

Cost-Benefit of E-Learning under ODL of Developing Economies

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Abstract: Does it cost less to apply e-learning in open and distance learning (ODL) of developing economies? This paper assessed the cost-benefit of e-learning compared to different approaches to ODL. Cost-benefit analysis is a formal way of adding up the advantages and disadvantages of doing one thing as opposed to doing something else. A range of factors affects the cost-benefit of particular distance learning programme. This includes the number of students enrolled, the size of the curriculum, the number of years over which courses are offered without change, technology apply, the level of student support, working practice, and so on. Cost of essential e-learning equipments such as laptops, Internet modem, and mobile phones are analyzed side by side with the cost of residing in the institutes' environment, photocopy of materials and the opportunity cost of time during working period for the student. While cost-benefit of correspondence are analyzed side by side with the cost-benefit of providing ICT centers. It is observed that e-learning application on ODL of less developed economies is cost effective in the long run when a sizeable number of students per programme are achieved. However, economic constraints on both the students and the ODL institutions require partial application in the short run. More so, it takes time to adapt students to scarce technology that is not affordable to them. The ODL institutes also require time and resources to up-date e-learning to international standard. Nevertheless, full application of e-learning in developing economies is feasible in the long run with more benefits than cost. In this world of scarce economic resources, e-learning application in developing economies is inevitable.

INTRODUCTION

The term e-learning is defined as the “use of information and communication technologies (ICTs) to enhance and/or support learning in tertiary education” (OECD, 2005: 11). E-learning is designed to deliver training, education and collaboration using various electronic media but with Internet tools as main drivers. A properly designed and managed e-learning can overcome many barriers associated with traditional educational methods. These barriers are students' tardiness, conflicts in schedules, unavailable courses, geographical problems, economic disadvantage, and so on. E-learning is applicable to ODL and can also be 'blended' with face-to-face teaching. Rosenberg (2001) observed that because e-learning is networked, it makes it capable of instant updating, storage/retrieval, distribution and sharing of instruction or information thereby reducing the associated costs.

E-learning means provide, for the first time in history, a key ingredient that was lacking in all the analogue systems that raised high expectations when introduced in the educational system. Through e-learning means we can not only present information with all the audio-visual expressive possibilities of television or film, but also can receive information from the user, and can adapt the presentation to the user needs, preferences or requests. With e-learning devices the student learns by interacting with a programme stored or sent. This programme is designed to react to the student's needs according to predetermined pedagogical criteria. In this case the student conducts a “distant dialog” with the lecturer,

who - in a well-designed programme - will have considered the learning difficulties involved in the subject, and designed accordingly a set of remedial interventions. Each student may learn according to his or her cognitive level and learning speed, independently of his or her classmates. Instead of isolated classes, students can communicate with one another and gather information from around the world, thereby increasing their motivation to use higher-level analytical skills for their study (Osin, 1998).

Higher education in particular, is seen as crucial to a nation's competitiveness in the knowledge economy (Saint *et al.*, 2003). Sharma *et al.*, (2009) linked the nation's route to becoming a successful knowledge economy to its ability to become a learning society. Despite the fact that higher education has been required to become responsive to many more social interests than before and to engage with the imperatives being voiced by many different groups ranging from unions and associations to industry, business and regional authorities (Czerniewicz and Brown, 2009), the higher education has been in crisis in much of the world today (Daniel, 1996).

As observed by Pityana (2009), for the Developing World, ODL is a promising and practical strategy to address the challenge of widening access thus increasing participation in higher education. It is an educational delivery model which is cost-effective without sacrificing quality. On the African continent - where resources are scarce and higher education provision is poor, ODL is accepted as a viable, cost effective means of expanding provision without costly outlay in infrastructure. According to Ajadi *et al.*, (2008) using Nigeria as a focus, ODL is needed for three main reasons: firstly, majority of the population lives below the poverty level; thus, they are unable to access urban based institutions and consequently the eligible candidates remain deprived of higher education; secondly, people who joined the workforce early without completing their education due to family commitments and other issues are unable to combine work and study despite interests due to the limited capacity of the contemporary institutions; lastly, in some parts of Nigeria, majority of the female population are deprived of higher education due to early marriage or religious and traditional beliefs.

Adam (2003: 196) is of the view that "it is becoming apparent that higher education reform cannot take place without paying attention to ICTs... in support of teaching, research, and lifelong learning." Does it cost less to apply e-learning in ODL of developing economies? This paper analyses the cost-benefit of e-learning to both the students and the ODL institutions. To achieve this, the paper is divided into theoretical and conceptual issues, literature review and measurement issues, analysis of information, and conclusion and recommendation

THEORETICAL AND CONCEPTUAL ISSUES

The Concept of e-Learning

As stated earlier, e-learning denotes the "use of information and communication technologies, ICTs) to enhance and/or support learning in tertiary education" (OECD, 2005: 11). ICTs are defined as a "diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information" (Blurton, 2002). These technologies include computers, the Internet, broadcasting technologies (radio and television), and mobile phone. E-learning is commonly associated with higher education and corporate training, and encompasses learning at all levels, both formal and non-formal, that uses an information network—the Internet, an intranet (LAN) or extranet (WAN)—whether wholly or in part, for course delivery, interaction and/or facilitation. Others prefer the term online learning. Web-based learning is a subset of e-learning and refers to learning using an

Internet browser (such as Netscape or Internet Explorer). Ferl Practitioners' Programmeme (FPP) (2006) propounds similar definitions that e-learning is applicable to distance learning and can also be used in conjunction with face-to-face teaching, in which case the term Blended learning is commonly used. E-learning is networked; hence it makes it capable of instant updating, storage/retrieval, distribution and sharing of instruction or information (Rosenberg, 2001). In Rosenberg's typology, this is the next great "restructuring" technology that transforms the world into a global village of unbridled connectivity. This transformation highlights the shift from traditional face-to-face classroom-based teaching/learning to the e-learning paradigm. E-learning has the potential to revolutionize the education across the world. By the simplest definition: e-Learning is a learning process created by interaction with digitally delivered content, network-based services and tutoring supports (Markus, 2005). This definition emphasized the revolutionary impact of network-enabled technology. E-learning can be defined by Anderson *et al.*, (2001) as any technologically mediated learning using computers whether from a distance or in face to face classroom setting. This means that it is a clear shift from traditional education or training to ICT-based personalized, flexible, individual, self-organized, collaborative learning based on a community of learners, teachers, facilitators, experts, etc.

E-learning according to Wikipedia, "is most frequently used to refer to computer based training which incorporates technologies that support interactivity beyond what would be provided by single computer. E-learning may also be used to support ODL through the use of WANs (Wide area networks), and may also be considered to be a form of flexible learning where just-in-time learning is possible. Courses can be tailored to specific needs and asynchronous learning is possible. Where learning occurs exclusively online, this is called online education. When learning is distributed to mobile devices such as cell phones or PDAs, it is called M-learning."

The Norwegian Research and Educational Network have the following definition of e-learning and web-based education: Learning which communicates through different instruments (video, sound, text), who contains a certain degree of interactivity and are available through the Internet." Another definition from the E-learning Europe initiative: "e-learning is the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration." The concept of e-learning is quite new. The concept was probably born after the introduction of e-business or e-commerce, trading over the Internet. What most of the definitions have in common is the fact that they define e-learning to be interactive learning which communicates through different instruments using the Internet. According to Mishra (2007), there are many different connotations of e-learning, and individual researchers define the subject in their own context. To some, e-learning is electronic learning, and thus, covers learning through all electronic media including audio, video, radio, television, etc. For others, it is the use of computer, the Internet and the web. For example, using Web-based Instruction: It is a "hypermedia based instructional programme which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported" (Khan, 1997). Using Virtual Learning, e-learning is "The educational process of learning over the Internet without having face-to-face contact" (French, Hale, Johnson and Farr, 1999). However, for some virtual learning may also include tele-learning. E-learning may be Online Learning, synonymous to web-based learning where learning is fostered via the WWW only, in an Intranet or Internet. Mishra (2001) calls it as the new generation in the evolutionary growth of open, flexible and distance learning. A similar definition shows that e-learning uses different alternatives: "The term e-learning covers a wide set of applications and processes including computer-based learning, web-

based learning, virtual classroom, and digital collaboration” (WR Hambrecht +Co, 2000: 8). Interestingly, the term e-learning is also written differently by different individuals. Some of the examples are: eLearning, e-learning, e-Learning, E-learning, E-Learning.

Distance Education and Open and Distance Learning

According to Wikipedia, the free encyclopedia, “Distance education is a method of teaching in which the students are not required to be physically present at a specific location during the term”. This is debatable as Coldeway’s quadrants do allow for four different models of delivering distance education. Most often, regular mail is used to send written material, videos, audiotapes, and CD-ROMs to the student and to turn in the exercises; nowadays e-mail, the Web, and video conferencing over broadband network connections are used as well. Often students are required to come to meetings at regional offices on specific weekends, for example to interact with the lecturers and take exams. Distance education is offered at all levels, but is most frequently an option for university-level studies. Full time or part-time study is possible, but most students choose part-time study. Research study is possible as well.

Distance education is a newer term for correspondence courses, which arose from the need to provide schooling to students in remote, sparsely populated areas that could not support a school. Such courses are generally offered at the primary or secondary level, often with the students’ parents supervising their education. Another definition taken from an article written by Blurton (2000) is that “Distance learning is a type of education where students work on their own at home or at the office and communicate with faculty and other students via electronic mail, the WWW, electronic forums, video conferencing and other forms of computer-based communication.” The definition is very close to the e-learning definitions we have looked at. This shows that e-learning can be distanced education, but the concept of distance education can be much broader. E-learning is one way to implement distance learning, but distance learning does not have to involve e-learning.

The term open and distance learning (ODL) means that all or most of the teaching is conducted by someone removed in time and space from the learner, and that the mission aims to include greater dimensions of openness and flexibility, whether in terms of access, curriculum or other elements of structure (UNESCO, 2002). ODL systems can usually be described as made up of a range of components such as: the mission or goal of a particular system, programmes and curricula, teaching/ learning strategies and techniques, learning material and resources, communication and interaction, support and delivery systems, students, tutors, staff and other experts, management, housing and equipment, and evaluation. Most courses and programmes of ODL are targeted at the adult population. In developing countries in particular where many adults work with lower certificates, distance education for school equivalency is an important way of expanding educational opportunities to the adult population. Open schools that use a variety of media are of particular interest to high-population countries.

ODL, according to the Commonwealth of Learning, is “a way of providing learning opportunities that is characterized by the separation of teacher and learner in time or place, or both time and place; learning that is certified in some way by an institution or agency; the use of a variety of media, including print and electronic; two-way communications that allow learners and tutors to interact; the possibility of occasional face-to-face meetings; and a specialized division of labour in the production and delivery of courses.” In this paper, we consider the two terms distance learning and ODL as same in order to discuss the cost and benefit.

COSTS AND BENEFITS OF E-LEARNING

Cost-benefit analysis is a formal way of adding up the advantages and disadvantages of doing one thing as opposed to doing something else (UNESCO, 2002). From Wikipedia, the free encyclopedia, cost benefit analysis is a term that refers both to: helping to appraise, or assess, the case for a project, programme or policy proposal; an approach to making economic decisions of any kind. Under both definitions the process involves, whether explicitly or implicitly, weighing the overall expected costs against the total expected benefits, of one or more actions in order to choose the best or most profitable option. This process is often referred to as either CBA (Cost-Benefit Analysis) or BCA (Benefit-Cost Analysis). According to Raymond *et al.* (1997), “CBA is a technique intended to improve the quality of public policy decisions, using as a metric a monetary measure of the aggregate change in individual well-being resulting from a policy decision. Individual welfare is assumed to depend on the satisfaction of individual preferences, and monetary measures of welfare change are derived by observing how much individuals are willing to pay, i.e., willing to give up in terms of other consumption opportunities.” In the words of Raymond *et al.* (1997) “(CBA) is the primary tool that economists employ to determine whether a particular policy, or policy proposal, promotes economic efficiency. At the most general and comprehensive level, CBA is an aggregator of all impacts, to all affected parties, at all points in time. The impacts, both positive and negative, are converted into a common monetary unit, and the cost-benefit criterion is simply a test of whether the benefits exceed the costs. If the net benefits are positive, the policy promotes economic efficiency.”

Costs and benefits are expressed in money terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time are expressed on a common basis in terms of their “present value.” Closely related, techniques include cost-effectiveness analysis, economic impact analysis, fiscal impact analysis and Social Return on Investment (SROI) analysis. The latter builds upon the logic of cost-benefit analysis, but differs in that it is explicitly designed to inform the practical decision-making of enterprise managers and investors focused on optimizing their social and environmental impacts. CBA is often used by governments to evaluate the desirability of a given policy. It is heavily used in today's government. It is an analysis of the cost effectiveness of different options in order to see whether the benefits outweigh the costs. The aim is to weigh the efficiency of the policy relative to the status quo. The costs and benefits of the impacts of a policy are evaluated in terms of the public willingness to pay for them (benefits) or willingness to pay against them (costs). Inputs are normally measured in terms of opportunity costs - the value in their best alternative use. The guiding principle is to list all parties affected by a policy and place a monetary value of the effect it has on their welfare as it would be valued by them.

The process CBA involves monetary value of initial and ongoing expenses compared with expected return. CBA attempts to put all relevant costs and benefits on a common temporal footing. A discount rate is chosen, which is then used to compute all relevant future costs and benefits in present-value terms. Most commonly, the discount rate used for present-value calculations is an interest rate taken from financial markets (Ferrara, 2010). Empirical studies suggest that in reality, people's discount rates do decline over time. During CBA, monetary values may also be assigned to less tangible effects such as the various risks that could contribute to partial or total project failure, such as loss of reputation, market penetration or long-term enterprise strategy alignments. For example, the cost-benefit principle says that we should install a guardrail on a dangerous stretch of mountain road if the dollar cost of doing so is less than the implicit dollar value of the injuries, deaths, and property damage thus prevented (Ferrara, 2010). Cost-benefit calculations typically involve using time value

of money formulas. This is usually done by converting the future expected streams of costs and benefits into a present value amount.

Although the costs of offering distance education courses may be high, there are also high costs associated with offering conventional courses. E-learning can be cost effective and can provide economies of scale (Ruth and Shi, 2001). Research suggests that as programmes become more efficient, programme costs should decrease (Distance Education at a Glance: Guide 9). A number of benefits are identified by Distance Education at a Glance. These include Student reach benefits meaning that E-learning can reach a wider student audience. The question institutions must answer is whether it is part of their mission as educators to offer programmes to those who might not be reached without distance education. The primary benefit of distance education for many educational institutions may be the increased number of non-traditional students they are able to attract and serve. More so, E-learning can meet the needs of students who are unable to attend on-campus classes. It can provide accessible training to students in remote and rural areas. Other benefits are educational connection benefits meaning that e-learning can involve outside speakers who would otherwise be unavailable. Students can be exposed to the expertise of the most qualified faculty. E-learning can link students from different social, cultural, economic, and experiential backgrounds through the use of electronic facilities. There are also the benefits of flexibility meaning that e-learning can allow students to complete their course of study without suffering the loss of salary due to relocation.

Rosenberg (2001), sum up the benefits of e-learning:

- Students who choose distance education programmes were those with family responsibilities and limited time, and were more likely to be enrolled in school part-time and to be working full-time while enrolled.
- E-learning can enable students to pursue fields of study different from their professional careers
- E-learning allows professionals to upgrade their professional knowledge and expertise on an ongoing basis
- E-learning allows students to adjust their needs and learning styles to a variety of learning settings and media combinations.

Measuring ODL Cost and Benefit

Several cost components factor of a distance education system includes: Technology – hardware and software; Transmission – on-going expense of leasing transmission access; Maintenance – repairing and updating equipment; Infrastructure – the foundational network and telecommunications infrastructure located at the originating and receiving campuses; and getting rid of outdated hardware turns out to be an unexpected additional cost, and poses financial, environmental and ethical challenges. There are also time and personnel costs:

- Production – technological and personnel support required to develop and adapt teaching material
- Support – miscellaneous expenses needed to ensure the system works successfully, including administrative costs, registration, advising/counseling, local support, facilities, and overhead
- Personnel – to staff all functions previously described.

Adam (2003) sees cost as the total cost of ownership (maintenance, upgrading, skills development, etc), computers and peripherals, video equipment, specialized tools like digital microscopes, electrical wiring, Internet access, lighting, air-conditioning, space, network equipment, software, manuals, books, videos, audio-tapes, and other supplies. For computer-

based approaches the total cost of ownership therefore includes: fixed costs- Retrofitting of physical facilities, hardware and networking, software, upgrades and replacement (in about five years); variable or recurrent costs- professional development, connectivity, including Internet access and telephone time, and maintenance and support, including utilities and supplies. In order to determine cost efficiencies, fixed costs must be distinguished from variable costs, and the balance between the two understood. If the fixed costs of a technology project are high and its variable costs are low, then there will be cost advantages to scaling up (Markus, 2008).

Ruth and Shi (2001), relate benefits/yields and costs in implementing various distance learning approaches. Programme cost includes all the materials, technology, advising, infrastructure, rent, travel, software and hardware, etc., paid by an organization or donor to achieve the desired result. The second variable is benefit—the aggregate result or outcome obtained for the investment. Benefit can be measured in graduation rates, new approaches developed for further improvement, job success after training, etc. According to them, contrary to the expectations of many of e-learning’s promoters, distance learning costs and benefit seem to be related in inverse proportion.

A range of factors may affect the cost-efficiency of particular distance learning systems. These include: the number of learners enrolled, the size of the curriculum, the number of years over which courses are offered without change, containment of course development costs, sharing course development costs, technology choice, the level of student support, labour market practices, and structural practices (UNESCO, 2002).

Perkins *et al.* (2006), designed a schematic of the benefits and costs of investing in an additional year of education beyond the primary level. The private benefit (B) of investing in another year of education is the gain in earnings for the rest of a person’s working life. The private cost (C) will include any fees or direct cost that the individual pays plus the opportunity cost in terms of foregone income. Because these values occur over time, they must be discounted to the present to be comparable. The net present value (NPV) is the difference between the discounted values of the net present streams of benefits and costs. A rational decision maker – in this case a student or his/her family – will undertake the investment – such as an additional level of schooling – if the net present value is positive. An alternative would be to calculate the internal rate of return and compare it with the returns from alternative investments. From this schematic, if t represents a unit of time, the private rate of return to education (r) is computed straightforwardly from the following formula:

$$\sum Bt / (1+r)^t = \sum Ct / (1+r)^t$$

The social benefit (SB) is the monetized value of the gains to others in society, such as the positive effects of having educated people interact with each other, greater social cohesion, and so on. The social cost (SC) is the monetized value of the cost to others in society, such as the fiscal cost if the education is subsidized, including the dead-weight cost of mobilizing public resources. The social return is computed by replacing B and C by SB and SC in the equation above.

The earnings function method, also known as the Mincerian method (Mincer, 1974), involves the fitting of a function of log-wages ($\ln W$) – usually hourly or weekly, using years of schooling (S), years of labour market experience (X) and its square (X^2) as independent variables. Thus, the basic earnings function is:

$$\ln W_i = \alpha + \beta S_i + \gamma_1 X_i + \gamma_2 X_i^2 + \epsilon_i$$

In this semi-log specification, the coefficient on years of schooling (β) can be interpreted as the average private rate of return to one additional year of schooling, regardless of the

educational level this year of schooling refers to. Also, the earnings function method can be used to estimate returns to education at different levels by converting the continuous years of schooling variable (S) into a series of dummy variables, say D_p , D_s and D_u , to denote the fact that a person has completed the corresponding level of education (primary, secondary, university), and that, of course, there are also people in the sample with no education in order to avoid matrix singularity. Then, after fitting an extended earnings function using the above dummies instead of years of schooling in the earnings function, the private rate of return to different levels of education can be derived.

Rumble (1997), compares the average cost per student in open and distance learning institutions with that in broadly traditional institutions operating in the same jurisdiction shows that the former is not always the most cost-efficient option. He used the efficiency ratio (defined as the average cost per student in a distance teaching institution divided by the average cost per student in a conventional system) for a number of projects. An efficiency ratio of less than one (<1.0) means that the distance system is cheaper than that of a traditional system. An efficiency ratio of more than one (>1.0) means that the average cost per student in the distance system is higher than that in a traditional system. He found that open and distance learning is not necessarily the most cost-efficient approach but distance education methods may be the only way to reach some target audiences, in which case lowering the cost of education will not necessarily be an objective.

UNESCO (2002), observes that while a particular form of open and distance learning may be cheaper than some options, it may actually be more expensive than other options. More so, the comparative cost of different systems may change over time. In open and distance learning one would expect the cost per student to fall as economies of scale are achieved.

A range of factors may affect the cost-efficiency of particular distance learning programmes. These include:

The number of students enrolled

The greater the enrolment, the more the fixed administrative costs of the system, and the resources invested in developing the curriculum and study materials, will be shared by the student population, thus bringing down the unit cost per student. However, most of the economies of scale are reaped at an early stage. As student numbers rise, so the gain in efficiency increase but at a diminishing rate. Moreover, scale may bring its own complexities with the result that costs per student may actually begin to rise as diminishing return to scale set in.

The size of the curriculum

The broader the curriculum, the more courses will need to be offered, and the greater the volume of course materials that must be developed. The cost per student will therefore rise in line with the size of the curriculum unless the increase in the number of courses is compensated for by an increase in the number of students.

The number of years over which courses are offered without change

As we capture knowledge in text, audio, video or computerized formats, the material then exists as a more or less permanent record, and can be used for a number of years to teach successive cohorts of students. It makes it possible to reuse the materials from year to year, so that the cost of developing the materials can not only be spread over more and more years but also over more and more students. However, this can be a disadvantage if the format does not allow for easy changes to be made to the materials, and if once the course is launched it

becomes clear that poor initial design leads to the need to revise the course materials. A precautionary measure is that materials may be developmentally tested before they are produced in bulk. This is obviously a sensible strategy where it is intended that materials will last several years, or where materials are being used in a mass educational campaign even though most courses are so current requiring regular updates. An addendum or a supplementary material can be produced to ensure longer life span of the materials bulk produced for some courses most current in nature. However, the more years the materials are used, the greater the danger that they will become outdated. This is also more likely to be more serious in some subjects requiring currency (e.g. computing, social sciences, education) than in others mostly principles (basic math, history). The extent to which the need for update is a serious problem or not is to some extent affected by the approach taken to the design of the courses in the first place, and the ease with which changes can be made to materials. Modularization of the materials format, and the use of electronic formats, can make revision much easier. Indeed, one of the advantages of e-learning course formats is that development is no longer seen as a pre-presentation stage in the lifecycle of a course, but a continuous affair.

Technology application

Today there is range of media and technology employed to facilitate e-learning. Each technology has its own cost structure, so the choice of technology affects the costs of the system. The cost of a given technology will depend on the equipment used, availability of the equipment, the running costs of the technology, and the labour costs involved in the development, production and delivery of materials carried by the technology. For example, 'it generally takes a teacher more time to write a text that will occupy a student for one hour, than it takes to develop a one hour lecture; and it generally takes longer to write an e-mail response to a student query, than it takes to respond to a student orally' (Bates, 1995). Some of the technologies may also require teams of technicians and specialist producers to support the teacher. More so, a given media (text, audio, and video) may be produced and delivered in different formats and at varying costs of the materials. However, a number of researches showed that in both developing and developed countries, the costs of online education are more expensive than other forms of distance education (Orivel, 2000; and Rumble, 2001).

The level of student support

Successful distance education programme excellent teaching materials, efficient logistical systems, and responsive student support systems. The problem with this is that the cost of student support positively by the number of students in the system, and therefore, the absolute cost of providing student services increases rapidly with increases in student numbers. Additionally, student services are a direct student cost, meaning that the more that one spends on this, the less likely it is that the distance education option will prove to be cheaper than traditional education.

Working practices

Some courses take students many hours to study. The range of materials on such courses required mean that several people will be required to develop the materials. Course teams, in which overall responsibility for content and teaching strategy is vested in a team rather than the individuals, can be an effective but costly approach to course design. To reduce costs, the transaction costs of team working can be reduced by having a series of quasi-independent authors working under the direction of an academic editor. More so, the size of the course modules can be reduced so that just one or two people can produce them. In the student support area, the use of telephone call centers using less expensive help-desk operative staff can also reduce costs.

Student support may be focused on the student in the home, without relinquishing a network of learning or study centers where students come together to meet each other and advisors, to use facilities such as a library and computing and audio-visual equipment, and to take part in face to- face tutorials. Setting up and maintaining such centers can be costly, most particularly where equipment such as computers and electronic library are provided at sufficient levels to enable the numerous students to access resources easily. More so, these equipments needs to be regularly maintained and up dated in line with global trend.

Labour market practices

Employment of staff on short-term contracts where payment is on per student, per hour, or per script basis can reduce cost significantly. Many course developers, editors, producers, designers, and above all tutors can be hired on this basis. Ultimately, this can result in some open and distance learning institutions having a few core academic staff.

Cost/benefits and e-learning space

According Sife et al (2007) “ICTs have not permeated to a great extent in many higher learning institutions in most developing countries due to many socio-economic and technological circumstances”. In the views of Adam (2003), ICTs in some circles of education are regarded as a solution for the problem of having to do more with less, providing access to increasingly diverse demography of students and faculty and improving both quality and quantity of educational content. Nafukho (2007) also observed that current developments in technology have an extraordinary potential for transforming education to meet the growing need for customized, on-demand learning. However, there are a lot of barriers to developments of ICTs, Notable among them are:

- the challenge of digital divide exists among the student of ODL, some of them are unable to afford computers due to the relative cost to the average income of workers in the country (Ajadi, et al., 2008; Arikpo et al., 2009)
- the High cost of accessing the internet in developing countries
- irregular and frequent interruption of commercial power supply
- inadequate technical expertise (Aduke, 2008).

In the following, data used from Abuja Distance Learning generates the various cost functions which are used for estimations of costs given various approaches to ODL. The costs are presented on the vertical axis and are in US dollar approximation while the horizontal axis measure number of students per programme. Earlier on, we have stated the *total cost formula*, which reads $TC = F + V \times N$, where F stand for *fixed costs* and $V \times N$ *variable costs*, N representing the number of students and V the variable costs per student. Average cost per student is derived by dividing TC by the number of students. This is expressed in a formula: $AC = TC/N$ or $AC = (F/N) + V$. The common feature of such an average cost function is that it falls asymptotically towards a straight line parallel to the x-axis. This means it approaches the straight line with increasing number of students but never falls below it. The potential for economies of scale (*economies of scale* means that, with increasing numbers, average cost per students fall) is the differential between fixed costs and variable costs per student. The flattening of the curve shows the degree, by which scale economies are getting exhausted. The figure on TR and TC shows that at a point when purely correspondence approach is adopted, economies of scale is optimum with about 1000 number of students. Differentials of costs and revenues gives the cost –benefits. In this paper, three cases based on the size of students per programme and the types of distance learning approach are analyzed. More so, cost-benefit of e-learning is compared under different approaches to ODL.

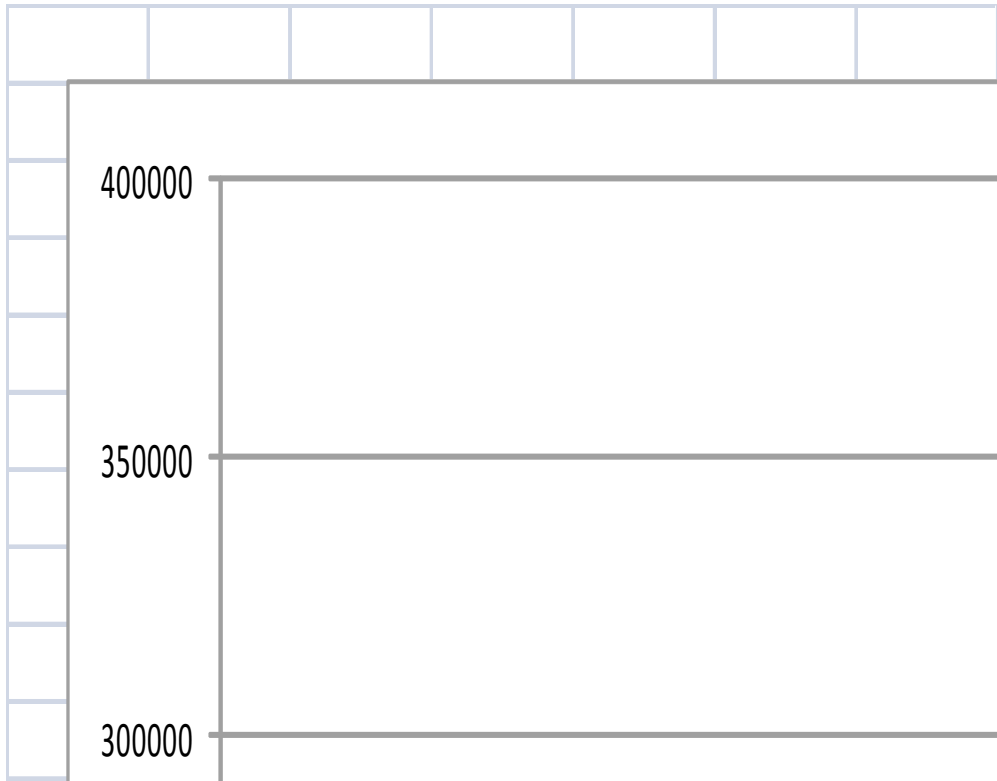


Figure 1: Total cost and Total Revenue cost

- Vertical axis of the curve measures cost/ benefit in term of dollar, while the horizontal axis measures number of students per programme
- The figure on TR and TC shows that at a point when purely correspondence approach is adopted, economies of scale is optimum with about 1000 number of students.
- At current fees and Supports, break-even point where cost is just equal to benefits set in at about 550 student per programme

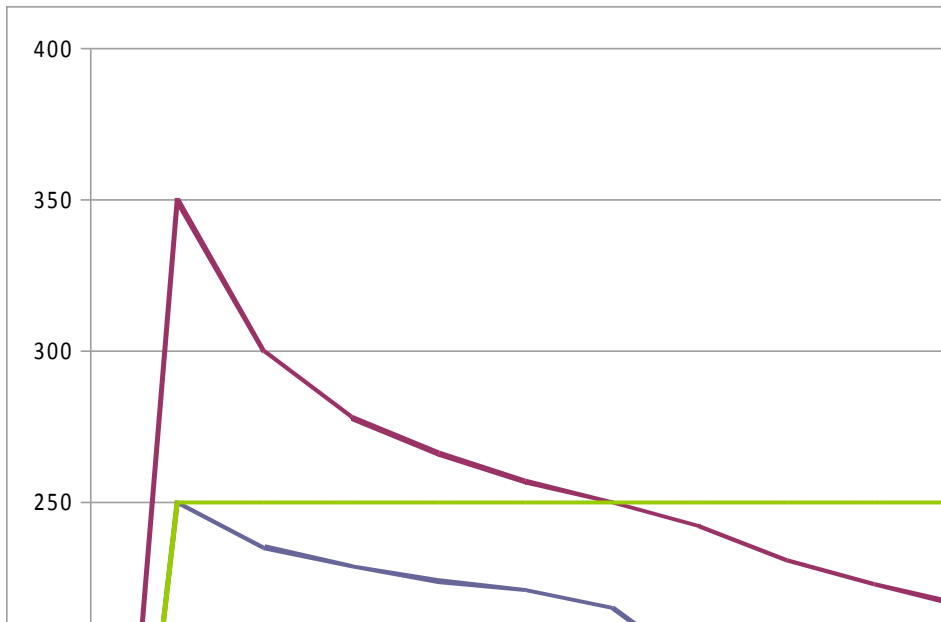
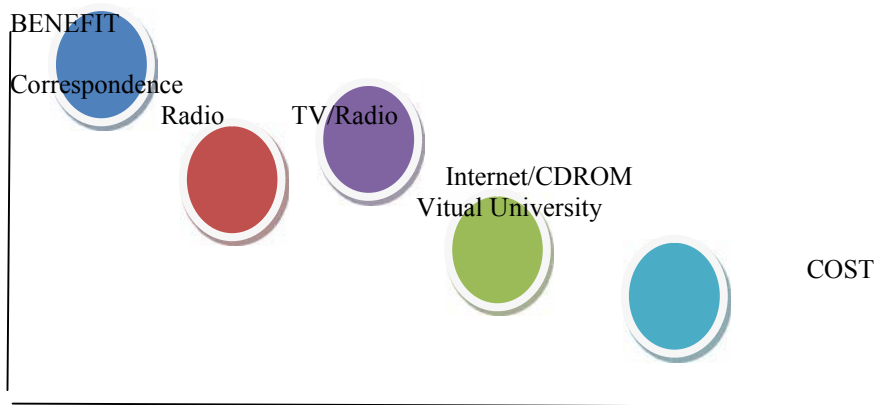


Figure 2: Marginal cost, Average cost And Average Revenue cost

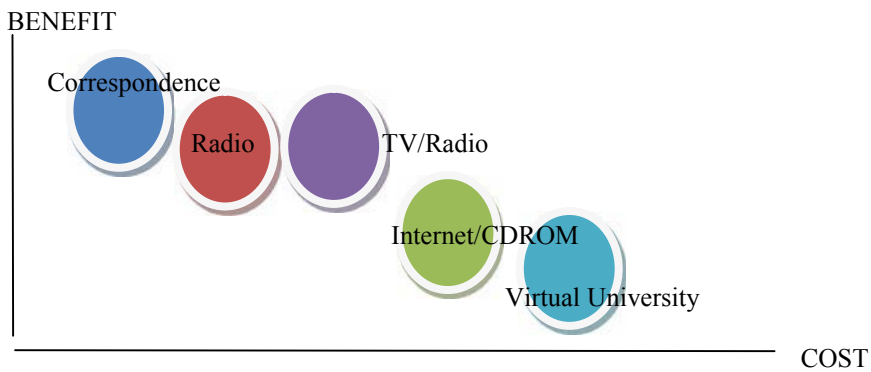
- At student size of more than 1000 per programme the difference between AR and AC begins to narrow.
- Beyond 1000 student per programme MC also begins to rise
- This suggests that diseconomies of scale begins to set in and hence the need for an alternative approach to ODL

Cost variation with e-learning

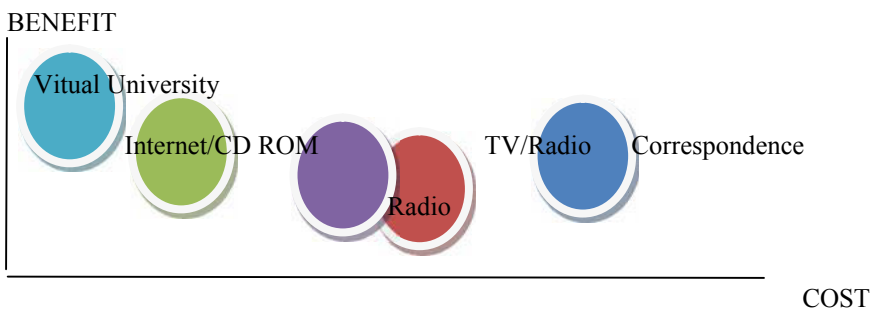
According to UNESCO (2002), educational television broadcasts and computer-based and online learning are more expensive than radio broadcasts. There is disagreement, however, over whether television broadcasts are cheaper than computer-based and online learning. More so, categorical assessments of cost-effectiveness are difficult to make because of lack of data, differences in programmes, problems of generalization, and problems of quantification of educational outcomes and opportunity costs. In the view Blurton (2002), speaking specifically on computers and the Internet, argues that “when considering whether ICT is “cost-effective” in educational settings, a definitive conclusion may not be possible for a variety of reasons. However, when considering the alternative of building more physical infrastructure, the cost savings to be realized from sharing resources, and the societal price of not providing access, ICT as a means of enabling teaching and learning appears to be an attractive and necessary alternative.” Focusing too much on initial fixed costs—purchase of equipment, construction or retrofitting of physical facilities, initial materials production, and the like to estimate the cost of a particular ICT educational application is erroneous. Open and distance learning institutions may be cost-effective through economies of scale. At what point should economies of scale become optimized for a given distance learning approach depends on the number of students per Programme. The estimates cost and benefit according to different approaches using the Abuja data are given in figure 3 panels A, B, and C.



A: 100-1000 Students per programme
 Correspondence approach yields higher benefits at lower cost followed by Radio, TV/Radio.
 Visual approach is not cost effective when the number of student is low



B: >1000Students<3000 Students
 Reduction of cost noticed in the application of e-learning at 1000 to 3000 student per programme but still it is more cost effective using correspondence and other approaches.



C: >3000 Students
 Virtual University approach yields more benefit than cost. This is followed by Internet/CD ROM.

Figure 3: Estimates cost Benefit points for implementing of various ODL approaches based on the size of students per programme

Figure 3 describes costs and benefits graphically. Five Distance Learning approaches are positioned on cost benefit graph. The ideal case is an approach that has low cost and high benefit, the upper left segment of the graph. The least valuable case is in the lower right part, where high costs are accompanied by low benefit. In panel A, Correspondence courses are positioned on the graph as being the best mix of cost and benefit. In the middle of the cost/benefit continuum are the combination of correspondence with TV as well as with and radio and Internet/ CDROM. Each of these has its own strengths and weaknesses but the weaknesses out weight the strengths because of digital divide and poverty however, the size of the students enrolls per programme matter. Although Radio is the dominant electronic communications device in the world, it is sometimes cumbersome to use in distance education without adequate recording systems. More so, most of the students who are already employed finds it difficult to listen to the radio during their somewhat tedious official working hour. TV is also popular but not as available and portable as radio. Recently the government of Nigeria banned watching of TV in public offices. In African countries, for example, there are several hundred radio receivers per 1000 inhabitants but less than a third of that for TV. CD-ROM has the advantage of combining the best of WWW and audio, but the disadvantage of requiring computer skills, economies, and culture. The benefit of virtual universities is relatively low, compared with the cost especially if the size of the student and the school fees they can afford to pay is low. Virtual universities are expensive, require good bandwidth, and need an ICT infrastructure. Panels B show the estimates of cost and benefit with different distance learning approaches when the size of students per programme increased beyond 1000 but less than 3000. In panel B, application of ICT gives more benefit than in panel A because of students' size. Panel C estimates distance learning approaches given the number of students per programme increased beyond 3000. At that point, economies of scale set in for the application of ICT.

CONCLUSION

It does not cost less to apply e-learning in ODL of developing economies in the short run. However, in the long run when the programme can attract a sizeable number of students if there is high economies of scale in full e-learning approach. This paper analyzed the cost-benefit of e-learning to both the students and the ODL institutions. It is observed that e-learning application on ODL of less developed economies is cost effective but depends on the size of students per Programme. However, economic constraints on both the students and the ODL institutions require partial application in the short run. More so, it takes time to adapt students to scarce technology that is not affordable to them. The ODL Institutes also require time and resources to up date e-learning to international standard. Nevertheless, full application of e-learning in developing economies is feasible in the long run with more benefits than cost to both students and the ODL institutes. In this world of scarce economic resources, e-learning application in developing economies is inevitable. However, embracing e-learning should be made by taking the peculiar situation of developing economies. High poverty level means that students can not pay school fees as much as paid by the students of developed countries. More so, the high cost of e-learning to students as a result of the digital divide means that total acceptability of ICT is more feasible in the long run.

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