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A comparative study of carbon footprint and opportunity costs of a distance education and a conventional university

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Abstract

The six-week study investigated two costs of education that are often overlooked, namely, the amount of greenhouse gases produced to support the learner's activities (carbon footprint); and what students forgo in order to pursue their studies (opportunity cost). The objective was to measure these two variables of a student in an ODL setting vis-à-vis that of a similar one doing a similar degree programme (Entrepreneurship) in a conventional university. The two basic questions were:

a. How does the carbon footprint of an ODL programme compare to that of a similar face-to-face programme?

b. How do the opportunity costs of an ODL programme compare to those of a similar face-to- face programme?

It was presumed that, *inter alia,* the investigation would contribute to the growing body of knowledge on the environmental impact and opportunity costs of conventional higher education, and of the ODL mode in the context of a developing nation. The participants comprised two purposively sampled classes of entrepreneurship students, one registered with a distance learning university, and the other registered with a conventional one. Both groups were in their final year at separate institutions in Gaborone. A questionnaire was used for data elicitation. Comparisons (ANOVA) were employed to determine whether there are statistically significant differences between the overall carbon footprints and opportunity costs of the two groups. Some of the findings were that the carbon footprint of a face-to-face programme is higher than that of the distance education one. Secondly, the distance learner missed the opportunity for government sponsorship (opportunity cost). Conclusions arising from the findings were that statistically, there was a significant difference in the manifestation of variables measured between the two groups (opportunity cost and carbon footprint). One of the recommendations made was that there was need for sustained education for providers of university education on environmental impact and opportunity cost. Regarding further research, it was recommended that future scholars should consider carrying out research with specific focus on how the quality of distance learning contrasts with that of face-to-face learning, given that opportunity cost and carbon footprint will have been objectively established.

Keywords: Carbon footprint, opportunity cost, open and distance learning, conventional setting

INTRODUCTION

Education as both an indicator of and catalyst for sustainable development is not a new idea. While the benefits of education have been studied at length, there is little research evidence about the potential costs of

education in certain aspects. Two costs of education often overlooked are:

i. *Carbon footprint*, that is, the environmental impact, which can be measured by the total amount of greenhouse gases produced to directly and indirectly to support the learner's activities (Henebery, 2017). Carbon footprint refers to the sum of all emissions of CO2 (carbon dioxide), which are induced by an individual's activities in a given period, and this is calculated over a period of time (http://timeforchange.org/what-is-a-carbon-footprint-definition). Carbon emissions are accounted for through the amount of paper used, fuel to and from school, electricity consumed, course textbooks, etc. Carbon footprint is measured in kilograms and tons.

ii. *Opportunity cost*, that is, what students forgo in order to pursue their studies Opportunity cost refers to a benefit that a person could have received, but gave up, to take another course of action. Stated differently, an opportunity cost represents an alternative given up when a decision is made *(*https://www.investopedia.com/terms/o/opportunitycost.asp*)*.

While these potential costs of education do not negate its intrinsic or instrumental value, it is important to be cognisant of both the opportunity cost and environmental impact associated with higher education so that we can better understand how to reduce or mitigate them.

It has been suggested that one way to reduce both the environmental impact and opportunity cost of higher education is the use of Open and Distance Learning (ODL) methodologies. It is presumed that the ODL mode of delivery ostensibly helps reduce the carbon footprint of learners and institutions, as this mode may utilise fewer material resources, and does not normally require extensive learner travel (Caird *et al.,* 2013.). Furthermore, the mode can reduce the opportunity cost associated with traditional face-to-face study by allowing the student flexibility in terms of study schedule, so he/she can continue to work and generate an income.

While these suppositions may seem self-evident, there are limited real world examples or case studies that have examined how the carbon footprints and opportunity costs of ODL learners compare to those of traditional face-to-face students, specifically in the context of developing countries like Botswana, South Africa, and Zimbabwe, to name a few SADC countries. Since an institution's geography, infrastructure, policies, and national development context have a large impact on carbon footprint, referencing a generic comparison based on anecdotes or averages from developed countries does not provide sufficient insight into a developing country's context (Cook & Washington, 2015). Similarly, the economic landscape and employment opportunities of a country affect opportunity cost greatly; thus, results from studies in developed countries may not be applicable to the developing world. Clearly, the developing country context requires a distinct, nuanced assessment of the environmental impacts of different delivery modes.

The current study, thus, sought to compare an ODL course with a traditional face-to-face course in Botswana, in order to determine whether there is any significant difference in their learners' course-related carbon footprints or the opportunity costs

incurred. The courses were similar in terms of duration and content, and both counted as a module, which makes up part of a recognised Bachelor's degree in Business and Entrepreneurship. An appropriate sample size and strategy was devised, and students from the two institutions were surveyed about their learning behaviours, consumption patterns, and demographics. Institutional contacts were also interviewed and reports or public documents reviewed in order to gather data on the individual institution. For the scope of this study, carbon emissions variables were calculated for electricity consumption, paper use and travel, and then added to come up with an overall 'carbon footprint' for learners' course-related activities.

Opportunity cost was estimated for the entire programme length and included costs of tuition, materials, travel and forgone income. The returns consisted of the predicted future lifecycle income. Only private monetary returns were calculated, as public and social returns are beyond the scope of this study. The study sought to ascertain whether there is a statistically significant difference between the ODL and face-to-face students' carbon footprints produced and/or opportunity costs incurred because of their participation in higher education.

THE SETTING

Botswana's fast-growing economy, boasts a GDP per capita (PPP adjusted) of $18,825 per year as of 2015 - one of the highest in the continent. It also has the highest Human Development Index of continental Sub-Saharan Africa. However, Botswana faces many challenges in regards to environmental degradation and climate change:

> *The welfare of the people, the performance of the economy, and the state of the environment in Botswana are all very closely linked to the climate. According to the Botswana government, the country is "highly vulnerable to climate change" due to its fragile ecosystems and (semi-) aridity. Climate change is likely to add to existing stresses in Botswana causing significant changes in prevalent vegetation and rangeland cover, affecting species types, composition and distribution, as well as those depending on them…The sectors emitting most greenhouse gas emissions in Botswana (1994) are agriculture/livestock, energy, industry, waste as well as land use and forestry (in declining order of importance)… Related to the second largest emitter, the energy sector is facing the challenge to increase supply while at the same time mitigating greenhouse gas emissions"* (Botswana Environmental and Climate Change Analysis, 29 May, 2008).

Botswana also faces challenges in its employment sector. The unemployment rate of approximately 18% has remained virtually unchanged, resulting in pronounced income inequality in the country (World Bank, Botswana, 2016). Education has been promoted as a way to create the skilled labour force the country needs to bolster and diversify its economy. At approximately 9% of GDP, Botswana's expenditure on education is amongst the highest in the world. Botswana has invested substantial resources in the education sector since it became a sovereign nation in 1966. At independence, there was no national university or tertiary institution. Botswana began a major reform of its higher education system in the early 1990s and in 1993; The Presidential Commission on Education was appointed and created a plan for sweeping, system-wide reforms. In 1994, this plan was adopted as the Revised National Policy on Education (RNPE). The highest level of tertiary

enrolment was seen in 2008-09, when 47,889 students were enrolled in either public or private tertiary education (54.6% in public institutions). Since 2009, public institutions have seen a minimal decrease in enrolment, while private institution enrolment has declined by close to 40%. In an attempt to move towards a knowledge-based economy, the Tertiary Education Council (TEC), now the Human Resource Development Council (HRDC) has been aiming to increase access to tertiary education to 17% by 2016, with the goal of increasing access to 20% by 2020. The Botswana International University of Science (BIUST) located at Palapye, held a roof-wetting rite on April 16, 2015 for the college's building. Along with the expansion of current institutions, this will be necessary to accommodate the expected influx of learners.

The two institutions selected for this study are the Botswana College of Distance and Open Learning (BOCODOL), and the Botswana Accountancy College (BAC). BOCODOL, now the Botswana Open University, was created by an Act of Parliament in July 1999, and is a semi-autonomous distance teaching university. In addition to its Headquarters in the capital Gaborone, the college has five Regional offices in Gaborone, Francistown, Palapye, Maun and Kang that operate through study centres countrywide. The Botswana Accountancy College (BAC) is a traditional face-to-face institution, which provides business education in Accountancy, Computing, Business Management and Insurance. The BAC owes its origins to a joint venture partnership between the Government of Botswana and Debswana, who are its guarantors. The Botswana Accountancy College's main campus is located in Gaborone with a second location in Francistown.

STATEMENT OF THE PROBLEM

In both conventional and open universities, there is the problem of finances and resources to sustain the student. However, the problem is that no studies have been conducted to establish for certain how much it costs to sustain an individual student in terms of expenditure on fuel, electricity, public transport, and quantities of paper used (carbon footprint). Further, there is also a gap in the knowledge about what opportunities the university student forgoes by studying either by distance mode or by studying full-time at university. Researched knowledge about these two phenomena has the potential to influence policy makers on future directions of tertiary education, more especially when the conventional and distance learning universities are juxtaposed for comparison.

RESEARCH QUESTIONS

The questions below guided the investigation:

a. How does the carbon footprint of an ODL programme compare to that of a similar face-to-face programme in the context?

b. Which factors contribute most to the carbon footprint produced by ODL learners and face-to-face learners?

c. How do the opportunity costs of an ODL programme compare to those of a similar face-to- face programme in the context of Botswana?

d. Which factors contribute most to the opportunity costs incurred by ODL learners and face-to-face learners?

THEORETICAL VIEWS

Today, governments, corporations and communities are striving to reduce their

carbon footprint and combat the impact of climate change – and schools are no exception.

With heat and power being emitted from classrooms, students and staff travelling to and from school, waste management, and the supply chain activities of companies providing goods and services, schools are contributors to this issue (Henebery, 2017).

Premised on the above, the present study was guided by The Polluter Pays Principle and Physical Harm propounded by Hayner and Weisbach (2016).

The Polluter Pays Principle (PPP) postulates that making polluters pay for the harm that they cause forces polluters to take all the costs of their actions into account. In other words, they must be aware of the consequences of their actions and appreciate the social costs in order for them to act more appropriately. Scholars, Coleman, Hershovitz, and Mendlow (2015, p. 6), put it succinctly thus, "…an individual has a duty to repair the wrongful losses that his conduct causes." That means, individuals are held responsible only if they know or should have known that their actions were unduly risky or would lead to harm.

The second theory is referred to as the Limited Resource Principle (LRP). According to Pickering and Barry (2012, p. 670), the theory is decomposed into three parts, namely: (1) all humans have a right, based in justice, to an equal share of the atmosphere's absorption capacity. Secondly, overuse of the atmosphere by anyone, such as by forcible taking, causes harm to those who are thereby deprived of their own fair usage; and thirdly, those who so overuse the atmosphere must compensate others for the overuse. Thus, guided by the theories, ODL students and full-time conventional learners, after developing awareness, become mindful of ways to approach carbon footprint.

According to Cook and Washington (2015), some of the ways that a carbon footprint can be reduced are using *sustainable transport* whenever possible, e.g. walking or riding a bicycle. In addition, using public transportation can drastically reduce carbon dioxide emissions. *Improving home energy efficiency* by insulating and sealing it properly. Using recycled paper for printing and photocopying. *Recycling and composting* helps to reduce carbon emissions associated with the "provision of goods", or the extraction of resources, transport, manufacturing, and disposal of goods. *Reducing water usage* in the home and hostels. This lowers the amount of energy required to pump, treat, and heat water. Conservation along with using water saving showerheads, toilets, dishwashers, and washing machines can help here.

One opportunity cost theory upon which this study was grounded is derived from educatorblog.wordpress.com/2008/06/20/opportunity-cost/. Briefly summarised, the theory has these characteristics:

Firstly, it defines opportunity cost as a course of action that represents the forgone benefit from an alternative action. In order for a benefit to be forgone, the chosen and alternative actions have to be mutually exclusive. This means one cannot do both actions at the same time. Secondly, the concept of opportunity cost reflects the scarcity of our resources – especially time and money. When we integrate opportunity cost into our decision-making, we ensure the most efficient use of our scarce resources. Thirdly, in order to figure out the true value of any decision, the decision-maker does a cost-benefit analysis (often subconsciously).

We must account for the "up front benefits" of an action and factor in forgone benefit.

The Theory highlights the concrete and abstract characteristics of opportunity cost, applicable to distance learning versus full-time study (Henebery, 2017), and these include:

- Time
- Money
- Physical safety
- Achievement
- Social services (health care, sex education, college and career consulting, etc.)
- Learning
- Fair distribution of social and economic opportunity
- Rights promotion
- Community-building and local support
- Emotional and mental stability
- Happiness and fulfillment

It is noteworthy that none of the items on this list is mutually exclusive. Suffice to say that the Theory serves as a guide in our discussion of opportunity cost for the ODL and conventional university learner.

Despite the growing popularity of sustainability principles in higher education institutions, the environmental impacts of different modes of delivery for higher education are not fully understood. Furthermore, there has been little research into the environmental impacts of existing HE course models, with the exception of the Factor 10 and SusTEACH projects that were conducted by the Open University of the United Kingdom (OUUK) research teams in the past 10 years (Caird *et al.,* 2013.)

The SusTEACH project compared four ICT-enhanced courses with four online courses and fourteen mainly face-to-face taught courses. The findings showed that HE online and blended ICT-enhanced distance teaching models had significantly lower impacts than face-to-face teaching models (Caird *et al*., 2013). While projects like SusTeach University have assessed and compared the carbon footprint of different modes of delivery, the focus has been on institutions in the UK, and the assessment tools used in these projects have not been applied widely in the developing world, or these results have not been widely published. Inferring similar findings for developing countries is problematic for a number of reasons.

i. Firstly, the emissions factors used in calculating carbon footprint vary from country to country.

ii. Furthermore, higher education institutions in developing countries may not have sustainability practices or infrastructure (like paperless courses, or energy efficient buildings) comparable to institutions in the UK.

iii. Conversely, the carbon footprint in a developing country may be affected by lower rates of consumption.

iv. Due to financial constraints, students in developing countries may be less likely to use vehicles to get to school, and may purchase fewer physical materials resulting in financially motivated, reduced consumption.

Clearly, therefore, the development context has the potential to greatly influence the carbon footprint of learners, and thus averages generated for ODL and face-to-face courses in the UK cannot be applied universally.

ODL is highly touted for its ability to increase access to higher education. Perraton and Hulsmann (2003, p.9) as summarised by Letseka (2012) contend that ODL can reduce opportunity costs in forgone earnings "and facilitate a higher integration of working and studying" (p. 223). In the traditional face-to-face mode of delivery, students may have to sacrifice income-generating activities in order to study. The costing of ODL normally takes into account both fixed and variable costs. However, it has been noted, "Many studies of educational economics leave … opportunity costs out of account" (Perraton, 2004 p. 15), and do not consider the income forgone by students in order to pursue their studies. In a comprehensive cost analysis, the private cost of higher education should include "any fees or direct cost that the individual pays ***plus*** the opportunity cost in terms of forgone income"; yet there is little information available on the cost of forgone income, and even less comparing income forgone by students in ODL and face-to-face delivery modes.

METHODOLOGY

Population and Study Sample

The population comprised students registered in a Bachelors Degree in Business and Entrepreneurship from BOCODOL, and from BAC, both classes in their final year. Additionally, the Chief Executive Officer of each institution, lecturers and academic registrars were included in the survey.

Only one class from either institution was purposively sampled, and the sample is summarised in Table 1.

Table 1 Research participants

Institution	CEO	Lecturers	Registrars	HoDs	Students
BOCODOL	1	2	1	1	26
BAC	1	2	1	1	34
Total	2	4	2	2	60

Two methods of collecting data were used, namely, oral interviews and written questionnaire. The Consultant and his research assistants recorded data from interviews and written questionnaire on Excel. Each respondent was given a number for tracking and the Consultant prepared a coding sheet for reference during the data analysis.

Ethics and Human Subjects Issues

Meticulous consideration was given by the Consultant to ethical issues at the levels of interaction with research assistants, institutional employees (CEOs, HoDs, registrars, and lecturers) and students. The following were taken into account: voluntary consent; liberty to withdraw consent at any point in the experiment; disclosure by the researcher of all information necessary for making an informed decision to participate in

the research project including, what the study entailed, and its foreseeable risks and potential benefits, to the participant; use of numbers only in order to ensure confidentiality; and pledging to safeguard information.

RESULTS

Demographics

The BOCODOL students ranged from age 26 to 51, with an average age of 35 years compared to the BAC students who ranged from 19 to 26, with an average age of 24 years. As evident in Table 2, there were more females than males in both the BOCODOL and BAC groups, with similar proportions across the two groups.

Table 2. Participants by Gender and Institution

BOCODOL Participants		BAC Participants		
Male	**Female**	**Male**	**Female**	**No Response**
8 (31%)	18 (69%)	10 (30%)	21 (64%)	2 (6%)

Travel Emissions

While BOCODOL students were more likely than their BAC counterparts to use a car as their main mode of transportation, they had significantly less programme related travel each semester. Table 2 shows the differences in the modes of transport for full-time and part-time students. The greater overall distance travelled by the BAC students contributes to their higher CO2 emissions for travel each semester, as compared to the BOCODOL students. Figure 1 reflects the mean kilometres and emissions. This is based on the travel mode used by students in the different institutions.

Table 2. Travel Mode by Institution

		BOCODOL	BAC	Total
Travel mode	car	22	7	29
	walking	0	2	2
	bus	0	3	3
	other public transport	4	20	24
Total		26	32	58

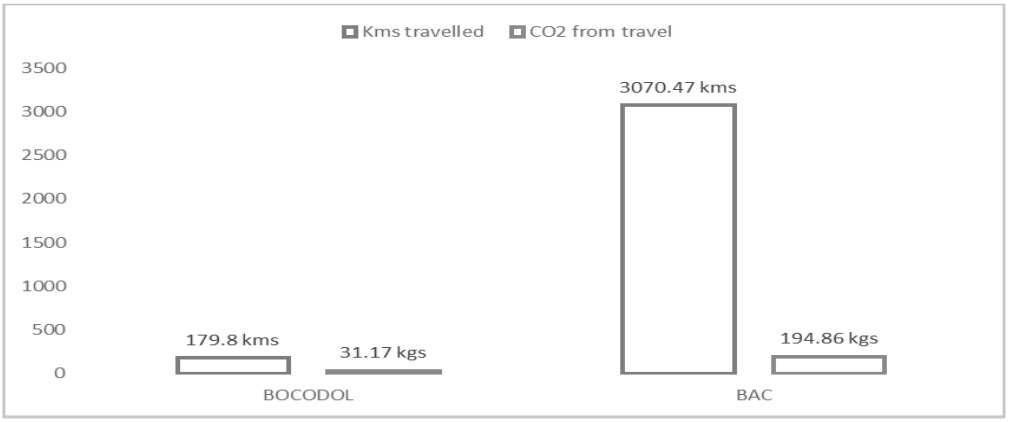


Figure 1 Kilometres travelled and co2 emissions per semester

Energy Consumption

On Campus

The on-campus electricity emissions were calculated as the sum of the classroom emissions and the emissions from on-campus ICT use. Overall, the BAC students have significantly higher emissions from on-campus energy use, as compared to the BOCODOL students. This result is expected, as the BOCODOL students are only required to be on campus for contact classes four times during the semester.

Table 3. On Campus CO2 Emissions

		N	Mean	Std. Deviation
TOTAL Campus CO2	**BOCODOL**	26	49.0928	3.11698
	BAC	33	137.2370	5.57144

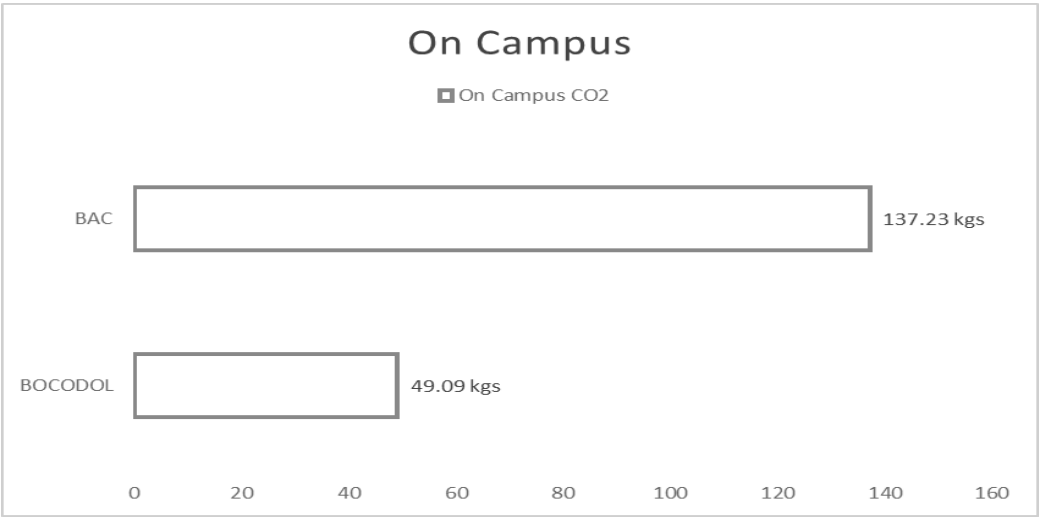


Figure 2 On Campus C02 emissions

At home/residence emissions

The at-home energy usage consists of lighting; heat and ICT consumption of electricity for programme related work and study. While BOCODOL learners have higher emissions for at home ICT usage than the BAC students (Table 5), they have lower usage of additional heat and lighting at home than their counterparts at BAC (Table 4). Overall, the BAC group has higher average home emissions than that BOCODOL group (Table 6 and Figure 3).

Table 4. Additional heat and lighting

		N	Mean	Std. Deviation
Additional Home Lighting and Heat CO2	**BOCODOL**	26	9.4985	18.28799
	BAC	33	24.6960	23.64462

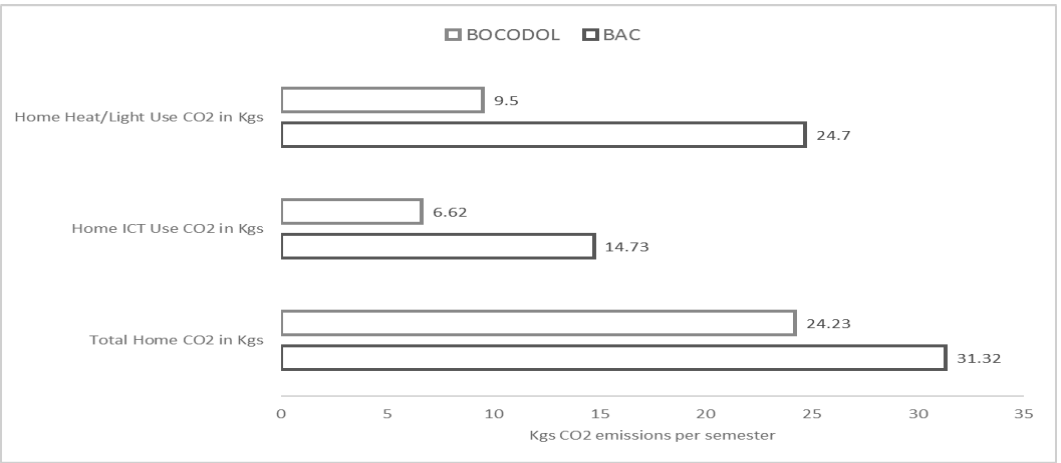
Table 5. Home ICT usage

		N	Mean	Std. Deviation
Home ICT CO2	**BOCODOL**	26	14.7328	34.10466
	BAC	33	6.6220	10.90689

Table 6. Total home emissions

		N	Mean	Std. Deviation
TOTAL Home CO2	**BOCODOL**	26	24.2313	48.45349
	BAC	33	31.3180	24.84029

Figure 3. Home CO2 Emissions



Paper Use

Respondents were asked to estimate the amount of paper they used in three different categories: paper distributed by the institution; paper for their own personal use; and, miscellaneous programme-related paper such as exams, registration documents, etc. The BAC students reported using significantly more paper than the BOCODOL students, resulting in much higher average emissions from paper, as reflected in Table 7

Table 7. Total Paper CO_2 Emissions

		N	Mean	Std. Deviation
TOTAL Paper CO2	**BOCODOL**	26	5.6686	2.02326
	BAC	33	30.0547	28.90344

Learning Materials

While the BAC students each received four assigned hardcopy textbooks for the semester, the BAC students received their learning materials on a single CD. The average total emissions from the BAC textbooks was estimated at 60kgs per student while the emissions from the CD for the BOCODOL group was 0.5kgs per student.

To arrive at the overall learner carbon footprint, the sum of the travel, at-home and on-campus energy use, ICT purchased, paper and learning materials CO_2 emissions value was calculated. Overall, the average carbon footprint of the face-to-face mode BAC group was more than three times greater than that of the distance mode BOCODOL group.

Table 8. Total $C0_2$ Emissions (Carbon Footprint)

		N	Mean	Std. Deviation
TOTAL CARBON FOOTPRINT	**BOCODOL**	26	210.7146	110.68349
	BAC	33	614.1240	235.53545

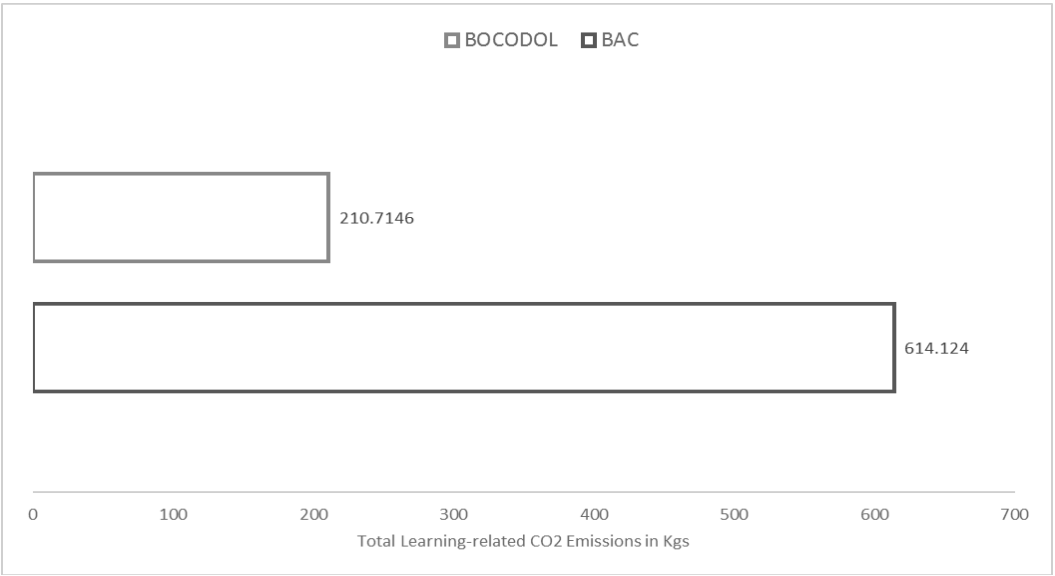


Figure 4. Average Learner Carbon Footprint (Kgs)

Production Emissions from ICT Purchased

Respondents reported whether they had purchased any ICT specifically for their programme or not. The BAC students were more likely to have purchased a laptop specifically for the programme, as evident in Table 9 while BOCODOL students were more likely to have purchased a tablet for their programme (Table 10). Only laptops and tablets were reported as being purchased specifically for the programme. Approximately 46% of BOCODOL students use existing ICTs for their programme (computer laboratories), while only 18% of the BAC students do. The total production CO_2 values used for ICT purchased was 200kg for laptops and 150kg for tablets. Due to the significantly higher proportion of BAC students who had purchased a laptop specifically for their programme as compared to the BOCODOL group, the average CO_2 emissions from ICT purchased was significantly higher for the BAC students (Figure 5).

Table 9. Percentage of Respondents that Purchased a Laptop by Institution

			BOCODOL	BAC	Total
Purchased Laptop?	NO	Count	16	8	24
		%	61.5%	24.2%	40.7%
	YES	Count	10	25	35
		%	38.5%	75.8%	59.3%

Table 10. Percentage of Respondents that Purchased a Tablet by Institution

			BOCODOL	BAC	Total
Purchased Tablet?	NO	Count	22	31	53
		%	84.6%	93.9%	89.8%
	YES	Count	4	2	6
		%	15.4%	6.1%	10.2%

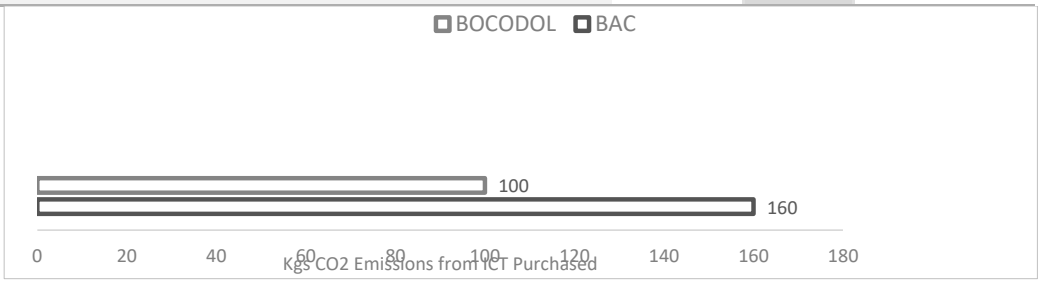


Figure 5. ICT Production Emissions for Devices Purchased for the Programme

To sum up, Table 11 lists the components of the overall carbon footprint calculation from the greatest difference in emissions between the two groups to the least. BAC students, on average, have higher emissions in every component.

Table 11. Components of Total Carbon Footprint

Factor	BOCODOL Emissions (Kgs CO2)	BAC Emissions (Kgs CO2)	Difference
Travel CO2	31.17	194.85	163.68
On campus energy use	49.09	137.24	88.14
ICT Purchased	100.00	160.60	60.60
Learning Materials	0.5	60	59.5
Paper	5.67	30.05	24.38
Home energy use	24.23	31.31	7.08
TOTAL	**210.71**	**614.12**	**403.41**

Opportunity Cost

The findings about opportunity cost are presented based on individual research question: How do the opportunity costs of an ODL programme compare with those of a similar face-to-face programme?

Of the 26 ODL students who were interviewed, 20 (77%) are employed, as opposed to 6 (23%) who are not. This means the majority work and earn. Out of the 34 interviewees from BAC, 32 (94%) students are not employed, while only 2 (6%) are employed while studying full-time. Thus, ODL students maximise the opportunity to work and acquire a qualification at the same time. Table 12 below captures the situation.

Table 12 Percentage of respondents employed

			BOCODOL	BAC	Variance
Employed?	NO	Count	6	32	26
		%	23%	94%	71%
	YES	Count	20	2	18
		%	77%	6%	71%

However, verification interviews with ODL students and tutors, revealed that:

...they wanted more face-to-face time as it was not always easy to study alone most of the time.

Incidentally, the tutors are part-time as well, and their conceptualisation of principles of ODL mode seems somewhat deficient. It was clear that their (tutors) background is in conventional face-to-face teaching, or they have no teaching experience at all, hence they seem to find it difficult to adapt to the new mode, something that was ostensibly also reflected in the students. An interesting finding with a tutor was that:

...he was from the banking sector, and did not have any training on how to teach his area (Financial Accounting), though he possessed a lot of knowledge of the content.

Thus, many tutors seem to lack grounding in pedagogics.

While the ODL student was found to be able to earn and learn, he/she forgoes the opportunity for constant support by subject experts. In our interviews with tutors from both modes of delivery, there was a shared view about the time invested in studies by students from either divide.

ODL tutors expressed the view that their students did not give enough time to attend to their studies, as they had to also cope with demands of full-time employment.

On the other hand, lecturers from the conventional set-up (BAC) were explicit that:

...it was the business of their students to devote time to the only preoccupation of working towards a qualification.

This observation has implications for the issue of quality between the ODL and the face-to-face student output, assuming that the more the time one invests in one's studies, the more the likelihood of quality outcome. However, this is a matter beyond the scope of the current study. To get back to the point, which is underscored, the ODL student forgoes the opportunity of devoting full time on studies, when compared to the face-to-face counterpart.

The ODL student pays P6 100 fees per semester, vis-à-vis P14 600 for the face-to-face student. However, the latter is fully subsidised by the Government, while the ODL student is self-sponsored. In this respect, the latter forgoes the opportunity to be sponsored by the state.

Interviews with ODL students revealed one issue that was not part of the scheduled questions, namely, the issue of socialisation. Students variously expressed the view that:

...they have problems when they want clarification of something because there will not be any of their peers or tutor in the vicinity.

Essentially, face-to-face students do not have a problem with that since:

...they study full-time, and have ready access to the library, the subject area specialists, as well as classmates.

The ODL students forgo this opportunity. ODL tutors observed that:

...their students were self-driven and purposeful because they paid fees for themselves and wanted to get the best out of what they did. They also revealed that in the attempt to balance their studies with their work, they had to create time to ensure equitably distributed attention.

On the contrary, lecturers at BAC indicated that:

...generally, the learners were not as motivated as they expected most probably because somebody paid their fees, hence in some cases motivation was not internal. Further, they were used to following a timetable prepared for them, and their independence was not as high as that of their ODL counterparts. They were not self-programmed.

Thus, face-to-face students forgo this opportunity of cultivating autonomy while pursuing their studies.

One of the findings, worth further investigation, was the employability of entrepreneurship graduates. The BAC students were somewhat concerned about how employable they would be after completing the degree. Botswana is a developing country where the conventional social expectation is that if one is going to look for a job as an accountant (accounting degree); teacher (teaching degree); pharmacist (pharmacy degree), and so forth. Entrepreneurship is a new qualification on the market, and according to students, the employment sector is not aware what sort of job someone with a qualification in entrepreneurship is capable of doing. In other words, their expressed concern was,

...What sort of job do I look for, other than going into self-employment?

In short, full-time students of BAC forgo employment opportunities by working on a degree qualification that is not properly understood in the market. The opposite was considered true for ODL research participants, the majority of whom were already employed, and the Entrepreneurship degree merely enhanced their promotion prospects.

Conclusions drawn from the results on opportunity cost

Deriving from the above, the following conclusions, serving as factors that contribute to opportunity cost incurred, were drawn:

i. Face-to-face learners incur the opportunity cost to learn and earn.

ii. ODL students incur the opportunity cost for government sponsorship.

iii. ODL students incur the opportunity cost to have adequate time to dedicate to their studies.

iv. Full-time students incur the opportunity cost to secure employment from a market that is used to conventional qualifications.

v. While face-to-face learners constantly have subject experts and peers any time, ODL learners incur this opportunity cost as they are separated by transactional distance most of the time.

vi. ODL students are taught by part-time tutors, unlike face-to-face students who are taught by lecturers solely dedicated to the programme. ODL students incur this opportunity cost.

vii. Full-time students follow a commonly inflexible programme timetable. On the contrary, ODL students have the opportunity to self-manage, as there is greater scope for flexibility. In this respect, face-to-face learners incur the opportunity cost of self-management and autonomy.

Limitations

Notwithstanding the informative results presented above, the study had its limitations, which are taken into account in the subsequent section on further research. One of the ostensible limitations was that there was the potential for conflict of interest, as the consultant belongs to one of the institutions in the case studies. However, this was mitigated, firstly, by engaging research assistants who were non-inclined to the institutions. They collected data and entered them on Excel, after which the Consultant crosschecked for accuracy. Secondly, to avoid any bias in the interpretation of findings, the Commonwealth of Learning (COL), sponsor of the study, also assisted with the analysis, which the Consultant later verified.

The second limitation had to do with low numbers per institution, and confining the study to only two institutions. This was mitigated by the following factors:

a. The study derives legitimacy from case study methodology where even one participant or institution can be focus of a study (cf. Yin, 1984). In this case, where there were 72 participants from two institutions, this argues favourably as justification for the study.

b. Each institution has its uniqueness, one ODL and the other face-to-face, and the two are located in the same geographical environment (urban). This enhanced comparability and authenticity of results.

The third limitation was that one of the two variables, carbon footprint, is not a commonly understood phenomenon in educational circles. This had the potential of attracting little enthusiasm from participants. In mitigation, the Consultant and the research assistants scheduled preliminary visits to the identified staff members of the institutions (CEOs, lecturers, academic registrars, and heads of departments), and addressed participating students explaining to them both concepts of carbon footprint and opportunity cost.

Discussion

Botswana is a developing country, and the Government of the country experiences budgetary constraints. The open and distance learning mode shares the same budget allocated for education with conventional institutions, and this is against a background where there is no open and distance learning policy in place as yet. The Policy would help towards rationalisation of funding to achieve the following:

1. To create opportunity to sponsor ODL learners, thus ensuring access to education for as many.

2. The ODL institution would have enough funding to give its part-time tutors adequate training so that they appreciate what ODL is in the fuller sense, than is currently the case, where there is minimal induction of tutors in ODL practices. With adequate training, tutors will be able to cascade principles of ODL to students, including minimisation of carbon footprint and maximisation of opportunity.

The link of carbon footprint and opportunity cost to equity in funding conventional and ODL systems, is that there are implications for better appreciation of the two issues. This is considered true against the background of the use of textbooks and requirements to purchase additional ones by face-to-face learners. It might be prudent for private

providers of tertiary programmes, like BAC, to train their lecturers and students on the use of ICT, and adopt blended learning using learning platforms, thus avoiding too many print media textbooks. This will have the potential to mitigate carbon footprint. The use of CDs, as established in the study, is a step in the right direction by the ODL institution.

For purposes of creating awareness in the country, a more systematic drive ought to be embarked on in terms of sensitising employers, and the communities at large, about entrepreneurship. Otherwise, graduates are likely to continue incurring employment opportunity costs in a competitive market where jobs are already jeopardised. The obverse of the argument is that with more graduates of entrepreneurship joining the labour market, it might be prudent for the government to set up funding to avail start-up capital for them to embark on their own enterprises.

FUTURE RESEARCH

Two limitations of the study influence suggestions for further research. These were outlined in one of the foregoing sections as the limited understanding of the concepts of carbon footprint and opportunity costs in developing educational environments. The second one pertains to the limited number of institutions and research participants for the current study. When combined, the two limitations motivate the view that it is imperative to conduct a broadened study, possibly beyond the borders of Botswana. This would involve multiple case studies, grouped as conventional and ODL providers. This would also take into account the Polluter Pays Principle (PPP) and the Limited Resource Principle (LRP), explained above. As Yin (2003) has aptly put it, this would enable the researcher to explore differences within and between cases. When carried out in two or more countries, this would enable replication of findings across cases, but most importantly, across the sub region. Having more cases has the potential of ensuring predictability of the phenomena of carbon footprint and opportunity cost across culturally comparable countries of Southern Africa, where a gap in the literature has been noted. In particular, the characteristics of the opportunity cost theory, which has already been explained (educatorblog.wordpress.com/2008/06/20/opportunity-cost/.) will find relevant scope for application on a wider plane.

The current study has been mainly on carbon footprint and opportunity cost, yet implicitly, it also touches on quality issues. The issues of time invested in the studies, money invested in textbooks and ICT gadgets, availing experts, to name some, manifest themselves differently in the two scenarios (in a developing environment). For example, is the qualification from BOCODOL of the same quality as that one from BAC? There might be need to investigate this phenomenon in a study that takes into account some of the items in the questionnaire that bespeak quality, by adding items more specific to that aspect of higher education. This is a phenomenon that does not seem to have been researched into in our developing countries. ODL enthusiasts have been vociferous about its benefits, but have little factual basis for their assertions relative to its quality. The question: What is the quality of ODL and conventional qualifications when a comparison is made of the two modes?, can be attempted in a similar way by juxtaposing BOCODOL and BAC, that is on a smaller scale, to begin with. This would then be broadened to accommodate more cases. At many conferences, the question of quality is often posed, and is yet to be answered.

CONCLUSION

The significant difference between the average carbon footprint of the BOCODOL group and the BAC group suggests that a given institution, as a proxy for mode of delivery, may be a determining factor of the learner's carbon footprint. The same applies to the significant differences in opportunity costs forgone in either institution. However, the issue of the quality of education offered by either mode of delivering higher education, bearing in mind, researched results, is another case for empirical investigation, and has not been objectified in the foregoing discourse.

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