# Analysis of Open Data in Courseware of Universities in Nigeria

**Omenogo Veronica Mejabi[1*], Muhtahir Oluwaseyi Oloyede[2], Adesina Lukuman Azeez[3] and Adeyinka Adedoyin[4]**

[1,2,4]Department of Information and Communication Science, University of Ilorin, Nigeria
[3]Deparment of Mass Communication, Universiti of Ilorin, Nigeria

[*]ovmejabi@unilorin.edu.ng

## Abstract

In the context of curriculum delivery, data can range from the course outline to detailed course notes for the benefit of the learner, which in turn is referred to as courseware. When this content is open to the public, it is often referred to as open courseware which in this study is framed as open data in courseware. Properly harnessed, open courseware which is necessary for e-learning, can be a driver for sustainable development. This study investigated the quantity and quality of open data in the online courseware of universities in Nigeria. The courseware of 30 universities in Nigeria were examined through qualitative content analysis of their websites. The major finding of the study is that only two universities (7%) have comprehensive courseware available on the Internet – National Open University of Nigeria (NOUN) and the University of Ilorin. However, 27% of the sampled universities published the course codes for their programmes online while 23% had course titles and 13% had course contents, published. The results were at variance with the established variations in education indicators across the country suggesting the positive role played by ICTs such as the Internet in bridging developmental divides. The quality of the open courseware of the two universities are examined and weaknesses such as inappropriate license for open courseware and limitations to reusability and remixing are identified.

Keywords: courseware, e-learning, open data, sustainable development, Nigeria.

## Introduction

In the context of curriculum delivery, courseware can be described as a data source. Courseware is an educational material bundled with the various course plans, lessons, assignments, tests, and other materials needed for learning. When this content is open to the public, it is often referred to as open courseware which in this study is framed as open data in courseware. It is usually packaged for the use with a computer. An open courseware is a free and open digital publication of high quality college and university-level educational materials which are organised as courses, and often include course planning materials and evaluation tools as well as thematic content (Open Source, n.d.). Writing about the open courseware of the Massachusetts Institute of Technology (MIT), Long and Sussex (2011) opined that open courseware is an example of open policies and practices that have enhanced the recognition of MIT's intellectual contributions and increased its competitive edge.

Properly harnessed, open data in courseware which is necessary for e-learning and comprises curriculum elements, can be a driver for sustainable development. Olasehinde-Williams (2011) in providing a schematic representation of the relationship among academic integrity, educational development and national development, shows that curriculum initiatives have a direct impact on sustainable national development by impacting directly on sustainable educational development in terms of planning, process and product quality.

Open data is being recognised more and more as a driver of accountability and good governance, as a tool for inclusiveness, and is likely to be a key as the world looks beyond the Millennium Development Goals (MDGs) which is concluding in 2015 (Open Data Initiative, 2012). Campbell and MacNeill (2010) defined open data as a philosophy and the practice requiring that certain data are freely available to everyone, without restrictions from copyright, patents and other mechanism of control. On the other hand, the Open Data Initiative (2012) defines open data as a freely available online service for the creation and dissemination of data for public consumption. It is, however, recognised that 'various types of data are apt to be more or less open, and the reasons for the degree of openness may vary from one situation to another, that is type of data, by country, by type of institution, etc.' (Cole, 2012).

The introduction of open data has energised political power, information and rights issues in developed countries. The improvement of services and contribution to economic growth has been made possible by making information about services and education data amongst other information publicly available on the web (Institute of European and International Affairs, 2011). It is generally agreed that data is 'open data' when it is complete, primary, timely, accessible, machine process-able i.e. data is structured for automatic processing, non-discriminatory i.e. available to anyone, no registration requirement, and license-free (Baur and Kaltenbuck, n.d.). Chernoff (2010) opined that data is open if you are free to use, reuse, and redistribute it — subject only, at most, to the requirement to attribute and share-alike.

Electronic learning (or e-learning) emerged in educational systems at the beginning of the 21st century (Sangrà, Vlachopoulos and Cabrera, 2012) and has definitions which Clark and Mayer's (2011) posit are concerned with the what, how and why of e-learning. E-learning comprises all forms of electronically supported learning and teaching with the aim being to transfer skills and knowledge (Neeraja, 2011). Though frequently associated with distance learning settings, e-learning is also used as part of face-to-face teaching, and this is referred to as 'blended learning' (Singh, 2003). With the advances in information and communication technology (ICT), higher institutions are increasingly creating a 'virtual learning environment' in which all aspects of a course are handled through a consistent user interface standard throughout the institution (Neeraja, 2011). Overall, the design of a particular learning environment should depend on the learning objective, target audience, access (physical, virtual and/or both) and type of content, while it is also important to know how the learning environment is used, and the influences of the tools and techniques that distinguish the differences in learning outcomes as the technology evolves (Moore, Dickson-Deane and Galyen, 2011).

Kistow (2009), states that e-learning is the next generation of learning because of its flexibility. The term is used to reference out-of-classroom and in-classroom educational experiences via technology which can be self-paced or instructor-led. These include media in the form of: 1) text, 2) image, 3) animation, 4) streaming video and 5) audio and content is delivered via: 1) Internet, 2) intranet/extranet, 3) audio or video tape, 4) satellite television and 5) compact disc (Rouse, 2009). These open

resources that support learning are also collectively referred to as open educational resources (OERs). Open data in courseware is at the core of an OER, which according to Johnstone (2005: 15), not only promotes academic collaboration but leads to 'economic development'.

Thus, it is important that courseware, especially open courseware, is of high quality. However, discussion of the quality of coursework often centered on the 'development' of high quality courseware (Grützner, Weibelzahl and Waterson, 2004), or the quality attributes of courseware/e-learning websites (Pruengkarn, Praneetpolgrang and Srivihok, 2005). However, compared to the emphasis placed on assuring quality of regular curriculum, the assurance of e-learning curriculum or courseware has received much less attention in curriculum studies (Sung, Chang and Yu, 2011). According to Syahrul Fahmy et al. (2012), the international standard for software quality, ISO 9216 defines a general framework for the evaluation of software quality and can be used across many systems including the academic domain of e-learning systems. The ISO 9216 dimensions are functionality, reliability, usability, efficiency, maintainability and portability.

The connection of curriculum to sustainable national development, may reveal why the skills gap that exists amongst graduates from Nigerian universities has a direct impact on the economy (Kayode, 2009). This gap has resulted in many organisations having to set-up graduate trainee schemes including the World Bank which trained 1000 Nigerian graduates for the outsourcing industry in 2012 because they recognised that skills gap was a hurdle in job creation (World Bank, 2012). Kayode (2009: 3), stated that

> … the gap that exists between what is taught at school and the skills required to perform on a job is so wide that a high percentage of young graduates are said to be unemployable for lack needed skills that would make them profitable for any employer. This state of affairs has existed in Nigeria for so long that there is urgent need for serious actions to stem the tide and correct the malaise that is robbing the nation of progress in many fields of endeavour (Kayode, 2009: 3).

A Nigerian blogger (Micaiah, 2012) on education reaffirmed this lack of the prerequisite skills required to function in the workplace – skills such as problem solving, communication, interpersonal, and teamwork; and lays the blame squarely on the lecturers. The blogger alludes to a serious gap between what is taught in the Nigerian school and what is obtainable in the market place and cites the example of a lecturer who taught in the 90's with a lecture note he prepared in the early 80's.

The skills gap problem as it affects sustainable development may be compounded by poor education indicators nationwide, according to the United States Embassy in Nigeria publication, Nigeria Education Fact Sheet. In the fact sheet, it is suggested that the already poor national education indicators are lower still in 'the predominantly Muslim north' (Nigeria Education Fact Sheet, 2012). So, the skills gap may be even worse in graduates from the northern parts of the country.

The chosen course of investigation for this research is based on the premise that if universities in Nigeria publish their courseware online, this would bring about quality curricular initiatives driven by the resultant competition for quality faculty, students and prestige, which in turn impact directly on sustainable development. Such courseware, targeted to skill acquisition, and released into the open domain, would also aid the 90% of school leavers who are unable to gain admission into Nigerian universities every year (Nick, 2013).

The objective of this study, therefore, is to examine the websites of universities in Nigeria in order to determine the quantity and quality of open data in any published courseware as a way of assessing the preparedness of the universities to expose details of the academic curricula to public scrutiny. The specific objectives are:

1. To determine the extent to which Nigerian universities are publishing their courseware online
2. To identify the open data components in any published courseware by the Nigerian universities
3. To relate the presence or otherwise of open data in courseware to the geographical zones to which the Universities belong
4. To examine the quality of courseware at the universities, where available

**Education and Sustainable Development**

Sustainable development can be interpreted in many ways. However, its main concept is an approach to development that looks to balance different and often competing needs against an awareness of the environmental, social and economic limitations faced as a society (Ciegis, Ramanauskiene and Martinkus, 2009). Sustainable development has been defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own need (World Commission on Environment and Development, 1987). Furthermore, it has been defined as a visionary development paradigm (Drexhage and Murphy, 2010). Hence, sustainable development is about equity, defined as equality of opportunities for well–being, as well as about the comprehensiveness of objectives (Soubbotina, 2004). Sustainable development provides a way of accessing current situation, setting goals that will produce better results and making the right choices about the direction to be taken (Strange and Bayley, 2008). Indicators of sustainability are different from traditional indicators of economic, social and environmental progress in recognising that the three different segments are very tightly interconnected and the impact of education on sustainable development can be seen by its interaction with other factors like health, profits and jobs (*What is an indicator of sustainability?*, n.d.).

The United Nations (2007) provides sustainable development indicators for education based on: 1) gross intake rate into the last year of primary education, 2) net enrolment rate in primary education, 3) adult secondary (tertiary) schooling attainment level, 4) lifelong learning and 5) adult literacy rates. Of these, the last three stand to benefit from well-developed university curricula. The details of the indicator for adult secondary (tertiary) schooling attainment level, is of particular interest to this study. It is stated as:

> Brief definition: Adult Secondary Schooling Attainment Level is defined as the proportion of the population of working age (25–64 years) which has completed at least (upper) secondary education. Adult Tertiary Schooling Attainment Level is defined as the proportion of the population of working age (25–64 years) which has completed at least the first stage tertiary education.

Description: These indicators provide measures of the quality of the human capital stock within the adult population of approximately working age. For instance, those who have completed upper secondary education can be expected either to have an adequate set of skills relevant to the labour market or to have demonstrated the ability to acquire such skills (United Nations, 2007: 56).

The post-2015 development agenda which is being framed as 'Sustainable Development Goals', has a Goal 4, which is to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'. Under this goal, with the target which says, 'by the year 2030 ensure equal access for all women and men to affordable, quality technical, vocational and tertiary education, including university' (United Nations Department of Economic and Social Affairs, n.d.).

Open education resources (OERs), according to Wiley, Green and Soares (2012) hold some of the answers to maintaining the quality of learning material while significantly reducing the cost of education. Johnstone (2005) opined that 'OER … represents those resources needed most to achieve Education for All … It is time for us to create high-quality online educational resources for local use to open them to our fellows around the world' (Johnstone, 2005: 18).

The Massachusetts Institute of Technology (MIT) was the pioneer of openness as a principle of institutional learning practice, when in 2001, it made most of its teaching materials free, publicly accessible, reusable and remixable via a Creative Commons licence, through its Open Course Ware (OCW) project (Long and Sussex, 2011). Other popular initiatives in the release of OERs are that by the Khan Academy and Washington's Open Course Library (Wiley, Green and Soares, 2012). Others are the Commonwealth of Learning (COL), WikiEducator and a number of the world's leading universities such as Carnegie Mellon University, Harvard and University of Oxford, and the Africa Virtual University in Kenya (Mejabi, 2013). In Nigeria, courseware projects have been reported by the National Open University of Nigeria (NOUN) and the University of Ilorin, Nigeria (Mejabi, 2013).

According to Okonkwo (2012), the major aim of developing courseware for NOUN is to address the differences in instruction between NOUN and conventional universities in the mode of instruction used, since NOUN students are instructed by open and distance learning methods within an open learning environment. So it can be deduced that the motivation for developing the courseware which commenced in 2011 is from the curriculum delivery point of view and to meet its mission, which is to make education available to as many people as are able, willing and ready to benefit from it.

At the University of Ilorin, one of the early motivations for making the courseware open was to increase the university's webometric ranking by having a preponderance of rich text files on the website – one of the indices measured by Webometrics. This strategy seemed to work because along with upload of academic publications to the website, the Webometric ranking of the University rose from 77 in Africa in July 2009, when upload of the courseware commenced, to the 31st position in July 2010 (Mejabi and Raji, 2010). However, in a study by Olasina (2012), it was found that faculty at the University of Ilorin developed courseware for the University's Open Courseware initiative for easy access to course materials for students and others and because it will enlarge the readership of the materials allowing other scholars to access materials they could not otherwise use. Thus, although increased Webometric ranking was a motivation, benefits to university faculty is also a major motivator. Similarly, in surveys of MIT staff, many of whom were initially sceptical of the open courseware experiment, had expressed belief that MIT's OCW has not only been beneficial to the institution, students and other faculty members and learners around the world, 'but has also raised their own – already very elevated – standing in their field' (Long and Sussex, 2011, para. 8). The MIT Open Courseware remains one of the most comprehensive open courseware projects known, since the courseware site was launched in 2002 (Johansen and Wiley, 2010).

**Methodology**

The 129 universities in Nigeria as at June 2013, formed the population for the study. The University of Ibadan (for being the first university in Nigeria) and the National Open University of Nigeria (for being the only Open University in the country) were automatically included as part of the

sample. The remaining 127 universities were clustered by type of university (federal, state or private) and by the six geo-political zones. The six geo-political zones of Nigeria and the states under them are:

1. North-Central: Benue, Kogi, Kwara, Nasarawa, Niger, Plateau and the Federal Capital Territory, Abuja
2. North-East: Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe
3. North-West: Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara
4. South-East: Abia, Anambra, Ebonyi, Enugu and Imo
5. South-South: Akwa Ibom, Bayelsa, Cross River, Delta, Edo and rivers
6. South-West: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo

This resulted in 16 clusters and two universities were randomly picked using a table of random numbers, from each cluster. However, the websites of eight of the universities drawn could not be accessed at the time of the data collection. Thus, the final study sample comprised 30 universities: 1) federal universities – 14, 2) state universities – 9, and 3) private universities – 7. The lists on the website of the National Universities Commission (NUC) were used for the sampling. The National Open University of Nigeria (NOUN), Lagos, was classified as 'National' because of its national reach.

The first step in the online analysis involved extracting relevant content from the website(s) of the universities in the sample and this was done in July 2013. This was done by accessing the website of each university using the official address on the website of NUC after which a Google search for the university was done in order to identify any other existing official website for the university. The websites were then scanned for any components of courseware or OERs. This involved first doing a search of the website in a cascading manner, using the key phrases: 1) 'courseware', 2) 'academic programme', 3) 'course code', 4) 'course titles', 5) 'course content' – terms synonymous with academic programmes in Nigerian universities; and 1) 'lectures', 2) 'modules', 3) 'lesson plans', 4) 'study exercise', 5) 'reading list', 6) 'video' – terms expected to fetch any embedded educational resources on the site. The website search was complemented with clicking on each of the menu items and scanning the linked page, to be sure that the data being sought has not been missed. The

content extracted from this process was recorded in a table that included the web link information.

The second step involved a manual content analysis of the extracted information and categorisation and coding was done under the following variables and values:

1. Information on Programmes offered: this was used to categorise a listing on the university website of the academic programmes offered in the university such as B.Sc. Mathematics, B.A. English, etc. – No/Partially/Yes
2. Courseware: describes the full complement of as aspects required for self-learning or e-learning – Available and Open/Available but Closed/No
3. Course Codes e.g. MAT 101, ENG 324 – No/Yes
4. Course Titles e.g. Introduction to Algebra – No/Partially/Yes
5. Course Content: a brief overview of what the course entails – No/Yes
6. Lecture Topics/Modules/Lesson Plan: a more detailed breakdown of what the course entails over the period for the course – No/Yes
7. Lesson Notes: the actual material with which the learner engages in order to learn – No/Yes
8. Study Exercises – No/Yes
9. Reading list – No/Yes
10. Study aids e.g. Videos – No/Yes
11. Links to external resources e.g. external courseware or OERs – No/Yes

The coded data were analysed using frequency counts and percentages. For the universities with open courseware, the courseware are examined on features of open data – 1) re-usable, 2) accessible, 3) machine process-able, 4) open friendly license (Baur and Kaltenbuck, n.d.; Chernoff, 2010) and 5) the ISO 9216 pertinent dimensions of: 1) functionality – the capability to provide functions which meet the stated and implied needs of users under the specified conditions of usage and 2) maintainability – the capability to be modified (adapted from Syahrul Fahmy et al., 2012: 118–119). An additional dimension – currency, is included to assess how recent the courseware is.

**Results and Discussion**

From the online analysis of the university websites, the distribution of universities according to the findings on whether information on programmes offered was available on the websites is presented in Table 1 and reveals that the Ahmadu Bello University does not have information about the academic programmes they run, online; while the University of Ibadan has the information for only some departments in the university. The other 28 universities have this information on their websites.

**Table 1** Information on programmes offered

| Information on programmes | Frequency | Percent |
|---|---|---|
| No | 1 | 3.3 |
| Partially | 1 | 3.3 |
| Yes | 28 | 93.4 |
| Total | 30 | 100.0 |

Source: Study data, 2013

Out of 30 universities sampled, two were found to have open courseware available online as presented in Table 2. These were the University of Ilorin and the National Open University of Nigeria (NOUN). Two other universities were identified as having courseware but which was available only to pre-registered users and so was closed. Others did not have any courseware although the Bayero University had a link labelled 'open courseware' on their website but this was a dead link. Also, news on the website of Federal University, Oye-Ekiti, promises the development of courseware.

**Table 2** Courseware availability online

| Courseware availability | Frequency | Percent |
|---|---|---|
| Available and Open | 2 | 6.7 |
| Available but Closed | 2 | 6.7 |
| No | 26 | 86.7 |
| Total | 30 | 100.0 |

Source: Study data, 2013

Although 26 universities were found not to have any courseware, several of these had components of courseware such as Course Codes with accompanying Course Titles in some cases, and some with Course Contents, as presented in Table 3.

It was the two universities which had open courseware (the NOUN and the University of Ilorin) that had the topics, modules, or lesson plans available online as shown in Table 4. The NOUN was the only university with lesson notes available online. Unlike the MIT Open Courseware, which does not have lesson notes for all its listed topics, all courses on the NOUN website have links to detailed course lesson notes in PDF format.

**Table 3** Course code, title and content availability online

| Item | Available online | | | |
|---|---|---|---|---|
| | No | Partially | Yes | Total |
| Course code online | 22 (73.3%) | – | 8 (26.7%) | 30 (100%) |
| Course title online | 22 (73.3%) | 1 (3.3%) | 7 (23.3%) | 30 (100%) |
| Course content online | 26 (86.7%) | – | 4 (13.3%) | 30 (100%) |

Source: Study data, 2013

**Table 4** Topics/modules/lesson plan and lesson note availability online

| Item | Available online | | |
|---|---|---|---|
| | No | Yes | Total |
| Lesson plan online | 28 (93.3%) | 2 (6.7%) | 30 (100%) |
| Lesson notes online | 29 (96.7%) | 1 (3.3%) | 30 (100%) |

Source: Study data, 2013

As shown in Table 5, only the two universities with online courseware had study exercises and reading lists available online. However, none of them had study aids such as videos or other dynamic objects for learning on the websites in contrast to the many lecture videos available on the MIT open courseware site. In the case of the two universities with courseware, perhaps the reason for this absence is the single file, PDF format, used to present the courseware. Only one university had links to external

courseware as shown in Table 5 and that was the University of Ilorin. However, under the 'Resources' tab on the website of Usman Danfodio University, there was a link labelled 'MIT Open Courseware' but the link did not lead anywhere (that is, it was a dead link).

From the foregoing, it can be deduced that nearly all the universities across all geo-political zones of Nigeria, have information about the programmes they offer, online. On other variables of analysis, items that showed online presence other than for the two universities with open courseware, were: 1) course code, 2) course title and 3) course content. These items were analysed to identify the geo-political zones to which the universities with such presence belonged and the finding is presented in Table 6.

**Table 5** Availability online of study exercises, reading lists, study aids or links to external OERs

| Item | Available online | | |
|---|---|---|---|
| | No | Yes | Total |
| Study exercises online | 28 (93.3%) | 2 (6.7%) | 30 (100%) |
| Reading list online | 28 (93.3%) | 2 (6.7%) | 30 (100%) |
| Links to external courseware | 29 (96.7%) | 1 (3.3%) | 30 (100%) |

Source: Study data, 2013

**Table 6** Geo-political zones indicating universities with online course code, course title and course content

| Item | Geo-political zones in Nigeria | | |
|---|---|---|---|
| | North East | North East | North East |
| Course code online | Yes | – | Yes |
| Course code online | Yes | – | Yes |
| Course title online | Yes | – | Yes |

Source: Study data, 2013

The pattern displayed in Table 6, cannot be said to support the assertion that the already poor national education indicators are lower still in the northern part of Nigeria (*Nigeria Education Fact Sheet*, 2012). This is

because, although the South West zone has shown greater activity in support of open data in courseware, the North West and South East zones, display similar patterns, as does the North Central and South South zones. Perhaps this is an indicator and a reality of the inclusiveness provided by the Internet.

The courseware at the NOUN and the University of Ilorin websites, the only universities found to have open courseware, were examined in order to elucidate the quality. The overall impression is that the courseware design is differs between the two institutions, perhaps because of the learning environment – the NOUN being modelled on distance learning and the University of Ilorin being modelled on blended learning. The assessment based on the dimensions of interest is summarised in Table 7.

From the quality dimensions examined, re-usability is not established, although both universities refer to their product as 'open' courseware. This dimension is linked to the type of license or the absence of a license that explicitly connotes re-use. This contradicts Johnstone's (2005) position and is at variance with MIT's use of a Creative Commons licence which allows users to reuse and remix (Long and Sussex, 2011). Although the courseware at both universities are accessible through the website, their maintainability and remixing flexibility is limited as a result of bundling each courseware for publication as a single PDF document. For the courseware to drive sustainable development, these weaknesses have to be addressed so that material with local content is freely available for re-use as much as that of courseware from more developed countries. The functionality of the courseware can still be improved so that usability, which has not been discussed as this requires user opinions of their experience and satisfaction with using courseware, can be optimal. Perhaps, converting the courseware from PDF documents to machine process-able platforms such as learning managing systems (Singh, 2003), may have the effect of increasing re-usability and promoting currency. These, in turn, are certain to impact on the quality of content and promote inclusion of different learning strategies that increase provision of relevant content and improves skill acquisition from learning.

**Table 7** Quality assessment of available courseware at NOUN and University of Ilorin

| Quality dimension | University | |
|---|---|---|
| | NOUN | University of Ilorin |
| Re-usability | Not re-usable because there is a clear "All Rights Reserved" statement accompanying every courseware on the site. | Not clear because there is no license or attribution statement associated with the courseware |
| Accessibility | Accessible on the university website. | Accessible on the university website. |
| Machine process-able | Not machine process-able because all courseware are in PDF format. | Not machine process-able because all courseware are in PDF format. |
| Open friendly license | License is not open friendly. | No license accompanies the software. |
| Functionality– the capability to provide functions which meet the stated and implied needs of users under the specified conditions of usage | Functional because the aim of the courseware to provide learners with enough detailed material so that they can learn on their own. | Functional because the aim of the courseware is to support teaching and learning and complement face-to-face teaching. |
| Maintainability – the capability to be modified | The courseware can be maintained because of the clear sectioning, though it requires the whole courseware to be changed, because of the PDF format. | The courseware can be maintained because of the clear sectioning, though it requires the whole courseware to be changed, because of the PDF format. |
| Currency | Indication of currency – shows year of print or re-print. | Indication of currency – shows the session in which the courseware was developed. |

Source: Study data, 2013

## Conclusion

The findings revealed that although many of the universities published information about their programmes along with the course codes and titles in some cases, the move to open courseware publication is being imbibed at a very slow pace. It can also be concluded that universities in Nigeria

are yet to embrace the role of open courseware in enhancing the quality of their academic programmes which not only impact on the existing programmes but also on the quality of faculty and students that desire recruitment. The study also reveals that the inclusiveness which the Internet provides, has resulted in findings in which the geo-political zones to which the universities belong, had little influence. Furthermore, the quality of courseware available, while adequate for the targeted audience, can benefit from designing the courseware with the objective of meeting the assessed quality dimensions.

All of the above conclusions have an impact on sustainable development. The link between education and sustainable development has earlier been established. This included a presentation of the skills gap amongst graduates from Nigerian universities and the connection to out-dated curricula and learning systems that do not foster skill acquisition. The argument has been made in the paper that courseware is very important for both onsite and offsite learning such as e-learning and that opening up components of the courseware to stakeholder scrutiny would result in improved quality of the curriculum and pedagogy, and consequently on the education indicators as well as other economic contributors to sustainable development.

## Recommendations

The study, recommends that the universities with open courseware should see the strategic advantages in providing courseware that is rich, up-to-date, and relevant to local and global audiences, with the incorporation of various data types such as images and videos. It is also recommended that in the short run, universities in Nigeria should publish the course codes, titles and course contents for all programmes offered, not to push for higher webometric rankings, but as a motivation for development of curricular that would lead to quality graduates towards sustainable national development. For further research, it is recommended that all universities in Nigeria to be analysed in order to determine the exact extent of open data in courseware within the Nigerian university system with qualitative aspects to determine any causal effects. The study did not consider the quality dimension of usability and assessing this is also recommended as an area for future research.

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