminars (2.84) web based presentation (2.72). Table 3 equally revealed a grand mean of 2.79 and a grand standard deviation of 1.11 respectively which also indicated that teachers employed the aforementioned teaching strategies for topics with entrepreneurial skills in secondary schools in Anambra State.

Research question 4

What are the entrepreneurial skills acquired by students?

Table 4:Mean and standard deviation on the entrepreneurial skills acquired by students.

S/N	Items	X	Students (N=673) SD	Remark
1.	Ability to do an electrical continuity testing	2.37	1.23	DA
2.	Simple electrical wiring & installation	2.41	1.23	DA
3.	Installation & maintenance of solar panel	2.14	0.52	DA
4.	Ability to repair generators	2.38	1.01	DA
5.	Ability to maintain & repair simple home appliances	2.76	0.97	SA
	Grand Mean	**2.41**	**0.99**	**DA**

The results from Table 4 showed that majority of the entrepreneurial skills were not acquired by physics students in secondary schools in Anambra State. The findings revealed that ability to do electrical continuity testing had (2.37), simple electrical wiring and installations (2.41), Installation and maintenance of solar panel (2.14), ability to repair generators (2.38), while Ability to maintain and repair simple home appliances had (2.76). Table 4 equally revealed a grand mean of 2.41 and a grand standard deviation of 0.99 respectively which also indicated that majority of the entrepreneurial skills were not acquired by physics students in secondary schools in Anambra State.

Research question 5

What are the entrepreneurial intentions of physics students?

Table 5

Mean and standard deviation on entrepreneurial intentions of physics students

S/N	Items	X	Students (N=673) SD	Remark
1.	Perceived market opportunities	2.93	1.00	SA
2.	Access to resources & networks	3.01	0.73	A
3.	Passion for innovation	2.96	0.99	SA
4.	Environmental factors	2.88	1.08	SA
5.	Risk tolerance	3.00	0.78	SA
6.	Self-efficacy and confidence	2.55	1.04	A
7.	Prior exposure and experience	2.68	1.04	SA
	Grand Mean	**2.85**	**0.95**	**SA**

The results from table 5 showed the entrepreneurial intentions of physics students. The findings revealed that perceived market opportunities had (2.93), access to resources and networks (3.01), passion for innovation (2.96), environmental factors (2.88), risk tolerance (3.00), self-efficacy and confidence (2.55) and prior exposure and experience (2.68). Table 5 equally revealed a grand mean of 2.85 and a grand standard deviation of 0.95 respectively which also indicated that physics students has entrepreneurial intentions.

Discussion of Findings

The findings in research question one revealed that simple A. C. circuit, electrical continuity testing, battery, electromagnetic field, principles of floatation, potential energy, electric field, fluid at rest and in motion, solar collector and application of lens and plane mirror are topics in physics that could expose students to entrepreneurial skills. The findings are in agreement with the view of Okeke & Nwoye, (2019) who opined that skills implicit in secondary school physics curriculum includes ability to construct and use simple electrical continuity tester, solar collector installation, maintenance of simple machines, vulcanizing, repair of generators amongst others. Similarly, Okoli&Onwuchum in Okeke & Nwoye, (2019) asserted that exposing physics students to scientific skills through practical lessons could expose them to acquisition of skills in thermal energy measurement, electrical continuity testing, energy conversion and simple A. C. circuit. Based on the above views, the researcher is of the opinion that the curriculum should be enriched with more physics topics to enable student's exposure to entrepreneurial skills.

The findings in research question two revealed that most of the teaching and learning resources that could enable students acquire entrepreneurial skills were not adequate. The findings are in contrast with that of Wibowo, Saptino&Suparno, (2018), who stated that quality and adequate resources improves the creativity and quality of entrepreneurship teaching and learning and foster

acquisition of entrepreneurial skills among students. Based on the above views, the researcheris of the opinion that adequate teaching and learning resources should be provided to enable physics students acquire entrepreneurial skills.

The findings in research question three revealed that the teaching strategies employed by teachers for topics with entrepreneurial skills. The findings are in agreement with the view of Solomon, (2007) who affirmed that the most common teaching strategy in entrepreneurship education are creation and development of business plan, case studies and lectures. Based on the above views, the researcher is of the opinion that more teaching strategies should be employed to enable physics students to be exposed to entrepreneurial skills.

The findings in research question four revealed the entrepreneurial skills acquired by students. The findings agrees with the view of Okeke & Nwoye, (2019) who stated that the ability to construct and use simple electrical continuity tester, solar collector installation, maintenance of simple machines, vulcanizing, repair of generators amongst others are the entrepreneurial skills ought to be provided for the students. Based on the above views, the researcher is of the opinion that the acquisition of such entrepreneurial skills by students will empower them.

The findings in research question five revealed the entrepreneurial intentions of physics students. The findings aligns with that of Thompson, (2009), who opined that perceived market opportunities, access to resources and networks, passion for innovation, environmental factors, risk tolerance, self-efficacy and confidence and prior exposure and experience are entrepreneurial intentions of students. Based on the above views, the researcher is of the opinion that students need to harness their entrepreneurial intentions as a necessary condition for the occurrence of entrepreneurship to make students become economically empowered.

Conclusion

Based on the findings of the study, it was concluded that Simple A. C. circuit, electrical continuity testing, battery, electromagnetic field, principles of floatation, potential energy, electric field, fluid at rest and in motion, solar collector installation and application of lens and plane mirror are topics in physics that could expose students to entrepreneurial skills. Most of the teaching and learning resources that could enable students acquire entrepreneurial skills were not adequate. Therefore, teachers should employed teaching strategies such as action learning, case study, group discussion, hands-on and minds-on activities amongst others in teaching topics with entrepreneurial skills in secondary schools in Anambra State, so as to enable students discover and create entrepreneurial skills themselves as well as galvanizing students' intentions to become economically empowered.

Recommendations

Based on the findings from the study and the conclusion, the following recommendations were made:

1. More topics should be incorporated into the physics curriculum to further expose the students to entrepreneurial skills.
2. Teaching and learning resources should be made adequate to enable the students acquire entrepreneurial skills.
3. More teaching strategies should be incorporated and employed to enable physics students acquire entrepreneurial skills.
4. Entrepreneurial training should be more of practical to enable the students acquire much entrepreneurial skills.

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