

ACHIEVING CARBON FOOTPRINT REDUCTION: THE USE OF TECHNOLOGY AS A LEARNING TOOL FOR MAKING LIFE-STYLE CHANGES AMONG SECONDARY SCHOOL STUDENTS IN IMO STATE

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Abstract

The increasing carbon dioxide emission in the global environment also known as Carbon Footprint (CF), or Green House Gas (GHG), no doubt, constitutes one of the major events leading to adverse climatic change, otherwise known as Global Warming. These CFs could be calculated or weighed by all individuals, only if empowered by ways such as sensitization and technological demonstrations, with the aim of developing a mind-set and suitable means to quickly reduce them, especially in age-brackets of the young, where sustainability will be achieved. Focusing on Imo State, Nigeria, this study compared urban and rural environments to establish the importance of the application of technological learning in the quest for positive life-style changes of secondary school students. With a sample size of 600, the researchers adopted the random sampling method to identify and use a total of 150 urban and 150 rural students from each of the two selected private and two public senior secondary schools in two geographic locations. Guided by four research questions and two hypotheses, a researcher-designed and validated questionnaire which yielded 0.86 co-efficient to confirm its reliability was used for data collection. Due process was followed to recruit two research assistants who assisted to administer the questionnaire. The research questions were answered, using mean, while z-test was used to test the hypotheses at 5% significant level. Among other things, it was established that the culture of CF reduction was significantly higher among students in the rural areas than those in the urban areas in Imo State because the latter are more exposed to technological tools which are irrelevant to the CF reduction.

Introduction

Carbon footprint (CF) is the total set of greenhouse gas emissions people individually cause. Usually, one's CF is measured in terms of one's direct or indirect total production of carbon dioxide. It is also a means of determining someone's environmental impact. Reducing emissions, therefore, is the key solution to tackling climate change. This is possible when individuals are aware of the activities that contribute to CF reduction and can calculate their CF with the use of a Carbon Footprint Calculator. In a survey report of Bekaroo, Bokhoree, Ramsamy & Moedeen (2019) in Mauritius, the majority of teachers in a chosen school heard about CF but only one of the teachers had good knowledge of calculating his personal CF with the correct instrument. This highly limited the knowledge of CF reduction among the majority of group members, thus creating an obstacle to the students' ability to achieve CF reduction.

Similarly, in Imo State, Nigeria, different studies by Mbagwu and Opara (2011) as well as Emuku and Emuku (1999 & 2000) respectively, reported minimal utilization of many available ICT facilities provided in some secondary schools in Owerri Municipal Council due to lack of teachers' knowledge of use of such facilities to enable CF reduction.

Avenues for the Reduction of CF: Realizing the need to limit the environmental and health challenges arising from increasing CF in people's daily lives, especially in recent times, it becomes exceedingly important to review the general known life-style of the people, with the aim of bringing the daily emission of carbon dioxide in the environment to the barest minimum. This could be achieved through the engagement of individuals, groups and organizations including teachers in different activities/projects. Some areas of focus as identified by Cho (2018) include the following:

Energy: Reducing carbon footprint by minimizing energy wasted which include switching off lights, air conditioners, electrical appliances and switching to energy efficient light bulbs will be of immense effort. Planting of trees and starting a new garden will equally comprise positive steps, as well as reconsidering transportation choices such as walking or riding a bike, instead of driving petrol vehicles and the likes will not only reduce CF but will also bring health benefits. In addition, one's journey can be managed by placing priorities on the tasks to be achieved on daily basis and how to move around in the entire day. Public transportation could be preferred to personal means, while some movements could be postponed or use another mode of communication to deliver messages.

Food Consumption: Preference to eating more of assorted fruits and grains as well as eating foods considered as next-to-nature, otherwise referred to as organic and subsistence foods are adequate, instead of dwelling much on highly processed foods like canned foods, parboiled rice and those that contain white/coloured flour, processed chicken, animal meat, among others (Cho, 2018). Imported food items, whether canned, preserved or raw would require passing them through different processes to avoid damages or being contaminated or bacteria-infected. Consequently, such food items undergo different processes before they are finally shipped, hence are liable of contributing to the increase of CF in the environment. It is equally important to note that when buying foodstuff in bulk, it is expected that reusable containers are preferred.

Preferred Clothing/Trending Fashion: Priority of the people should be placed on clothes and fashions that are considered reasonable, with regard to the quality and not quantity of what one should aspire to acquire. Fragile/delicate and very cheap materials should be avoided because hardly could one expect such materials, when purchased, to be durable and still be useful for a long duration. Consequently, the latter and the likes add immensely to the increasing huge dumps at different locations, thus constituting a menace and health hazards to the environment. In addition, they constitute a threat to aquatic lives.

Priority Purchase/Shopping: Generally, people are never satisfied with what they possess. However, reducing CF in the urban and rural environment requires people to be highly disciplined in their choices of items to be acquired. Opportunities now exist for discarded items to be recycled, especially with the introduction of new technologies. Hence, it becomes necessary that people should embrace the idea of focusing on purchasing items that provide ample opportunity to be recycled, in addition to reducing their flair to buying bulky items. For instance, the purchase of laptops, rather than desktops is opted for. Equally, some items in the shops and other business areas now have energy-saving labels. For instance, some washing machines now have opportunity for cold water wash as well as settings to regulate the washing duration. Cookers now have regulations for low, medium and high heat, while some cooking pots have pressure cooking opportunities. Such items should be the priority for purchase and their production should be encouraged.

Home: Energy audits are done at home and this shows how energy is used/wasted and efficiently conserved. Some ways in which energy is

conserved at home are by switching off lights, unplugging electronic devices that are not in use and reduction of heating temperatures.

From the foregoing avenues discussed, it is evident that CF will be greatly reduced, if all hands are on deck for the achievement of the common purpose to reduce the production of greenhouse gases, otherwise referred to as “carbon offsets” (Cho, 2018).

Carbon Offset: This refers to the total cost of an engagement that targets at achieving the reduction of greenhouse gases in a given location. For instance, when a certain weight is offset, equal amount of greenhouse gases that would have been let out in the environment or air is taken away or trapped. No doubt, this achievement or offset enhances sustainable development as well as the attainment of renewable energy. In other words, any carbon offset provides an avenue for achieving development in a given environment.

Carbon Footprint and Sustainability: Figure 1 represents CF reduction activities against the amount of carbon emissions being saved. The horizontal lines represent the amount in tons of carbon dioxide emission by each of the activities listed, the least being the upgrade of light bulbs.

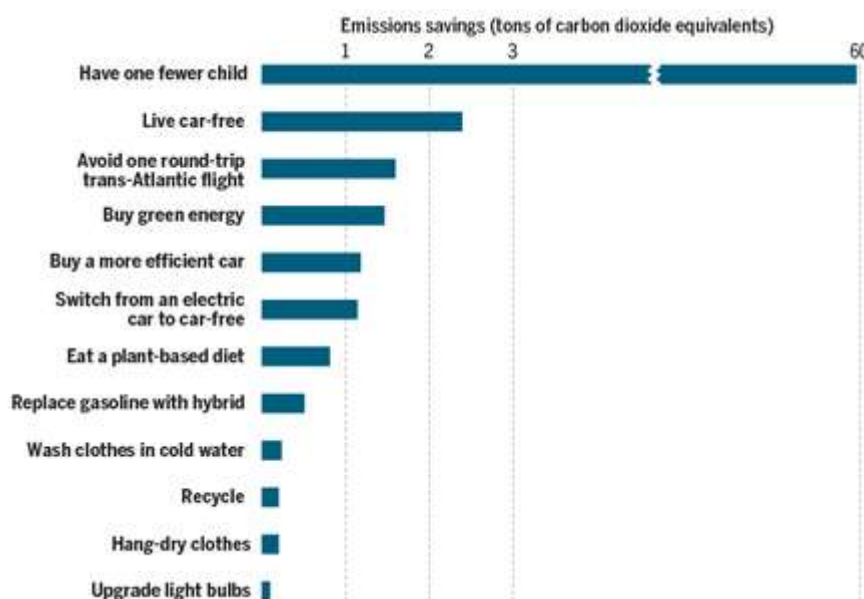


Figure 1: CF reduction activities against the amount of carbon emission being saved
 Source: Curled from Perkins (2017). Figure 2: The top ways to reduce your carbon footprint. sciencemag.org/news/2017/07/best-way-reduce-your-carbon-footprint-one-government-isn-t-telling-you-about

Given the foregoing background, it becomes necessary to examine the extent to which lifestyle changes are made in rural and urban secondary school environment towards achieving CF reduction and the influence of technology use as a learning tool for achieving CF reduction is also identified.

The following research questions and hypothesis guided the study:

- To what extent are rural and urban secondary school students affected in trying to achieve CF reduction technologically?
- To what extent are current technological learning tools implemented and used in secondary schools?
- To what extent are lifestyle changes to reduce CF currently being made?
- To what extent are private and public secondary schools affected by technological CF?
- There is no significant influence of CF reduction lifestyle on the use of technological learning tools by the teachers in the rural and urban areas.
- There is no significant influence of CF reduction culture/lifestyle on the presence of CF reduction technology in secondary schools in the rural and urban areas.

Method

Targeting two public and private secondary schools respectively in Owerri Metropolis, the study adopted a comparative study design. From the students' population in the study area, a total of 300 students was selected from each of the chosen environments (rural and urban in Owerri Metropolis), comprising a total of 150 students from two private and 150 students from two public secondary schools in each environment. Consequently, the sample size was 600.

For data collection, the study made use of an instrument titled, *Carbon Footprint Reduction through Learning with Technology Questionnaire* (CFRLTQ). The CFRLTQ was a 32-item structured questionnaire which was developed by the researchers. The researchers established the validity and reliability of the instrument through a test-retest method which was conducted, using 10 students from the population but not members of the research subjects. The two sets of data realized were subjected to Pearson Product Moment reliability test (α) which yielded a reliability coefficient of 0.86, meaning that the instrument was suitable for data collection.

The researchers administered the instrument, with the assistance of 2 research assistants, who were teachers recruited from the secondary schools,

trained, tested and found to be capable of carrying out their responsibilities. The response options were structured, using Modified Likert Scale rating type as follows: Very High (VH), High (H), Low (L) and Very Low (VL). These response options were weighted 4, 3, 2 and 1 respectively. The CFRLTQ being a four-point scale, the calculated weighted response $\{(4+3+2+1)/4\}$, established the mean response at 2.50 and this was used as the criterion mean for decision making. The data generated after the administration and collection of data were, organized, using mean and standard deviation to answer the research questions, while z-test was used to test the null hypotheses.

Result

Table 1: Mean Responses on the extent secondary school students achieved CF reduction technologically

S/N	CF reduction technology	School Area	VH	H	L	VL	Row Total	$\sum fx$	Mean	Dec
1	The use of personal mobile/computer devices are encouraged	Rural	8	11	152	129	300	498	1.66	L
		Urban	211	68	19	2	300	1088	3.63	H
2	The use of bicycles (non-carbon emitting means) within the premises are encouraged	Rural	101	146	30	23	300	925	3.08	H
		Urban	64	79	62	95	300	712	2.37	L
3	There are heating appliances for students in the school	Rural	47	26	71	156	300	564	1.88	L
4	Paper reduction awareness is encouraged	Urban	155	81	23	41	300	950	3.17	H
		Rural	38	24	137	101	300	599	2.00	L
5	Tree planting is encouraged	Urban	42	48	94	116	300	616	2.05	L
		Rural	134	98	35	33	300	933	3.11	H
6	Energy saving electricity is being used in the school	Urban	26	31	118	125	300	558	1.86	L
		Rural	21	15	113	151	300	506	1.69	L
7	Students have access to online learning tools	Urban	76	96	40	88	300	760	2.53	H
		Rural	38	52	101	109	300	619	2.06	L
8	Generators and other carbon emitting equipment are not being used within the school premises	Urban	84	126	32	58	300	836	2.79	H
		Rural	41	62	112	85	300	659	2.20	L
Grand Mean		Rural							2.21	Low
		Urban							2.67	High

Mean Response: < 2.5 = Low; > 2.5 = High

In Table 1, item 1, the findings indicate that in the urban areas, the use of mobile/computer devices is highly (3.63) encouraged, and the CF reduction technologies are being provided by the school authorities. In item 2, there was high (3.08) despondence from the rural secondary schools of those encouraged to use bicycles within the school premises which is a CF reduction technology, comparing the use of vehicles that emit Carbon. For item 3, in the urban secondary schools, the students highly (3.17) indicated heating appliances of different types within the school and these less support CF reductions. For item 4, the secondary schools in both environments (2.00 & 2.05 respectively) are less aware of paper reduction initiatives, and these comprise one of the drivers of CF reduction. Item 5 reveals that rural secondary schools are highly (3.11) encouraged to plant trees. This effort helps to offset carbon being emitted. In item 6, urban secondary schools highly (2.53) use some visible energy saving appliances such as energy saving bulbs and Energy Star products. For item 7, the urban secondary school students have high (2.79) access to online learning tools which is a CF reduction technology being utilized, while in item 8, urban secondary schools have generators and other carbon emitting equipment being highly (2.93) used within the school premises because of the inability to afford the electricity being provided by the State. Generally, the extent to which secondary school students achieve CF reduction technologically in Imo State is high (2.67) in the urban areas and low (2.21) in the rural areas.

Table 2: Mean responses on the extent current technological learning tools are being implemented and used in secondary schools.

S/N	Technological learning tools	School Area	VH	H	L	VL	Row Total	$\sum fx$	Mean	Dec
1	My teachers bring new models or internet software to share with students	Rural	52	45	80	123	300	626	2.09	L
		Urban	109	82	65	45	300	857	2.86	H
2	My teachers allow me share new knowledge learnt from new technology discussed	Rural	37	23	14	98	300	599	2.00	L
		Urban	105	87	72	36	300	861	2.87	H
3	My teachers connect the teaching to normal day to day activities	Rural	94	114	52	40	300	862	2.87	H
		Urban	90	109	59	42	300	847	2.82	H
4	My parents learn new things from assignments that help me know them better	Rural	62	83	73	82	300	725	2.42	L
		Urban	87	121	61	31	300	864	2.88	H

5	My teachers help me face challenges and solve problems in the class work	Rural	82	91	52	75	300	780	2.60	H
		Urban	94	125	47	34	300	879	2.93	H
6	Computers are sometimes used for class room work(not always paper work)	Rural	52	46	91	111	300	639	2.13	L
		Urban	97	103	74	26	300	871	2.90	H
7	Revisions and Feedback sessions are conducted by the teacher/students	Rural	85	92	69	54	300	808	2.69	H
		Urban	96	109	57	38	300	863	2.88	H
8	The school administration listens to students and teacher needs	Rural	54	68	86	92	300	684	2.28	L
		Urban	132	105	39	24	300	945	3.15	H
GRAND MEAN		Rural							2.39	Low
		Urban							2.91	High

Mean Response: < 2.5 = Low; > 2.5 = High

In Table 2, item 1, it is observed that urban secondary schools have teachers that bring high number (2.86) of new models and software to share with students for additional learning. Item 2 notes that in urban secondary schools, the teachers give the students high (2.87) opportunity to share new knowledge from new technology discussed. Item 3 reveals that schools located in both rural (2.87) and urban (2.82) environments highly connect their respective teachings to normal day to day activities. Item 4 indicates that in urban secondary schools, students’ parents learn more (2.88) new things from assignments that help them know the topics better.

However, item 5 states that the teachers in secondary schools located in both environments highly (2.60 & 2.93 respectively) assist their students when the latter face challenges as well as solve their problems in class work. In item 6, it is discovered that the urban secondary school computers are sometimes (2.90) used for class work. Item 7 states that revisions and feedback sessions are highly (2.69 & 2.88 respectively) given by the teachers in secondary schools in the two different environments. Item 8 states that in urban schools, the school administration is highly(3.15) attentive to students and teachers’ needs, while in rural schools the school administration is less (2.28) attentive to students and teachers’ needs. Generally, the extent to which current technological learning tools are being implemented and used in secondary schools in Imo State is high (2.91) in urban areas and low (2.39) in rural areas.

Table 3: Mean responses on the extent lifestyle changes to reduce CF are being made by the secondary school students

S/N	CF reducing lifestyles	School Area	VH	H	L	VL	Row Total	$\sum fx$	Mean	Decision
1	I walk to school	Rural	135	113	32	20	300	963	3.21	H
		Urban	104	79	64	53	300	834	2.78	H
2	I use generators at home	Rural	74	40	72	114	300	674	2.25	L
		Urban	142	93	37	28	300	949	3.16	H
3	I turn off the lights when I leave rooms	Rural	41	32	82	145	300	569	1.90	L
		Urban	106	114	42	38	300	888	2.96	H
4	I plant trees/crops at home	Rural	124	101	49	26	300	923	3.08	H
		Urban	58	42	106	94	300	664	2.21	L
5	I hang dry my clothes when I wash them	Rural	148	107	24	21	300	982	3.27	H
		Urban	109	78	88	25	300	871	2.90	H
6	I eat more of vegetables	Rural	85	94	104	17	300	847	2.82	H
		Urban	52	39	118	91	300	652	2.17	L
7	I know the things I do that reduce energy waste	Rural	21	36	157	86	300	592	1.97	L
		Urban	48	27	121	104	300	619	2.06	L
8	I correct my family members when they waste energy	Rural	29	32	145	94	300	596	1.99	L
		Urban	53	28	134	85	300	649	2.16	L
GRAND MEAN		Rural							2.56	High
		Urban							2.55	High

Mean Response: < 2.5 = Low; > 2.5 = High

Item 1 in Table 3, states that both rural (3.21) and urban (2.78) secondary schools highly engage in walking to school. Item 2 reveals that urban secondary school students highly (3.16) use generators at home and this contributes to their CF. In item 3, urban secondary school students highly turn off their lights when they leave rooms, while the rural secondary school

students talk about little presence of power sources for usage. In item 4, students that live in rural areas highly plant trees and crops at home (3.08). In item 5, both students from rural (3.27) and urban (2.90) areas highly (3.08) wash and dry their clothes manually which leads to CF reduction when compared to the use of washing machines. In item 6, students in the rural areas (2.82) eat more natural foods such as vegetables unlike those in urban areas (2.17) who are exposed to fast food joints. In item 7 and 8, the rural and urban secondary students know less about those activities that save energy and family members are not less corrected when energy is wasted. Generally, the extent to which lifestyle changes to reduce CF is being made by the secondary school students is high in both rural (2.56) and urban (2.55) areas of Imo State.

Table 4: Mean Responses on the extent private and public secondary schools are affected by technological CF reduction

S/N	CF reduction technology	School Area	VH	H	L	VL	Row Total	Σfx	Mean	Dec
1	The use of personal mobile/computer devices are encouraged	Private	113	98	42	47	300	877	2.92	H
		Public	64	79	98	59	300	748	2.49	L
2	The use of bicycles (non-carbon emitting means) within the premises are encouraged	Private	39	48	109	104	300	622	2.07	L
		Public	52	73	114	61	300	716	2.39	L
3	There are heating appliances for students in the school	Private	117	92	47	44	300	882	2.94	H
		Public	84	61	86	69	300	760	2.53	H
4	Paper reduction awareness is encouraged	Private	34	27	147	92	300	603	2.01	L
		Public	28	21	136	115	300	562	1.87	L
5	Tree planting is encouraged	Private	42	37	113	108	300	613	2.04	L
		Public	84	60	73	83	300	745	2.48	L
6	Energy saving electricity is being used in the school	Private	97	89	23	91	300	792	2.64	H
		Public	21	14	163	102	300	554	1.85	L
7	Students have access to online learning tools	Private	102	82	55	61	300	825	2.75	H
		Public	96	68	39	97	300	763	2.54	H

8	Generators and other carbon emitting equipment are being used within the school premises	Private	126	101	27	46	300	907	3.02	H
		Public	19	27	78	176	300	489	1.63	L
		Private							2.55	High
	GRAND MEAN	Public							2.22	Low

Mean Response: < 2.5 = Low; > 2.5 = High

The responses in Table 4, item 1 indicate that the use of personal mobile/computer devices is highly encouraged in private secondary schools but less encouraged in the public secondary schools in Imo State. In both private and public schools, the use of bicycles (non-carbon emitting means) within the premises is less encouraged. The presence of heating appliances for students in both groups of school is equally high, while paper reduction awareness and tree planting are less encouraged for them, as noted in items 4 and 5 respectively. From the responses in item 6, energy saving electricity is highly (2.64) being used in private school, but less (1.85) used in public schools. In both schools, students have high access to online learning tools as shown in item 7 responses.

However, in private secondary schools, generators and other carbon emitting equipment are highly (3.02) being used, but less (1.63) used in public schools within the school premises (item 8). Generally, private secondary schools are highly (2.55) affected by technological CF reduction, while public secondary schools are less (2.22). affected

Table 5: z-paired sample test analysis showing the influence of CF reduction lifestyle on the use of technological learning tools by the teachers in the rural and urban areas

Variables	n	Pairs	Items	Mean	SD	Std. Error Mean	Z	Z tab	Decision
Rural	8	1	Lifestyle Technology	0.17625	0.75332	0.26634	0.66	0.7454	Accept
Urban	8	2	Lifestyle Technology	0.36125	0.49299	0.17430	2.07	0.9808	Reject

There is a significant influence of CF reduction lifestyle on the use of technological learning tools by the teachers in the rural areas but not in the urban areas.

Table 6: z paired sample test analysis showing the influence of CF reduction lifestyle on the presence of CF reduction technology in secondary schools in the rural and urban areas

Variables	n	Pairs	Items	Mean	SD	Std. Error Mean	Z cal	Z tab	Dec.
Rural	8	1	Lifestyle Technology	0.35125	0.81292	0.28741	1.22	0.8888	Reject
Urban	8	2	Lifestyle Technology	-0.11625	0.72162	0.25513	-0.46	0.32276	Accept

There is a significant influence of CF reduction lifestyle on the presence of CF reduction technology in secondary schools in the urban areas but not in the rural areas.

Discussion

In Imo State secondary schools, students cannot motivate themselves alone on achieving CF reduction, without the help of teachers and school management, who will actively provide CF reduction technology as part of the school curriculum for adaptation.

This finding is in line with earlier findings in Mauritius reported by Bekaroo et al. (2019) that majority of secondary school teachers had heard about CF, but only one employee of the whole group had actively calculated his personal CF. Consequently, availability and knowledge application of CF reduction technologies should be part and parcel of the teacher’s essentials for successful teaching and learning in the modern times. This study established that in Imo State, the extent to which secondary school students achieve CF reduction technologically is high ((2.67) in the urban areas and low (2.21) in the rural areas. Similarly, the implementation and use of current technological learning tools are high (2.91) in urban areas and low (2.39) in rural areas. On the other hand, the extent to which lifestyle changes to reduce CF is being made by the secondary school students is high in both rural (2.56) and urban (2.55) areas. There is a significant influence of CF reduction lifestyle on the presence of CF reduction technology in secondary schools in the urban areas but not in the rural areas. Among the secondary school teachers in Imo State, the influence of CF reduction lifestyle on the use of technological learning tools in the rural areas is significant but not in the urban areas.

Again, private secondary schools are highly affected (2.55) by technological CF reduction, while public secondary schools are less affected (2.22) in Imo State. These disparities between the urban and rural areas should

not be avoided since in modern times, both the urban and rural areas have been exposed to various types of technological learning tools. Generally, teachers stand strategic in both knowledge acquisition and delivery, hence should be supported and given all the necessary opportunity to equip themselves with the essential tools to succeed in the modern classroom. This call corroborates Mbagwu and Opara's (2011) earlier findings that teachers in secondary schools in Owerri Municipal have not been able to maximally utilize some of the ICT facilities available in their schools and this situation will be worse in the rural areas of Imo State. Emuku and Emuku (1999 and 2000) result was in tandem with this claim.

Conclusion

It has been proven in this study that in Imo State, lifestyle changes are being made by students in both rural and urban secondary school unknowingly, due to lack of awareness and inability to have access to CF reduction technology which either the school has not provided, or the student's family cannot afford. However, the influence of CF reduction lifestyle on the presence of CF reduction technology in secondary schools in the urban areas is significant but not in the rural areas. Among the secondary school teachers in Imo State, the influence of CF reduction lifestyle on the use of technological learning tools in the rural areas is significant but not in the urban areas. Although lifestyle changes such as walking to school have greater impact than technology, these different technologies which may also be carbon emitting products are invented and produced for daily activities to be carried out easily. In all these, teachers stand strategic in both knowledge acquisition and delivery, hence should be supported and given all the necessary opportunity to equip themselves with the essential tools to succeed in the modern rural and urban classrooms

Recommendations

Consequent upon the findings of the study, the researchers recommended the following:

1. CF reduction awareness sessions, initiatives and programmes should be included in the curriculum of secondary schools.
2. The government needs to fund rural secondary schools and raise public secondary schools' standards to avoid unnecessary students' deprivation of educational values.
3. More relevant ICT facilities should be provided and maintained regularly, while already related existing ones should be utilized by employing ICT savvy teachers in secondary schools that will teach the

students effectively. In all, there should be regular monitoring and assessment of progress.

4. ICT teachers should undergo regular workshops to equip themselves with the knowledge of new technologies and impart same on the students successfully.
5. More teachers should be recruited, trained and certified in relevant fields for immediate employment to fill the gap in the emerging technologies.

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