ASSESSING TEACHERS' COLLABORATIVE USE OF INFORMAL LEARNING RESOURCES IN BASIC SCIENCE INSTRUCTION IN POST COVID -19 ERA

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Abstract
Informal collaboration has become one of the most sought-after learning skills in the 21st century post COVOD 19 era learning of Science Technology Engineering Arts and Mathematics (STEAM). This is because collaboration encourages members of the society to think and work together on issues of critical concern, shifting the emphasis from individual efforts to group work using informal engagement with STEAM resources in the community. This research was conducted to assess the level of teachers' collaborative use of informal resources and industries in instructional delivery in basic science in Mangu and Pankshin Local Government Areas. A survey research design was used. The population consists all basic science teachers in Mangu and Pankshin Local Government Areas. Fifty-two teachers were randomly selected for the study. The instrument used for the research was the Collaborative use of Informal Resource Questionnaire (CIRQ) comprising of three sections. The instrument was validated by test experts and had a reliability coefficient of 0.75 using Cronbach Alpha. Data were analysed using mean and rank order. Results indicated that basic science teachers' level of collaborative usage of informal resources and awareness of relevant local resources/industries for use in science and technology learning was very low, among others. It was recommended among others that government and book publishers should incorporate collaborative informal resources in formal STEAM learning in areas such as curriculum materials development and text books productions as this has been useful in efforts at containing COVID 19.
Keywords: *Collaboration, 21st Century Skills, Informal Learning Resources, STEAM.*

Introduction

The turn of twenty first century has brought with it great advancements in the fields of Science Technology Engineering and Mathematics (STEAM) globally. The advancements have improved the living conditions and livelihood of all nations that have progressed in 21st Century skills. These improvements can be seen in positive developments in areas such as agriculture, medicine, media entertainment, military space, engineering and design, etc. Progress in fields of science technology and engineering are used to gauge the prestige of nations and this has made investments in science education reform in 21st century skills a worthwhile enterprise. In response to recent developments in science technology and engineering, governments all over the world are reforming curriculum goals to suit the needs for present day 21st century skills requirements.

21st century skills is defined by P21 (2009) as skills and knowledge students need to succeed in work, life and citizenship, as well as the support systems necessary for 21st century learning outcomes. Zook (2019) thus classified 21st century skills into three categories: Learning Skills, Literary skills and Life Skills. He opined that each of these 21st century skills are needed by students in order to remain globally competitive in a changing job market. The 21st Century learning skills are subdivided into four skills area: Critical thinking, Creativity, Collaboration and Communication (4Cs**). Other classifications of the 21st century skills needed by learners are the literacy and life skills.**

However, the adverse effect of the global pandemic COVID-19 has posed great challenge for STEAM education. For instance, despite the global demand for 21st century skills as a tool for innovation and development of nations, a skills gap assessment by United Nations Industrial Development Organization (UNIDO) (2016) shows that Nigeria learners are deficient in six areas related to science technology and engineering. Similarly, World Intellectual Property Organization (2012- 2021) Global Innovation Index on global creativity index (GCI) and related indices for shows that Nigeria ranking has remained dismay on all creativity and innovation indices measured (Table 1). This implies that Nigeria has serious creativity skills gap deficit which needs urgent attention. The consequences of Science Technology Engineering (STE) skills gap in 21st century skills means that Nigeria will continue to play a second fiddle in committee of nations benefiting from the creativity and innovations arising from the use of collaborative skills. A gap also exist in literatures on how teachers use

collaborative learning centre. There is the need to look at teachers' collaborative use of informal learning resources in basic science.

Table 1: Global Creativity Index ranking of Nigeria 2012 – 2021

Year	No. of Countries Featured	Ranking
2012	144	115
2013	148	120
2014	144	127
2015	140	124
2016	138	127
2017	137	125
2018	137	118
2019	129	114
2020	131	117
2021	132	118

Source: World Intellectual Property Organization Global Innovation Index 2021. Retrieved at https//www.wipo.int/global_innovation_index 15/3/2022

The problem of skills gap in Nigeria and its inability to meet science and technological target continue to be a nightmare to policy planners and implementers alike. In Nigeria efforts aimed at achieving the educational objectives for basic science in Nigeria has continued to be at the fore front of educational reforms in Nigeria. Some recent reforms FGN (2013) has seen the merging of Basic Science, Technology, Physical and Health Education and Computer Science to address emerging contemporary 21st century skill gaps identified in Nigerian employment space. Also, the Federal Republic of Nigeria (2018) has taken extraordinary measures of gazetting the Presidential Order No. 5, aimed at promoting Nigerian content of Science Technology and Engineering in all projects. In addition, the technical departments in colleges and universities utilize the Students Work Experience Scheme (SIWES) as links between formal classroom interaction and informal industrial experience, the science subjects seem to be lagging behind. Consequently, despite this position one thing that seems to be neglected in the learning of basic science is the collaborative use of informal learning resources with formal classroom instruction in Nigerians schools.

Formal learning can generally be seen as learning that takes place when a teacher and students interact with each other within a systematic framework of a fixed curriculum, standards, and tests. Informal learning is learning that

takes place outside the formal classroom. Wellington (1990) defined formal science learning as compulsory, structured, assessed, closed, teacher-centred, and with less social interaction. Examples of informal science education settings are the home, television, radio, magazines, nature parks, museums, and zoos.

NSTA (2009) advanced that informal contexts provide resources for expanding the curriculum, reinforcing key concepts, and providing links to real-world situations and scientists, as well as scientific data, instruments, and laboratories. Informal learning environments encompass a wide range of contexts and settings, including everyday experiences; experiences in designed settings, such as museums, zoos, nature and environmental programs, and other science-rich cultural institutions; experiences in structured programs, such as after-school youth programs, clubs, and citizen science; and experiences through science media, such as gaming, television, radio, and the internet (NRC 2009). The question to ask however is: Are teachers collaborating with informal learning environments relevant to basic science? This study was undertaken to assess teachers collaborative use of informal learning resources in teaching of basic education.

Collaboration is an educational approach to teaching and learning that involves groups of learners working together in or outside the school environment to solve a problem, complete a task, or create a product. Learners also have the opportunity to converse with peers, present and defend ideas, exchange diverse beliefs, question other conceptual frameworks, and are actively engaged (Srinivas, 2011). Vallamis (2022) further posit that collaboration has social, psychological as well as academic benefits to the learner. The social benefits of Collaboration is that it helps to develop a social support system for learners. It also has the benefit of building diversity and understanding among students and staff. Informal collaboration helps to establish a positive atmosphere for modelling and practising cooperation.

On the psychological benefits of collaboration, it is learner-centered instruction which increases students' self-esteem; Cooperation reduces anxiety and develops in them positive attitudes towards teachers. Collaboration promotes critical thinking skills. It also involves students actively in the learning process while also acquiring problem solving skills which are in high demand in the 21st century.

Another benefit of informal collaboration is its use in authentic assessments. Authentic assessment utilises learners' portfolios and direct observations of works which is the bases of 21st century skills' assessment. Despite these benefits the problem is how are basic science teachers using informal collaborative learning environments to achieve acquisition of 21st century skills in Nigeria?

The purpose of the study was to assess science and technology teachers' levels of collaborative usage of informal resources in instructional delivery as a measure of functional education. Specifically, it sought to:

1. Identify the environment – industry links of some topics in basic science curriculum
2. Assess the extent to which science and technology teachers take their students on excursion to industries for skills acquisition.
3. Ascertain if science and technology teachers are aware of local industries that can be used for teaching basic science concepts.
4. Investigate the extent to which science and technology teachers can identify local resources /industries that could be used for informal learning.

The study was guided by the following research questions.

1. What are the informal environments – industry links topics in basic science curriculum that can be utilized for basic science teaching?
2. To what extend do science and technology teachers use informal resources in collaborative learning?
3. To what extent are science and technology teaches aware of informal resources/ industries that can be used for teaching basic science concepts?
4. To what extent can science and technology teachers identify areas /industries that could be visited for informal learning?

Method

The research design for the study was a survey design. The target population comprised all the junior secondary school teachers' in Mangu and Pankshin local government areas of Plateau State. Stratified random sampling was used to choose nineteen schools from each of the two local government areas used. The total number of teachers used was fifty two.

An instrument called Collaborative use of Informal Resources Questionnaire (CIRQ) comprising three sections A, B & C was constructed by the researchers and validated by science education and test experts. The first section, section

A of CIRQ was a questionnaire, containing nineteen items and constructed on a 5-point Likert scale, containing statements regarding teachers' problem on teaching for skills acquisition using excursion and local resources. Section B consists eighteen topics from the junior secondary school basic science curriculum. The instrument requires the science and technology teachers to identify the informal collaboration spaces that are relevant for the teaching and learning of such topics. Section C solicits for list of local industries/resources relevant for science and technology teaching and learning. The reliability of the instrument was 0.75, using Cronbach Alpha Correlation Co efficient.

Results

Table 2: Basic Science Curriculum Content and informal Industry Links

S/N	Curriculum	Industry Link
1	Family health and nutrition	Hospital and nutrition centres
2	Environmental conservation safety and sanitation	Good/bad drainage, huge refuge dumps
3	Diseases/vectors	Hospitals, medical laboratory
4	Living & non-living things	fumigation centres anywhere inside/outside classroom
5	Drug abuse	NDLEA, psychiatric wards
6	Earth & space/space travel	National air space agency, NASRDA
7	Gravitation & weightlessness	Swimming pool
8	Satellites	stars &moon, remote sensing centre, weather station
9	Energy	Hand pump, wind mills Kurra falls, bell, coal, wood, torch
10	Renewable energy	Solar power, wind mill, hydro stations
11	Non-renewable energy	Coal, crude oil, wood, gas
12	Forces	Grinding mill, quarry site, magnets, games

13	Environment pollution	Timber shed, generating sets, stagnant water, refuse dumps garage
14	Changes in matter	Ice block, water, Bunsen burner
15	Changes in non-living things	areas of decomposition, fermentation
16	Information & comm. Tech. (ICT)	Cyber cafes, internet, phone booths, headsets
17	Crude oil & petrochemicals	Filling stations, NNPC depots, pharmaceutical company
18	Simple machines	carpentry workshops, metal workshop, wells, garage, opener, knives, scissors and hoes opener, knives, scissors, cutlass, hoes
19	Environmental hazards	Bush burning sites, erosion sites, mining ponds, tree felling sites
20	Resources from living things	dairy, shoe, industry, leather
21	Skills acquisition	Storing, carpentry, mechanics, poultry, internet, photography, survival, networking

An inspection of the junior secondary school curriculum (NERDC, 2007) reveals that the curriculum is designed in such a way that most of the resources required for teaching and learning are within the immediate environment. More so, the basic science curriculum is designed in such a way that most of the topics therein have industry links. Examples are seen in Table 2

Table 3: Mean Responses of Science and Technology Teachers on How Regular They Take Their Students to Local Industries for informal Learning.

SN	Items	Mean Response	Rank	Remarks
1	I feel informal resources do not have much to offer	3.00	12th	Significant
2	I feel the industries within my state do not have much to offer	2.50	17th	Insignificant
3	Out of class activities are not worth the time	3.80	8th	Significant
4	My kind of students are such that I cannot waste my time on them	3.60	11th	Significant
5	I fear, students are stubborn and can injure themselves during excursion	3.00	13th	Insignificant
6	I feel the syllabus is too wide, so I cannot plan for excursion	3.90	6th	Significant
7	I feel it is costly to organize for excursion	4.00	5th	Significant
8	I am worried that I have no time for extra-curricular activities	3.85	7th	Significant
9	I am worried that I have no time for excursion	4.05	4th	Significant
10	I don't have enough time to prepare my lessons	4.06	3rd	Significant
11	Time to cover syllabus is my number one problem as an STM teacher	4.52	1st	Significant
12	Time is not a problem for me as an STM teacher	2.30	18th	Insignificant
13	I feel the local industries are always happy to receive us for excursion	3.00	13th	Insignificant
14	I feel the industries within the state are always happy to receive Us for excursion	3.00	13th	Insignificant
15	Most of the local industries are not always on production so no Need for any excursion	4.30	2nd	Significant

16	Most of the industries within the state are not always on production so no Need for any excursion	3.70	10th	Significant
17	The local industries are dirty so no need for excursion	2.00	19th	Insignificant
18	Industries fear students so no need for excursion	2.90	16th	Insignificant
19	Distance of the industries do not allow me to effectively use them	3.75	9th	Significant

Result with mean value of 2.6 and above are significant and 2.5 and below are insignificant.

Table 3 shows 19 areas that could constitute the problem of teachers on taking their students for collaborative informal learning to acquire skills. Anxiety to cover syllabus, cost of taking students out on excursion, teachers not having enough time, poor pay package for teacher and inadequate industries major problems of teachers.

Table 4: Topics identified by Science and Technology Teachers that are Related to Some Basic Science Concepts

S/N	STE Topic	Relevant Industry
1	Alcohol	Jos International Brewery & Local Brewery (Burkutu) joints
2	Distillation of crude oil	NNPC depot
3	Public water supply	Water Boards
4	Polymerization	Plastic Industries
5	Saponification/detergents	Nasco Household
6	Water analysis (P^H) metals	Fish farm Panyam, Steel Industry, Jos
7	Purification of water	Dam Pankshin, SWAN Kerang
8	Conservation of energy generating electricity	Kura Falls in BarkinLadi, Radio stations Jos
9	Wild life conservation	Zoo, wild life game reserve, in Jos
10	Soap making	Widowhood centre Mangu
11	Cassava processing	Zoo, wild life game Reserve Jos
12	Pest and diseases	NVRI Vom
13	Man in space	Airport, NIMETH
14	Saving your energy	JIB,NBC,NASCO
15	Pollution	Refiner (oil-refinery)

16	Mining	Jos tin mining sites
17	Reproduction	Medical Hospitals
18	Habitat	Fish farms

Key*; NVRI National Veterinary Research Institute, JIB Jos International Breweries, NBC Nigerian Bottling company, NiMET Nigerian Metrological Agency, NASCO Company.*

An analysis of Table 4 reveals that most of the science and technology teachers only thought of big companies or industries such as NNPC, Water Boards, Jos Steel Rolling Mill, NASCO, Air Port as areas they could visit to teach some relevant topics. A topic such as pollution was only associated with NNPC in all the cases. Respondents could not associate pollution to huge refuse dumps.

Table 5: List of Industries Identified by Teachers for Informal Collaboration

Local Industries identified by the teachers
Nasco Foods
Grand Cereal
Swan Water Kerang
Vita Foam
Air Port
Jos International Brewery
Steel Industry

The teachers identified eight big industries that they thought were relevant for science and technology education in Plateau State. The industries identified included: NASCO Foods, Grand Cereal, Coca Cola, NVRI Vom. Teachers seemed to neglect the collaborative importance of informal resources such as huge refuse dumps, hospitals and bakeries.

Discussion

Findings show that most science teachers hardly take students to industries especially local ones for informal collaborative learning. Most of them tend to associate their negligence in these areas to their poor pay package. Other reasons advanced by the teachers for their negligence in these areas included high cost and risk involved in excursion, teachers not having enough time and industries not being on production always. Other reasons advanced for this inadequacy is the desire to cover the syllabus and the need to stay in class and

prepare the students for final examinations. This agrees with Okebukola (2002) where he identifies over-loaded examination syllabus as one of the major challenges of the science and technology teachers, skills can only be acquired if the child is allowed to practise hands-on skills. The best way to inculcate in the students the skills required by the UBE programme is to expose the students to the relevant opportunities that the society can offer by encouraging the students through excursions to areas where they can appreciate such skills as contain in the science and technology curriculum.

Research findings also reveal that the respondents' knowledge of topics and relevant areas that could be visited to enhance learning, leaves much to be desired. Most of them only think of big companies that have little or no relevance to the topics as areas that could be visited to inculcate the required science and technology skills in the students. Topics such as pollution was only associated with NNPC. The teachers did not see huge refuse dumps in their environments as areas that could be visited. Huge refuse dumps have the advantage of helping the students to see how such dumps can pollute water, land, air and how such dumps can be transformed to a source of generating money if properly handled. Duguryil, Duguryil and Katniyon, (2006) had lamented teachers' inability to identify and utilize ICT learning resources in the teaching of science technology and engineering subjects. This calls for concerted effort at training teachers to be innovative in identifying useful informal resources to enhance hands on learning.

Findings show that the teachers identified eight industries within the research areas and the state at large. Most of the industries within the research areas such as black smith, mechanic village, Arts galleries, museum and brewery homes were conspicuously absent in the responses of the teachers. Ha, Le and Theo (2018) had identified that for teachers to engage in meaningful collaborative learning resources, those available to learners must be utilized. Unfortunately, this finding implies that the available local industries within the local area are not being explored by science and technology teachers. The implication of this on learning is that students miss the vital industry link within their context which enhances learning in science and technology subjects, which in turn creates employment as a measure of functional education in the country.

Conclusion

Teachers are central to the acquisition of functional science education in Nigeria. Using of local resources, especially, industries create awareness of the vital roles local industries can play to enhance teaching and learning. This study observed the non-utilisation of these critical resources by teachers in teaching Basic Science. This situation must improve if the learners are acquiring concrete and usable education in schools.

Recommendations

Based on the findings of the research, the following recommendations were made:

1. Massive refresher courses should be mounted by ministry of education for science and technology teachers to reorient them of the usefulness of local industries for teaching and learning of science and technology subjects.

2. Supervising ministries of teachers training programmes in colleges/universities should include mandatory entrepreneurship courses to acquaint the teachers with school- informal industry link.

3. Collaboration between formal and informal science teaching and local resources' use should be deliberately incorporated in the curriculum and text books by government and science text book authors.

4. Government should provide resources for teachers to take students out on excursion to industries.

5. Ministries of education should ensure that secondary school science classes are not over crowded.

6. Workshops, conferences and seminars should be organised by state and federal government for serving science and technology teachers to attain the objectives of basic science.

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