

**The Potential for Virtual Library Services to Promote Teaching and
Research and Reduce the Digital Divide: A Case Study of the
University of Malawi**

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ABSTRACT

This article attempts to answer the question whether the emergency of virtual libraries (VL) and an information access paradigm has the potential to promote teaching and research besides bridging the digital divide between developed and developing countries.

A document delivery capability test was conducted to assess the ability of the University of Malawi library to deliver 300 citations, which were systematically sampled from the International Science Institute's list of High Impact Journals. A control document delivery test was conducted at Curtin University of Technology in Perth, Western Australia. An adaptation of Hawkins' application of Sigmoid Growth Model and Continuous Growth Model in information environment was used to analyse the results.

The findings reveal that the University of Malawi's electronic delivery compared favourably with Curtin University of Technology's suggesting the potential of the VL. The study concludes for this potential to be fully realised in developing countries like Malawi, critical attention needs to be paid to the development of information technologies infrastructure. The article recommends that in order to gain a more conclusive picture, there is need to carry out time series tests.

“The university is a complex institution which has multiple missions, including instruction, research and diffusion of new information through scholarly communication. All of these functions are dependent on the library and resources that it houses. Over a century and a half ago, Thomas Carlyle suggested that ‘the true university of [those] days [was] a collection of books’...the library of today is far more than books.” (Hawkins, 2001: 188).

Introduction

This article attempts to answer the question whether the emergency of virtual libraries and information access paradigm have the potential to bridge the digital divide besides promoting teaching and research in the universities of developing countries. Teaching and research are considered the essential functions of any university, as places where knowledge is created and transferred. They are undertaken to support the acquisition of knowledge, in an environment that is not affected by external pressures or conventional thinking.

A library is an essential component of a university because it acquires and organises published information to help produce new knowledge. The mode in which information is accessed, stored and disseminated by libraries is a major factor in determining the quality of teaching and research performance of universities. Traditionally university libraries have been engaged with developing print based collections. However, changing information and communication technologies, decreasing acquisition budgets, the escalating cost of scholarly journals and increasing user expectations have influenced many libraries to automate their services and this has given rise to the concept of the virtual library (Saunders, 1996).

A virtual library has been defined by Gapen (1993:) as, “the concept of remote access to the contents and services of libraries and other information resources, combining an on-site collection of current and heavily used materials in both print and electronic form, with an electronic network which provides access to, and delivery from, external worldwide library and commercial information and knowledge sources”. The speedy and wide access to current information contents makes virtual libraries a global symbol of the information access paradigm. The VL has changed the traditional focus of librarians on the selection, cataloguing and management of information resources such as books and periodicals. The virtual library is putting emphasis on access without the need to allow for the time required by these

technical processes (Saffady, 1999). VLS have induced libraries, scholars, publishers and document delivery vendors to develop new partnerships that are working for the good of scholarly communication in both developed and developing countries.

Problem or Promise for Developing Countries?

However, while these new partnerships have raised hopes, the manner in which virtual libraries have evolved has not been the same in the developed and developing countries. Libraries in developed countries evolved virtual library services much earlier than libraries in developing countries because of access to good telecommunication infrastructure, and they had sufficient funds to acquire library automation technology and related computer industry products. Libraries in developing countries, however, have found that the lack of adequate funding has meant that they cannot afford the technical infrastructure required to support virtual library services. This has threatened to create a 'digital divide' between the developed and developing countries: that is the disparity in information services and knowledge generation and usage, which exists, between developed countries and developing countries.

The Digital Divide

Since the concept of the digital divide was first acknowledged in the early 1990s, much of the debate in the library and policy literature has focused on access to technology, that is, which groups of people have internet connections and which ones do not, which ones go to public facilities to gain access and which ones do not. More recent literature argues that access to content must be the real issue. For example, librarians are not just interested in mere provision of the Internet to scholars, but they are interested in finding out whether access to the Internet is enabling the scholar to access the desired content (Salinas, 2003). The mission of libraries within an information access paradigm therefore is to use ICT to enable users to have access to content. The argument is that if ICT is well utilized by libraries, it could enable library users on both sides of the digital divide to have equal access to content (Heuertz, 2003). It is against this background that all propositions for or against the potential of the VL have to be tested.

First proposition: Virtual libraries will reduce the digital divide

Proponents of this school of thought believe that if the diffusion of technology were to be done without favouring some nations over others, it would enable scholars on both sides of the digital divide to have equal participation in the virtual world (Lancaster, 1982). Garcha (1995) argues that technology offers libraries in developing countries, no less than those in the industrialized world, an ideal solution to a number of problems of managing a modern research library. An interesting aspect of the virtual world is that there are distinct virtual communities and accepted rules of behaviour or etiquette for online use. The participants are not bound by geographic location, political ideology, cultural or religious affiliations, racial classification, ethnicity or even physical location. These virtual communities would bury the sad histories of existing gaps between the rich and the poor in scholarly communication.

The belief in this proposition is well demonstrated by Raseroka (1999) who reported at African Association for Universities' (AAU) Technical Experts meeting on the use and application of information and communication technologies in higher education in Africa, that ICT has emerged globally as a necessary facility in enhancing both the academic and governance activities of institutions. The meeting recommended that a review of the ICT capacities of every African University should be undertaken as a matter of priority, and that the AAU would offer guidelines for the formulation of strategic plans for ICT implementation. AAU's further questioning as to whether ICT has been utilized in Africa in the same way as it has been in developed countries to transform higher education from the traditional mode to one propelled by the new technology, has been one of the springboards for the study conducted at the University of Malawi.

Alternative proposition: VLS will exacerbate the digital divide

While the potential of virtual libraries remain, new fears are emerging built around the cost of acquiring ICT infrastructure and also the associated cost of information delivery. This is seen as a potential hindrance to information access for developing countries. Feather (1994:36) notes "the gradual convergence of previously separate technologies, [has] tended to emphasize both the cost of infrastructure of information systems and that of delivering the service to the user." In this regard, Maggerison (2001) argues that while communication technology was increasingly pervading many facets of life in developed countries, the potential of such systems in

developing countries that are still struggling for basic survival is highly questionable. There are fears that new means of telecommunications such as the Internet threaten to deepen the obvious social inequalities by giving the wealthy more access to information while shutting out the poor.

Daly (1999) is skeptical about assessment of the potential of the VL from a methodological point of view. Writing on measuring impacts of the Internet in the developing world, he asks what it means to measure impact of technology when one of the most advanced technologies (the Internet) is introduced into a setting in which exposure to technology in general, is relatively minimal and, perhaps, naïve. He further argues that measuring the impacts of the Internet in developing countries is difficult because it requires measuring the penetration of the Internet, the utilization of the Internet, and the effects arising from the utilization.

Measuring impact of the virtual library services

This study acknowledges that the impact of the Internet will differ from one country to another. Even within developing countries, differences will follow from the differing availability of the Internet. The idea of impact connotes that the more you use technology, the more effect it has. In poor countries like Malawi, with little Internet use and with few people who can afford the services on offer, not many people will use the Internet, and therefore little 'impact' is expected.

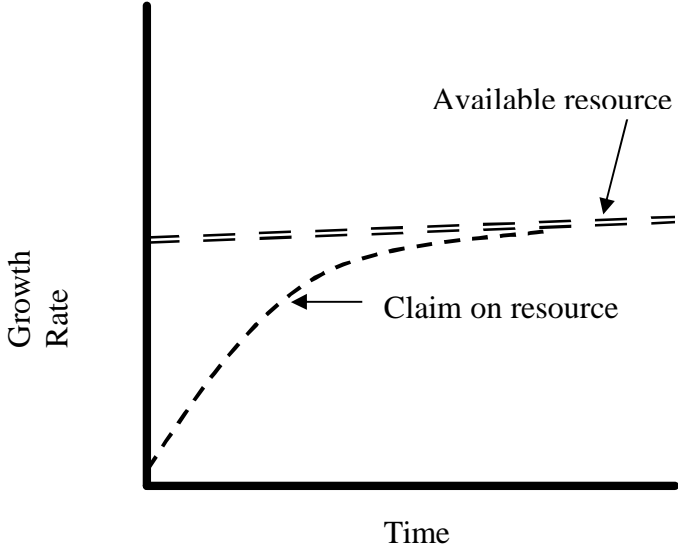
This article argues that while it is true that two countries can have comparable Internet services, use those services in different ways, and therefore see different effects, if Internet users in two different countries have the same access to Internet services and the same user skills, then the Internet will have the same impact on them. The result of that impact will be irrespective of whether they are from developed or developing countries, provided that the social and economic variables are consistent. Thus although Internet connectivity in Africa is low compared to the developed countries, if well utilized it would facilitate the potential of the virtual libraries to bridge the digital divide. Arguably, wherever the Internet services have been made available in the developing countries, institutions of higher learning such as universities have been amongst the foremost beneficiaries. Thus it is possible to compare a university in the south with one in the north.

Daly (1999) theorizes is that the best way to investigate the potential of the Internet or virtual library services as a tool for bridging the digital divide is to take an approach that allows further aggregation of impacts in larger socio-economic systems such as education. If education was looked at, teaching and research would be particular variables. One would therefore be able to investigate the impact of the Internet (or virtual library services) on a university's teaching and research on a comparative basis between developed countries and the developing countries. Such a comparison is practical, revealing than comparing the general situation in a developing country with that of developed.

Theoretical Model and Document Delivery Capability Test

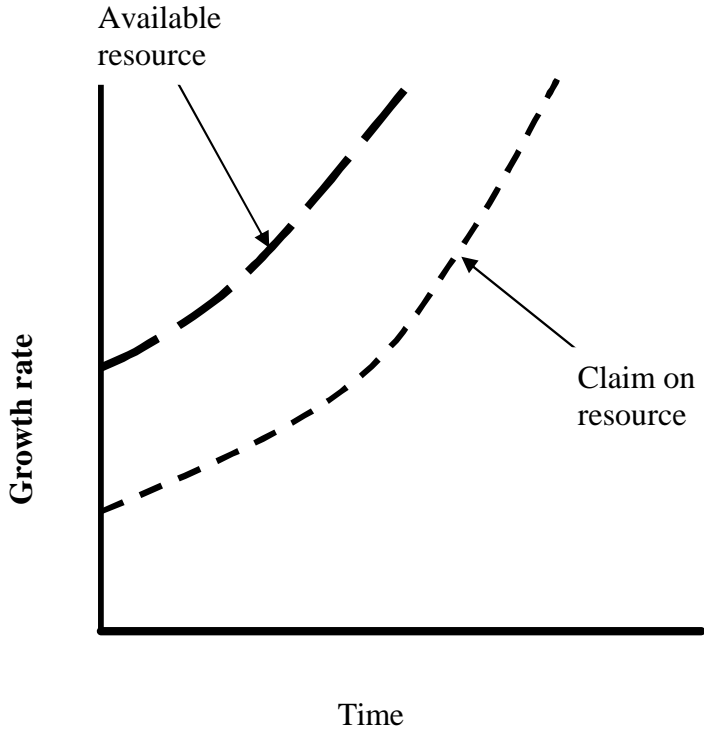
In order to understand and analyse the impact of the Digital Divide on access to scholarly information and the potential of the digital divide to bridge the same, this study adapted Hawkins' (2001) application of the Sigmoid Growth Model and the Continuous Growth Model. Drawing on ecology literature, Hawkins observes that there are predictable modes of reaction related to available resource when demand goes beyond the available resource. He points out that the ecology literature identifies two models of coping with or reacting to the problem of demand overshoot. One of them is the Sigmoid Growth Model in which the demand is scaled back to meet the constraint and becomes asymptotic with the supply as feedback makes it clear that continued exponential growth is not possible (see Figure 1).

Figure 1: Sigmoid Growth Model



The other is the Continuous Growth Model in which the available resources are allowed to grow exponentially as well thus paralleling the demand and never reaching a point of overshoot (see Figure 2).

Figure 2: Continuous Growth Model

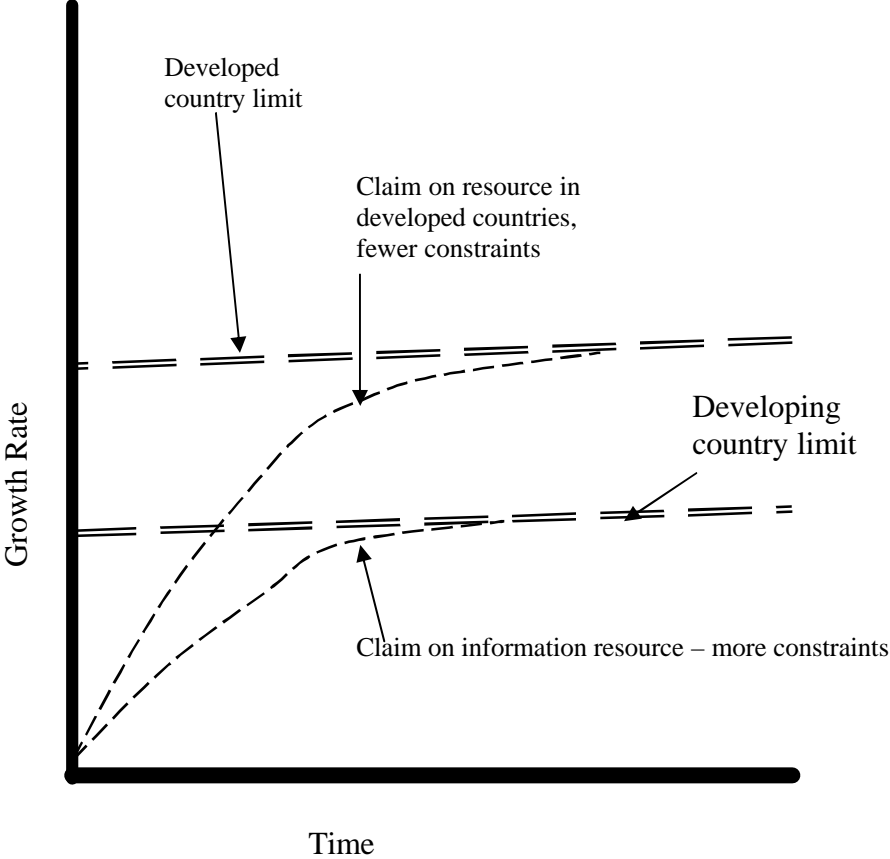


Relating these models to the world of libraries and information use, Hawkins argues that the Sigmoid Growth Model represents the way libraries buy and collect materials only up to the level of the appropriated budgets. In this case the growth of information is limited by the budgetary constraints and therefore the use of the available information will eventually plateau. On the other hand the Continuous Growth Model represents a continuous growth in collecting and making information accessible and there is unconstrained growth in the use of that information resource.

This study argues that the Sigmoid Growth Model does usefully represent the experience of libraries and scholarly information in the collection-building paradigm, whereby a library depends primarily on its own collection in order to meet the users' needs. The availability of the information resource is constrained by the budgets and therefore growth capacity is hindered. This study equates claim on resources to demand for scholarly information and the available resources to the number of information items that a library is able to hold within its walls. Thus in a traditional collection-building paradigm, users' willingness to go for an alternative is non-existent and it results in scaling down the claim in order to make it asymptotic to supply. In this case demand is scaled back to meet the constraints set by the collection of the great library.

This study further argues that since the level of available resources (number of information items) as well as the constraints (library's acquisition budget) differs between developed and developing countries, their points of overshoot will also differ substantially. The availability of information resources is likely to be much less in developing countries than in developed countries due to inadequate funds. Theoretically, comparison of a library in a developed country and a library in a developing country in the traditional collection-building paradigm environment would create two distinct patterns if the Sigmoid Growth Model applied. The point of constraint in a library in a developed country would be reached much later than in a library in a developing country. Thus graphically represented, the two patterns represented as a Sigmoid Growth Model would look like Figure 3:

Figure 3: Suggested patterns of Sigmoid Growth Model between developed and developing countries' libraries

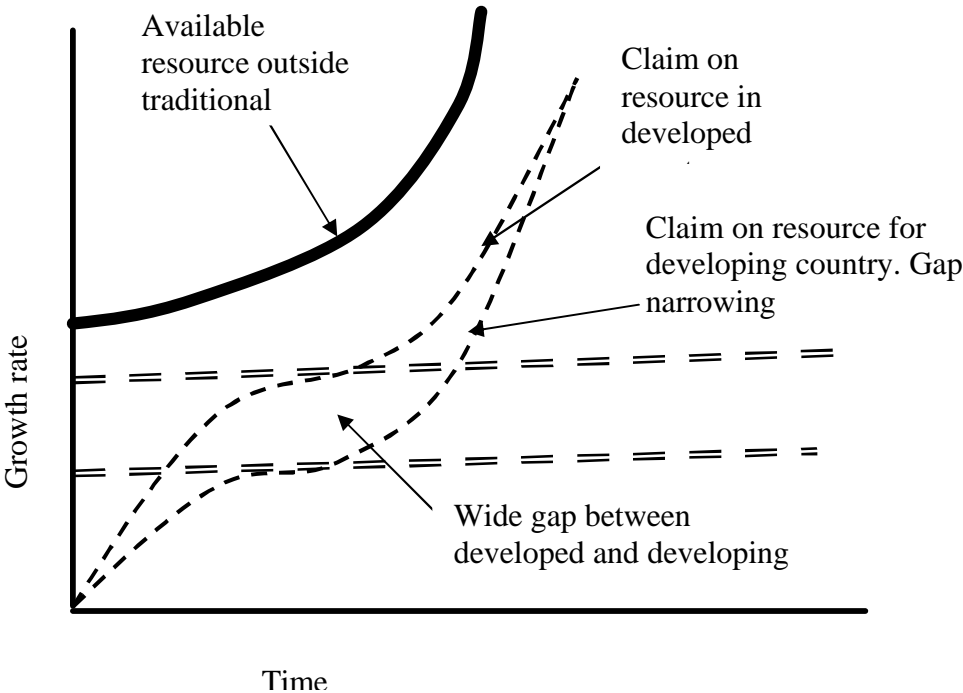


Based on this diagram, the difference (gap) between the developed country limit and developing country limit can be theoretically suggested as the information gap or the difference in the document delivery capability. The term 'information gap' is used here as opposed to 'digital divide' because both the Sigmoid Growth Model and the traditional collection-building paradigm are accounting for information use behaviour based on pre-digital assumptions. It can also theoretically account for the behaviour of users who are dependent on the print collections of a library only. The difference in the claims on the resource between the developed and the developing countries is the theoretical extent of the information gap. This study's hypothesis is that conducting searches for information items that are limited to collections as represented in the library catalogues of the University of Malawi and Curtin University of Technology while using the same samples of information items, will produce the pattern suggested in figure 3 over a period of time.

In the same vein, the Hawkins' Continuous Growth Model represents the information access paradigm environment. This model best describes libraries that have broken beyond their local limited physical information items and are now relying on electronic sources. Since the available information in the information access paradigm is no longer defined by what is contained in the library, the library becomes a virtual world not limited by geographical location. Using this model, this study hypothesizes that as libraries in developing and developed countries shift from the traditional collection-building paradigm to the information access paradigm, they will exceed the limitations of their physical collection and supply resources according to the demand made upon them by users. In this case, there is no physical limit imposed by collection size, and the demand will potentially continue to expand in accordance with a library's increasing ability to retrieve digital information sources from beyond their own 'collection'. Therefore the curve representing the libraries in developing countries will begin to reduce the gap set by the curve representing developed countries. Where the libraries in developed countries have access to ICT while libraries in developing countries don't have access to the same, then the information gap would be transferred from the collection-building paradigm to the information access paradigm. This time the gap would be wider and it would rightly be called the digital divide. When all the factors that support virtual libraries services are equal, the ability of a library in the developing country to supply information will be equal to the ability of a

library in a developed country. Theoretically, this will have signified the closing of the information access aspect of the digital divide. These views are graphically represented in Figure 4 below:

Figure 4: Suggested patterns of the Continuous Growth Model, between developed and developing countries



Theoretical Model and Study Objective

This study uses this adapted model (as in Figure 4) to establish whether the introduction of electronic documents supported by a fully implemented virtual library services in the University of Malawi has improved access to global information for teaching and research.

In this sense, the sample population of items for the study is being considered as a representation of the larger universe of information items that are published which in the ideal sense can be equated to all the available resource outside the library. The number of sample items discovered in the physical collection of the libraries being tested will determine the limit of the resource. What the catalogue offers is a measure of the limit of the resource in the model i.e. the information items available in the

physical collections. All the sample items obtained through the electronic delivery (i.e. free searches on the Internet or commercial electronic document delivery) are measures of the continuous growth model since they are obtained from outside the library walls.

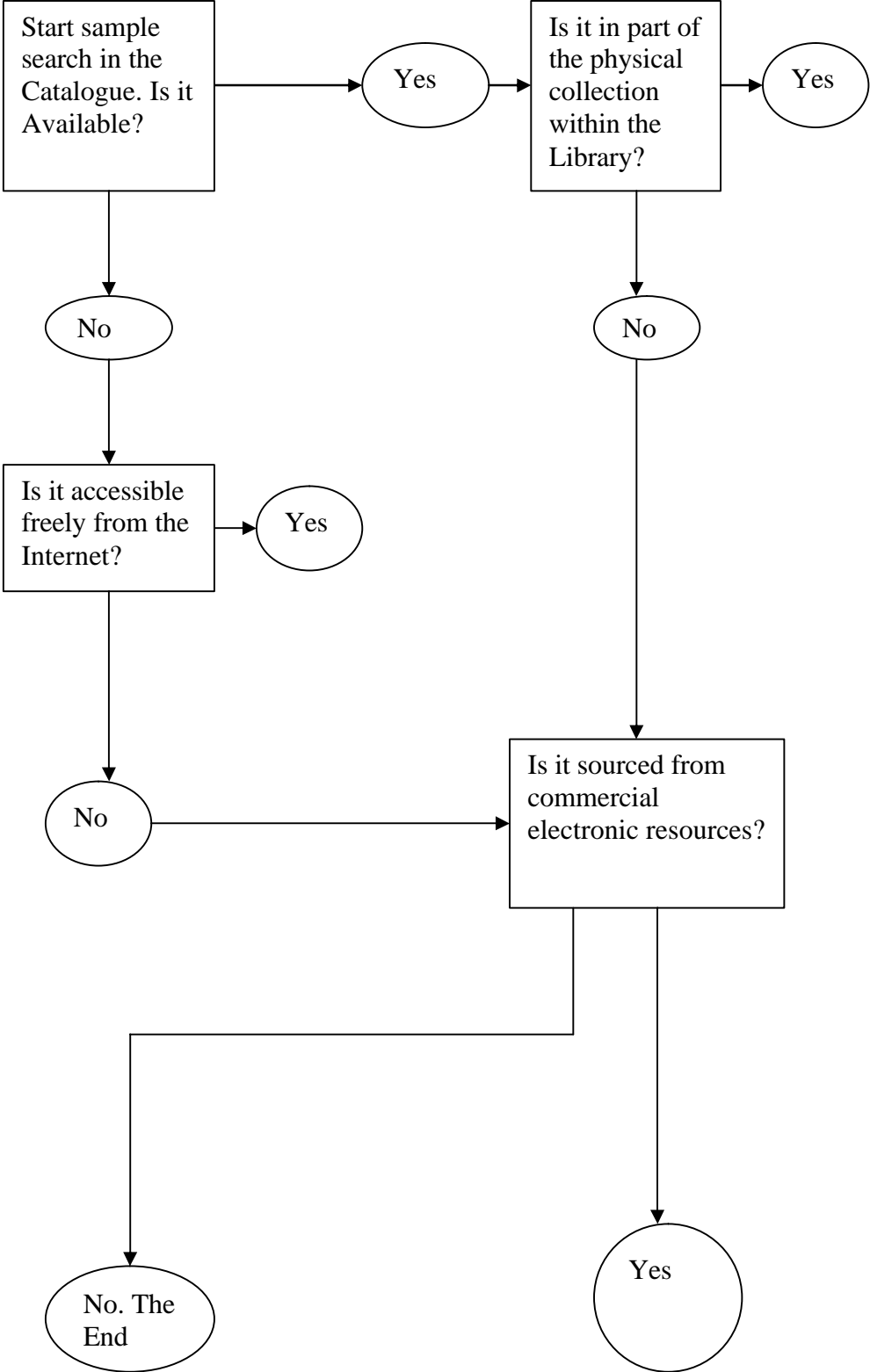
Methodology

A document delivery test (DDT) was conducted at the University of Malawi whose objective was to establish the document delivery capabilities of the library's physical collections and electronic sources. A control document delivery test was also conducted at Curtin University of Technology in Perth, Australia. Lancaster (1977) has defined the document delivery capability of a library as the principal criterion by which a library collection would be judged in terms of whether it would satisfy the demands placed upon it. Document delivery capability, he further suggests, is an index of what proportion of demand a library would be able to satisfy. A document delivery test is one of the ways of establishing that index. A population of 300 sample citations sampled from high impact journals ranked by International Science' Institute's Journal Citation Reports was used. A document delivery instrument was designed for checking then nature and size of sample item delivery. A document was considered delivered in this study only after a full item was accessed.

Procedure

The entire sample item search procedure at both Universities is diagrammatically presented in the flowchart in Figure 5 below.

Figure 5: Flow chart of sample item search

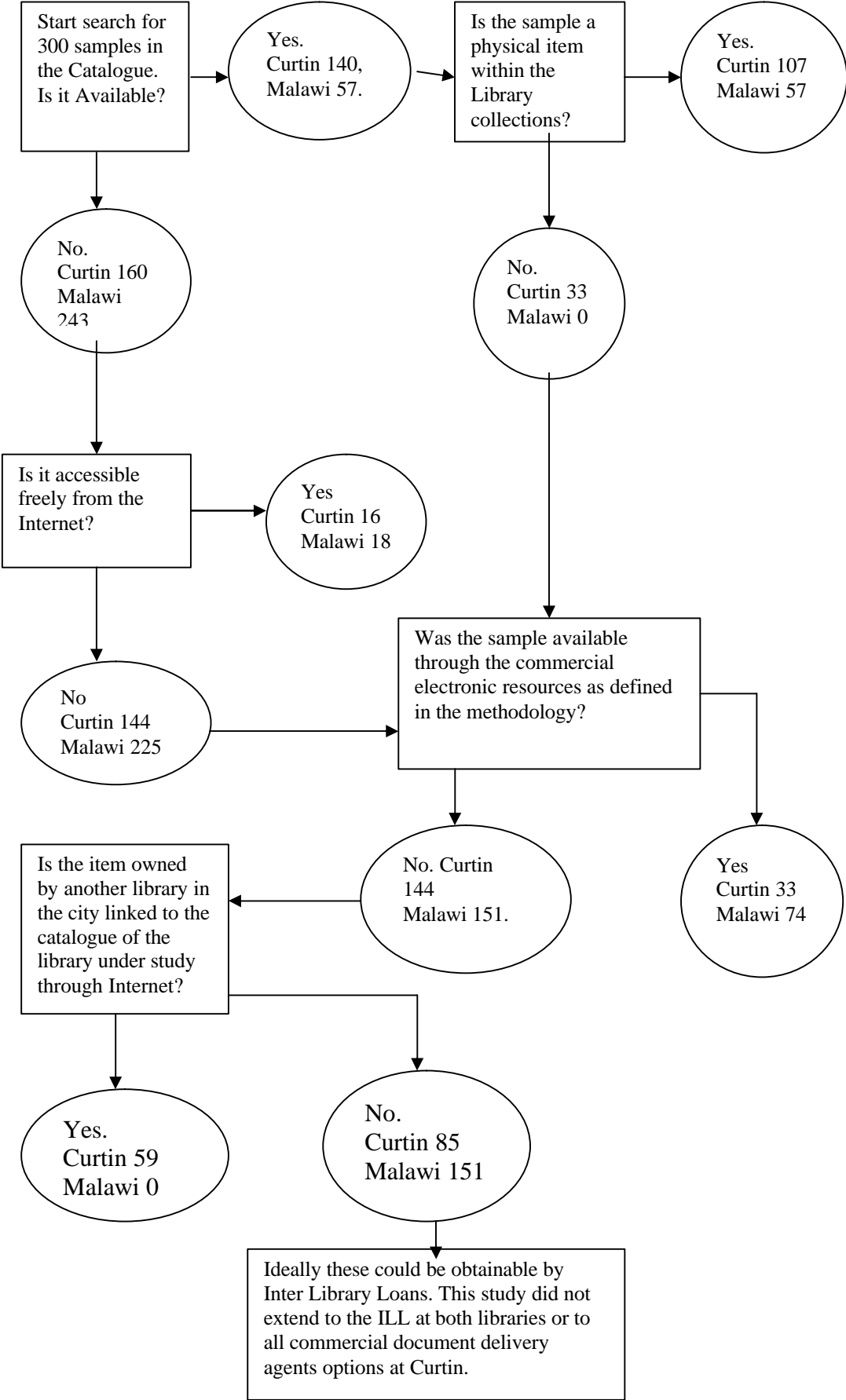


At both two universities all the 300 sample items were thoroughly searched in the physical and electronic resources. Thus in total, the survey had 600 forms or datasheets which represented 600 sample incidences or cases for analysis using SPSS.

A summary of the Results

Figure 6 below displays a flowchart that shows the sample search procedures and a summary of all the results obtained from items accessed in the catalogues of the libraries, those freely accessed from the Internet and those available through commercial electronic resources. It shows that overall, Curtin University Library performed better than University of Malawi Library. However the electronic resources enabled the University of Malawi to narrow the gap created by the physical resources.

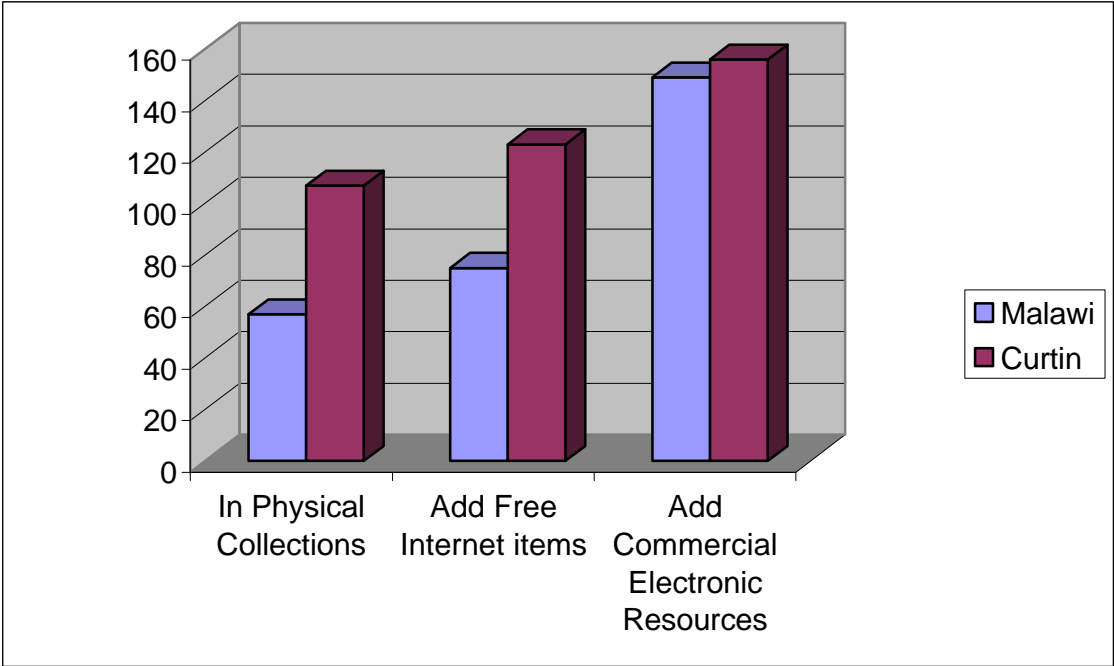
Figure 6: A schematic view of the major findings of the study



The results at Curtin University of Technology show that 107 sample items were found in the physical collections, 16 sample items were found freely on the Internet, 33 sample items were found through commercial electronic resources. This brought the cumulative total of the successful sample items at Curtin University of Technology to 156 out of the 300 searched.

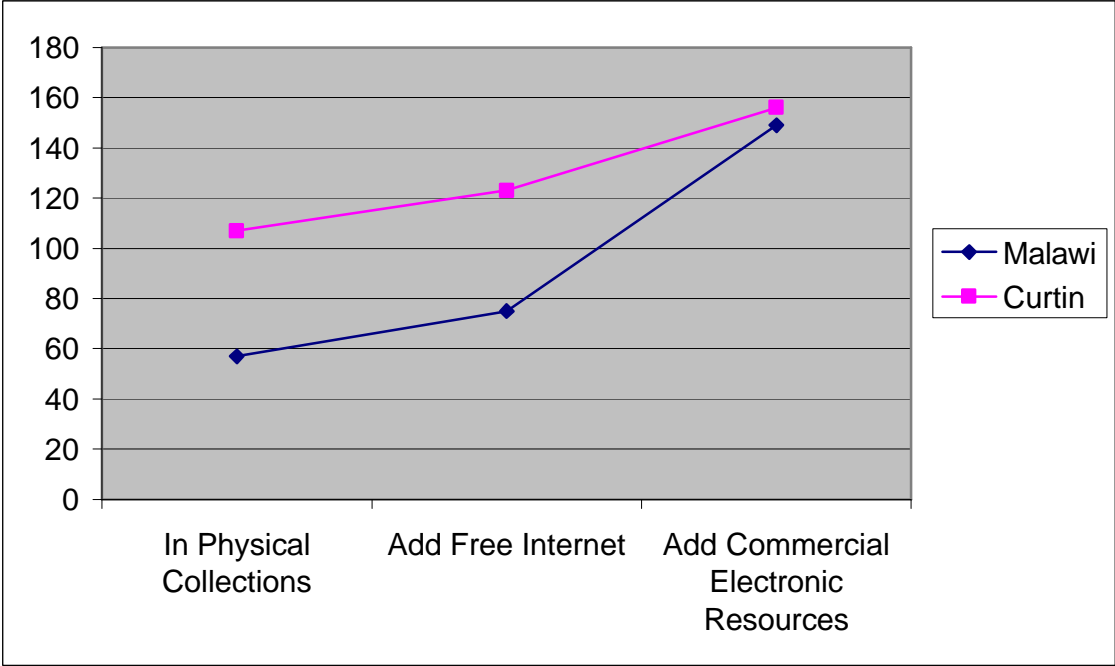
As shown in Figure 7 below, the number of successful sample items increased cumulatively from the 107 sample items identified in the physical collections of the Library to 123 after searching the Internet and to 156 after taking into account the 33 accessed from the commercial resources.

Figure 5: Bar graph of cumulative results of successfully accessible items at Curtin University of Technology (Curtin) and University of Malawi (Malawi)



The results at the University of Malawi shows that 57 sample items were found in the physical collections, 18 sample items were found freely on the Internet bringing the cumulative of successful items to 75. And 74 sample items were found through commercial resources bringing the cumulative total of successful items to 149. Figure 7 shows the cumulative increase of successful sample items for the University of Malawi against those of Curtin University of Technology.

Figure 8: Linear graph of the cumulative results for Curtin University of Technology (Curtin) and University of Malawi (Malawi)

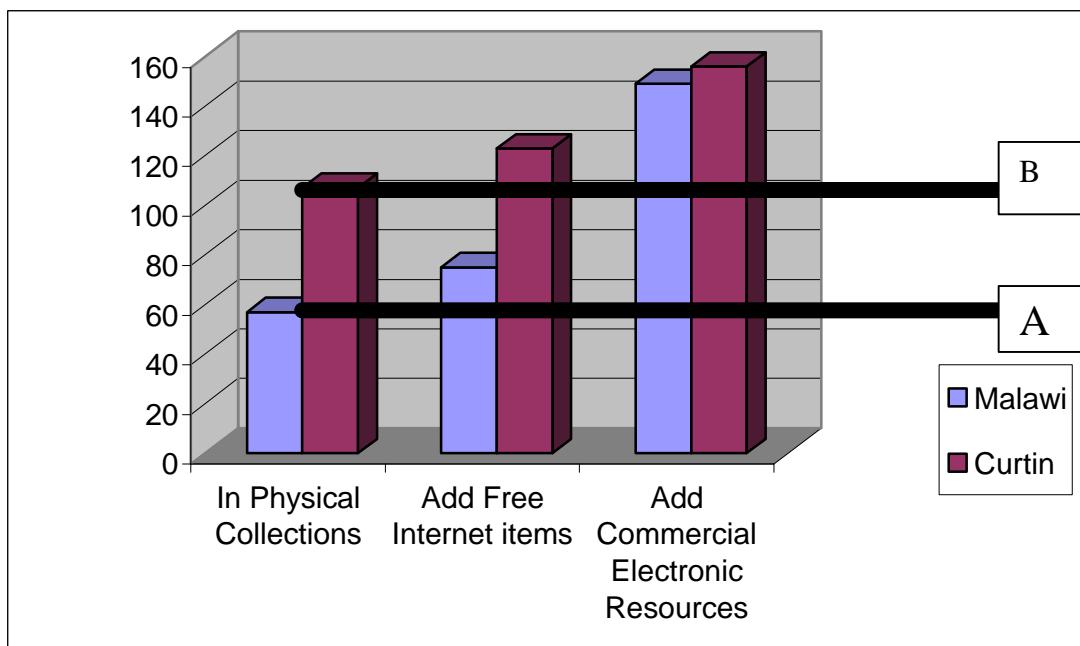


As demonstrated in figures 7 and 8, the results have offered the basis for analysis and discussion of deliverability of information items within the traditional and the virtual environment. At both Curtin University and the University of Malawi, the electronic or virtual options enabled the institutions to break through the limitations of their physical resources of their collections. The more the sample items were searched in electronic options, the more the cumulative total of successfully identified and located items became.

Discussion of the results: Trends in the Physical Collections

This trend of the results supports the suggested patterns of Hawkins' application of the Sigmoid Growth Model that has been adapted in the theoretical model of this study. The theoretical model suggested that the physical collections of libraries in developed countries would be less limited in the delivery of information items than the physical collections of libraries in the developing countries. This pattern is better understood if the maximum number of sample items found in a library's physical collection is accepted as a simulation of the limit on the information resource described in the theoretical model. In that regard, Figure 9 below reconstructs the results using Hawkins's application of the Sigmoid Growth Model. Line A in Figure 9 is the limit or the point of constraint on the resources in the physical collections of the University of Malawi. Line B in the same Figure 9 is the limit or the point of constraint on the physical resources of Curtin University of Technology.

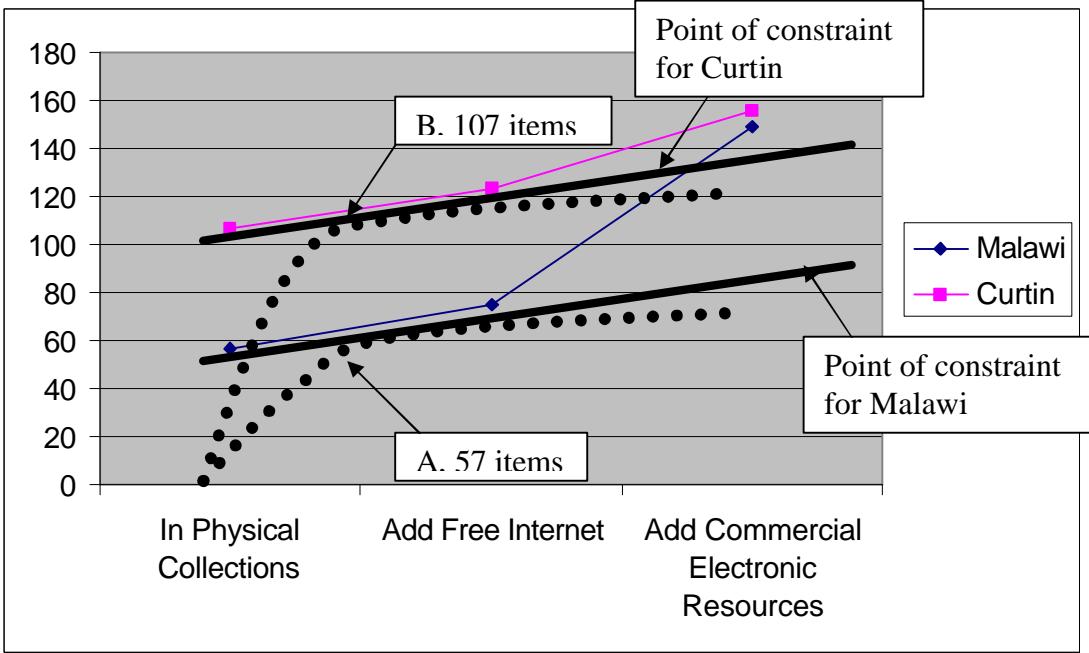
Figure 9: Points of constraint for physical collections of the University of Malawi (Line A) and Curtin University (Line B)



Although the reconstruction of the model concepts using the results in the physical collections of both Universities has been represented by the histograms, the results could also be represented as points A and B on two curves of a linear graph. Theoretically A and B would be points on two different curves of a linear graph if this

study was a time series DDT survey done over a significant period, where growth of the resource was allowed to register. Thus A and B would appear as shown in Figure 10.

Figure 10: University of Malawi (Point A) and Curtin University (Point B). Results from the physical collections as points on linear graph



The curve indicating the use of the resource (i.e. availability of the resource for the user) for the University of Malawi would not exceed the point of constraint for the University. The Curve showing utilisation of the physical resources for Curtin University on the other hand, would exceed the point of constraint for the University of Malawi, but would not go beyond the point of constraint for Curtin itself.

Whether this result would be true every time the physical collection of a university library in a developing country is compared to a university library in a developed country is only a point of speculation at this juncture. Only more time series surveys comparing many libraries in developed and developing counties could bring about an affirmation of this speculation. This study established that some of the contributory factors to the difference in the trends in results included different funding capabilities and differences in the cataloguing processes between Curtin University and the University of Malawi.

Discussion of results: Trends in the electronic resources

Two types of electronic resources were explored in this study: free Internet resources and commercial electronic resources to which the institutions subscribed. There were no significant differences in terms of the capability of Curtin University (8% of items searched) and University of Malawi (10% of items searched) to deliver free Internet resources suggesting the current potential of the Internet to level the information playing field is limited. Indeed these success rates for the two universities suggest that there is a low probability that high impact items can be accessed from the Internet for free whether in Australia or Malawi. That is, whether in a developed or developing country there is a low probability that the high impact journal articles can be accessed freely from the Internet.

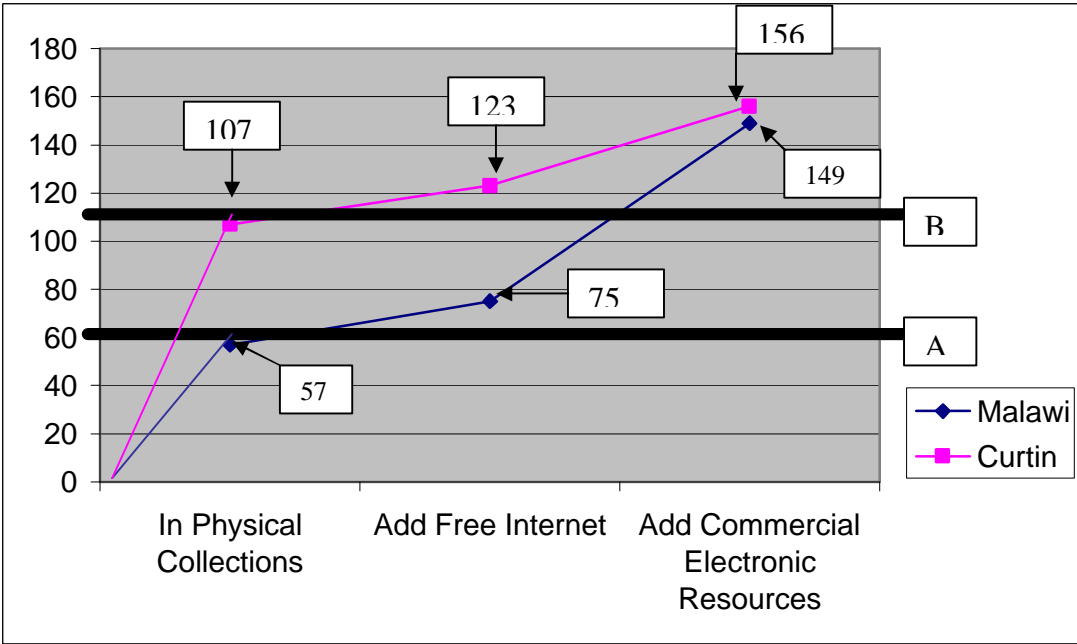
With respect to commercial electronic resources, the results show a significant improvement for the University of Malawi (30% of sample items searched) as compared to Curtin University, which registered only 17% of the sample items searched although it is acknowledged that not all the available commercial electronic resources were utilised. The overall picture that emerges suggests that electronic resources - that is, sample items obtained freely from the Internet and sample items that were accessed from commercial electronic resources - have the potential of improving the limits imposed on the physical collections at the University of Malawi. The results suggest that electronic resources have the potential of promoting teaching and research at the University of Malawi and in reducing the gap in access to scholarly information between developed and developing countries in situations where telecommunication systems are well developed and Internet connectivity has a relatively high speed. It is only those with better technology to support the Internet that would benefit immensely from such resources. Inevitably this has implications on financing such activities since it means investing in the much-needed electronic infrastructure to support information access, storage and delivery. It should be noted that suitable access to electronic resources is not necessarily cheaper than the compiling of large physical collections.

Continuous Growth Model and Electronic Resources Results

The results achieved for the retrieval of electronic resources at both Curtin University and the University of Malawi supports the results indicated by the Continuous Growth

Model, which has been adapted for this study from Hawkins. The key arguments were, firstly, in the Continuous Growth Model environment, the claim on the resource (i.e. on the information items), would not be restrained by the point of constraint imposed by the physical collections. Secondly, that once the libraries included electronic resources the difference between them would begin to narrow towards a state where in the ideal electronic environment there would be no difference in the performance of the libraries. A graphic representation of the cumulative results for both universities demonstrates this pattern as shown in figure 11 below.

Figure 11: Cumulative results and continuous growth model



In Figure 11, the free Internet resources and the commercial electronic resources have enabled both libraries to breakthrough the point of constraint for the physical collections represented by line A for Malawi and line B for Curtin University. However it should be noted that the time factor shown in the Continuous Growth Model in the Theoretical Model of this study has not been reflected in Figure 11. While as the Y axis of the graph represents the number of cumulative sample items found, the X-axis represents the source where the sample items were located during the study. X-

axis does not represent the time because this was not a time series survey. The electronic results at both Curtin University and University of Malawi still validate the suggestions made in the Theoretical Model because the emphasis is on the impact of electronic resources on limited physical collections and not what happens over a particular period of time.

Conclusion

In conclusion the results have demonstrated that both Curtin University and the University of Malawi were limited in supplying the sample items from their physical collections. This suggests that no library can be self-sufficient whether in a developing country or in a developed country. The difference in capacity for the physical collection of Curtin University and the University of Malawi seems to confirm the fear that because of poor funding to university libraries in developing countries; the physical collections will be poor as far as access to up to date high impact scholarly resources is concerned. The results have also suggested that the introduction of the electronic resources at the University of Malawi would if well utilized and supported with a good infrastructure improve access to these high impact scholarly resources, and thereby improve teaching and research. The trend in the results has also suggested that the virtual resources can enable disadvantaged libraries to narrow the gap.

This study is of the view that the formation of the Malawi Library Consortium (MALICO) and the ICT programmes that this consortium is putting in place for libraries in Malawi will foster the continued emergence of virtual library services. MALICO is setting a new standard for libraries in Malawi as far as access to, and utilisation of, electronic resources are concerned. The introduction of V-SATs and fibre optic networks in the Universities of Malawi through MALICO and its continued partnership with INASP and EIFL and other programmes, will go a long way towards solving the current telecommunications infrastructure problems being faced by Internet users at the University of Malawi.

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