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Using ICT for rural development

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About the journal

The International Journal of Education and Development using Information and Communication Technology (IJEDICT) is an e-journal that provides free and open access to all of its content.

Regional economies and communities are facing increasing economic, social and cultural hardship in many parts of the world as economies adjust to the demands of the new orders of commerce and governance. A part of this is the paradox that regional economies and communities can be either enhanced or disadvantaged by information and communication technologies (ICT) products and services. The potential enhancement comes from the increased social, economic and cultural capital that comes from harnessing ICT products and services in a community sense. The disadvantage comes from the power that ICT products and services have in centralizing commerce, service provision and governance away from the regional community.

Unless we get a greater level of access AND adoption of information and communication technology (ICT) for education and development at community level, we will miss the opportunity to turn the "digital divide into a digital opportunity for all, particularly for those who risk being left behind and being further marginalised" ("Declaration of Principles", WSIS-03/Geneva/Doc/4-E, Principle 10). The International Journal of Education and Development using Information and Communication Technology (IJEDICT) is an e-journal, with free and open access, that seeks to address this issue.

IJEDICT aims to strengthen links between research and practice in ICT in education and development in hitherto less developed parts of the world, e.g., developing countries (especially small states), and rural and remote regions of developed countries. The emphasis is on providing a space for researchers, practitioners and theoreticians to jointly explore ideas using an eclectic mix of research methods and disciplines. It brings together research, action research and case studies in order to assist in the transfer of best practice, the development of policy and the creation of theory. Thus, IJEDICT is of interest to a wide-ranging audience of researchers, policy-makers, practitioners, government officers and other professionals involved in education or development in communities throughout the world.

Coverage

IJEDICT has a major emphasis on the use of ICT in education and development in hitherto less developed parts of the world. The journal includes descriptive case studies about ICT projects in developing countries and in rural and remote regions of developed countries, as well research articles evaluating such projects, developing policy or creating theory. Topics covered include, but are not limited to, the following areas:

Community informatics and development in remote, rural and regional areas;
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E-Commerce and Business in remote, rural and regional areas;
ICT for micro, small and medium enterprises;
ICT in local governance;
E-Democracy;
ICT and social marketing;
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IJEDICT comprises the following sections: "research articles" (academic, peer-reviewed articles); "studies from the field" (edited but not peer reviewed case studies); “research in progress”; “literature reviews”; "project sheets" (brief descriptions of relevant projects); "notes from the field" (working papers, and other commentaries on relevant topics); "book/media review" (software and other media reviews).

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Editorial

This section contains the editorial written by the editors for the specific issue.

Refereed Articles

This section contains articles that have been reviewed by at least two academic peers in a process that ensures that authors and reviewers remain unknown to one another. To be included in this section, articles must be based on research and scholarship, and contribute "new" and significant knowledge to the field of ICT for education and/or development. Reviewers for research articles are selected from the Editorial Board, the Review Board and the Peer Review Panel.

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This section includes peer-commented and editorially reviewed case studies (2000-5000 words) of the use of ICT in education and/or development.

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This section includes peer-commented and editorially reviewed articles describing research in progress.

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This section includes peer-commented and editorially reviewed articles that review the literature of the use of ICT in education and/or development.

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This section includes brief descriptions (500-1000 words) of education and development projects that utilise ICT.

Notes from the Field

This section contains short comments or notes that are useful for practitioners working in the field of ICT in education and/or development.

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This section contains editorially reviewed reviews of books that are relevant to the use of ICT in education and/or development.

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Registration and login are required to submit items online and to check the status of current submissions.

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- Submissions are invited for all sections of this journal. Refereed articles should be between 3,500 and 6000 words in length. Project descriptions for the "Project Sheets" section should be between 500-1000 words in length. Submissions for other sections of the journal can be any length.
- Submissions can be in Microsoft Word, Rich Text Format (RTF), equivalent Open Source document file format, or HTML format.
- Please use Arial 12-point font for the Title, which should be in bold "title" (upper and lower) case.
- Use Arial 10-point font for the remainder of your article.
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- Second level headings should be in bold "title" (upper and lower) case.
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Please supply a short (100 word) biography for each author. This should include the name, rank, institution, institutional address, and email address. Do not place the biography in your submission file but copy it into the appropriate text box during the on-line submission process.

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Submitted manuscripts must be written in the Harvard editorial style:

- References should relate only to material cited within the manuscript and be listed in alphabetical order, including the author's name, complete title of the cited work, title of the source, volume, issue, year of publication, and pages cited. See the following examples:

  Marshall, S. (1991), "A genre-based approach to the teaching of report-writing". English for Specific Purposes, vol. 10, no.1, pp. 3-13.

  Taylor, W. & Marshall, S. (2002), "Collaboration: the Key to Establishing Community Networks in Regional Australia", Informing Science, vol. 5, pp. 155-162.

  Marshall, S., Taylor, W., & Yu, X. (eds.) (2003), Closing the Digital Divide: Transforming Regional Economies and Communities with Information Technology, Greenwood Publishing, Westport CT.

- Citations in the text should include the author's name and year of publication where you use the source in the text, as in the following examples:

  In this way, information technology can be seen to effect and influence changes in organisational structure (Orlikowski & Robey 1991).

  Edwards (1995, p.250) views the globalising of distance education as "invested with the uniform cultural messages of modernity".

  Globalisation, especially in relation to open and distance education, will reduce the tolerance of difference and so "how can local issues and contexts be addressed?" (Evans 1995, p.314).

- Further information about the Harvard editorial style can be found at:

  http://lisweb.curtin.edu.au/referencing/harvard.html
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Table of Contents

editorial

refereed articles

from the field

research in progress

International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2007, Vol. 3, Issue 2, pp. 2-3.

Editorial: Using ICT to transform education

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Welcome to Volume 3 Issue 2 of the International Journal of Education and Development using Information and Communication Technology (IJEDICT). This issue contains articles concerned with using information and communication technologies (ICT) for rural empowerment. It brings articles from and/or about Pakistan, India, Ghana, Nigeria, Tanzania, Uganda, Malaysia, New Zealand and Australia.

In the article “Study of diffusion and adoption of Male Annihilation Technique”, Zaheeruddin Mirani describes the “Male Annihilation Technique” (MAT) - an economical, non-polluting, non-hazardous, environment friendly, less laborious technology to control the fruit fly. Despite all these advantages offered by MAT, it has failed to reach the maximum level of adoption among the growers of Pakistan particularly of Sindh province. The article describes research that identified barriers in the rate of adoption of MAT and also identified the information sources that have created trust among farmers resulting in the dissemination of MAT on a larger scale.

In the same country, the article by Kashif Sattar - “A sustainable model for use of ICTs in rural Pakistan” - proposes an ICT-Training Centre consisting of a network of Rural Kiosk Machines placed at every village, updated by the ICT-Rural Development Department. The author contends that by using this model, a major proportion of the population can play an important role in the development of this country.

Mrinalini Shah discusses the position of India in the e-governance environment and issues and challenges ahead. In the article “E-Governance in India: Dream or reality?” the author describes how e-governance can be attained in four steps: Information or Cataloguing, Transaction, Vertical Integration & horizontal integration. The author outlines various barriers, including geographical, social, and economical disparities, which are the biggest barriers for full-fledged e-governance.

Olivia Kwapong discusses the logic of designing a disaggregated ICT policy in her article “Problems of policy formulation and implementation: The case of ICT use in rural women’s empowerment in Ghana”. The basic hypothesis in the study was that the wide differences in the socio-economic status of rural women households’ influences their choice of information delivery technology and also their willingness to pay for a selected technology. The results point to a merit in allocating considerable authority to regional and local authorities in setting priorities and approaches to empowering rural women through the use of ICT.

In their article, Adesope, Asiabaka and Agumagu examine the “Effect of personal characteristics of extension managers and supervisors on information technology needs in the Niger Delta area of Nigeria”. Their findings revealed that number of associations belonged to, educational qualification, training, category of organization were the personal characteristics that significantly influenced information technologies needed by extension managers and supervisors. On the basis of their findings, the authors make various recommendations regarding the training of extension managers and supervisors.

Using examples from Tanzania, Sife, Lwoga and Sanga discuss “New technologies for teaching and learning: Challenges for higher learning institutions in developing countries”. The article discusses new learning and training technologies, considering their pedagogical, cost and technical implications. It also discusses challenges for integrating these technologies in higher learning institutions, and giving best practice approaches for addressing each of the challenges.

In “Challenges and opportunities in ICT educational development: A Ugandan case study”, Ryan Wells and Susan Wells examine an organization which is partnering to provide ICT solutions for secondary schools in Uganda. Based on interviews and observation, they identify nine key transitions in this organization’s development. This study intends to contribute to the dialogue concerning ICT, education, and development and aims to expose some ways to build bridges across the digital divide.

In “Academic computing at Malaysian colleges”, Mokhtar, Alias and Rahman address three research questions: What are the indicators for assessing academic computing? What are the general characteristics of academic computing at different levels of performance? What is the general performance of academic computing at colleges in Malaysia? The authors conducted an academic computing survey involving 62 public and private colleges in Malaysia. The findings of this study showed that performances varied between areas and between colleges in Malaysia.

Mary Allan, in her article “Millennial teachers: Student teachers as users of Information and Communication - A New Zealand case study” argues that personal usage of ICT within student teachers own learning will form their models of teaching practices. This paper draws on a survey conducted in 2005 at a teachers’ education college in New Zealand. The findings provide a snapshot into the current situation of teachers’ education in relation to the use of Internet technology and online learning systems and have implication for teachers’ education in the new millennium.

In “Engagement Theory, WebCT, and academic writing in Australia”, Simone Marshall describes a case study in which a popular learning management system, WebCT, is used in an academic writing course at the University of Sydney, Australia. The study highlights both the benefits and difficulties of using technology when teaching academic writing and shows how effective Engagement Theory has been in the design, implementation, and outcomes of the website associated with the course.

The emphasis in IJEDICT is on providing a space for researchers, practitioners and theoreticians to jointly explore ideas using an eclectic mix of research methods and disciplines, and we welcome feedback and suggestions as to how the journal can better serve this community.

Stewart Marshall and Wal Taylor
Chief Editors, IJEDICT

Original article at: http://ijedict.dec.uwi.edu//viewarticle.php?id=373&layout=html

International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2007, Vol. 3, Issue 2, pp. 4-15.

Effect of personal characteristics of extension managers and supervisors on information technology needs in the Niger Delta area of Nigeria

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ABSTRACT

This paper examines the effect of personal characteristics of Extension managers and supervisors on their information technology needs in the Niger delta area of Nigeria. Data collection was with the aid of a structured questionnaire administered to 87 respondents in the study area. The z-test result showed that there is no significant difference in the Information Technology needs of both categories of respondents. Findings also revealed that number of associations belonged to, educational qualification, training, category of organization were the personal characteristics that significantly influenced information technologies needed by extension managers and supervisors. It is therefore recommended that training in various areas of Information Technology such as use of Internet, sending and receiving e-mails, surfing the web, using chat rooms, and newsgroups, should be enforced to further enhance the performance of extension managers in the discharge of their duties. This is to make the recipients ready to meet challenges in the contemporary global network of Information Technology. Extension Managers and Supervisors should be encouraged to belong to Professional Associations in their various disciplines. This should be made compulsory and possibly a condition for promotions so that it can be adhered to. Allowances should however be made available and regularly too, for such activities. Extension Managers and Supervisors should be given available opportunity to use and apply Information Technologies regularly. This will expose them significantly and encourage a fuse into the global community.

Key words: *Extension managers, supervisors, information technology needed*

INTRODUCTION

Information is a necessary component of agricultural extension. Olowu and Yahaya (1998) observed that over the years, agricultural information experts have been trying to develop some framework or methodology upon which to effectively and precisely predict and analyze information needs. Agricultural extension organizations in Nigeria employ agents that will help to hasten the communication of information needs of farmers identified by Olowu and Yahaya (1998). The information needs arise in the technical, marketing, social and legal information areas. These are mostly delivered through various media such as television, radio, newspaper, bulletin, and pamphlets. But the limitations of these media in actually improving extension work are many. This incorporates the use of computers and other electronic equipments for efficient communication of agricultural information. These technologies apply scientific information to the end-users need.

Information has been identified as one of the resources required for the improvement of agricultural production (Aina, 1995). It is said to be a resource that must be acquired and used in order to make an informed decision. Those who possess appropriate and timely information will make a more rational decision than those without. The various agricultural information users populations can be categorized as policy makers and planners; researchers; extension staff; educators and students; agro-based industries and services staff; and farmers. It was also observed that each of the sectors mentioned above contribute directly to the improvement of agriculture hence relevant information provided to each category of these user populations will contribute positively to the development of agriculture in Africa. Information is the potential ingredient for the advancement of agriculture. Without information the agricultural sector may degenerate into extinction. Information provides the basis for scientific innovations in agriculture. Agricultural information has been defined as all published or unpublished knowledge on all aspects of agriculture.

The advent of the computer gave a new direction to the information and communication technology industry. This is evident in the use of technologies such as electronic mail (e-mail), electronic commerce (e-commerce) and more recently mobile phone, which Salihu (2000) referred to as *Palm assistant,* because of its palm-size nature. According to Kerrigan, Lindsey and Novak (1994) communication technologies such as electronic mail (e-mail) and electronic conferencing provide scientists, administrators and information staff with rapid and reliable communication, while increasing productivity and decreasing communication costs by reducing the physical means of communication channels. These are some of the benefits of information technology. In the same vein, while discussing information technology as a transfer, Metcalfe and Gilmore (1990) observed that because of the remarkable pace of development within the short time that computers were introduced information technology now impinges upon virtually every aspect of society; and has developed dramatically. Information technology can be described as computer-related mechanisms through which information is obtained and shared with relevant users. Metcalfe and Gilmore (1990) listed Compact Disk - Read Only Memory (CD-ROM), local databases, electronic publishing and the expert systems as useful information technologies.

In recent years there has been much discussions about the appropriate role of the agricultural extension service (Nitsch, 1982). These discussions reflect drastic changes that have occurred during the last few decades in agricultural production and in the characteristics of rural communities. Rural communities according to Mchombu (1992) have two information systems, which have become uncoupled, the indigenous knowledge system and the external knowledge system. It was stated that both are closely knit. The provision of information to rural communities is a responsibility fragmented among several government ministries, non-governmental agencies and parastatals. These agencies have helped to provide valuable information to the end-users.

Originally, agricultural extension service was conceived in Europe at a time when agriculture was the mainstay of the economy. In Nigeria agriculture was the main source of revenue generation and a sustained means of livelihood in the pre-oil boom era. Nitsch (1982) observed that Extension which was widely conceived as an information-delivery based structure was at the fore of channeling the proper agricultural information to farmers who remain the major stakeholders in the agricultural development process. Under the conditions prevailing when extension was initiated it could be assumed that new technology was relevant and applicable for most farmers. It could be expected that once a farmer had adopted a new farm practice, others would learn about the new practice and soon the information diffuses to the majority of farmers in the community. As farmers usually had little exposure to technical information through mass media, it was natural for the agricultural extension service to take as its primary role the function of a linkage “between the producers of technology and the end-users of these innovations” to promote economic efficiency in farming (Rogers, Eveland and Bean, 1976).

Allmand, Balantyne and Ngwira (2001) observed that in this new millennium the information world faces an era of great changes, which influence directly the way scientific information is produced, processed by intermediaries, distributed and accessed. They noted that information and communication technology and especially the internet have made a huge impact. It was therefore stated that information services, traditionally responsible for managing this information, are passing through a process of change. Meera, Jhamtani and Rao (2004) noted that a new paradigm of agricultural development is fast emerging. It was noted that old ways of delivering important services to citizens are being challenged; and traditional societies are being transformed into knowledge societies all over the world.

Meera et al (2004) stated that agricultural extension has to escape from the narrow mindset of transferring technology packages to transferring knowledge or information packages. If this can be achieved, with the help of Information and Communication Technology, extension will become more diversified, more knowledge-intensive, and more demand driven, and thus more effective in meeting farmers' information needs. Apart from the conventional Audio-visual Aids (AVAs) used by agricultural extension personnel in Nigeria modern information technologies have not been fully utilized in the discharge of their job functions.

For agricultural extension in Nigeria to be effective, extension personnel, especially managers and supervisors must acquire the requisite knowledge and skills necessary for using modern information technologies. Supervisors and Managers are highly indispensable to the extension programme because as Madukwe (1993) observed the extension supervisor is the link between top and middle level extension administrators and farmer-contact extension agents. In this wise the success of the extension agents and indeed the entire extension service depends partly on the effectiveness of the extension supervisors (Igben and Nwosu 1987; Madukwe 1990). The position of supervisors in the extension service is so strategic that they are in constant touch with the management and thus will be useful to the lower level officers for decisions concerning them.

The extension personnel at the managerial level and or supervisory levels do not have direct, personal or skin-to-skin contact with farmers but their decisions make extension work to progress in the right path. Since managers and supervisors are indispensable they should be conversant with the information technology dynamics for the benefit of agricultural extension service. The communication of agricultural information can only be meaningful if the extension personnel at this level of management actually know how to use the complex information technologies (both hardware and software), and also to know when the information technology would be useful in discharging their duties adequately.

The world today is going electronic and electronic communication has many advantages over the traditional and conventional methods of using paper-based materials. A larger volume of information can be handled with the aid of information technology (which is electronic based), and it is faster and more efficient. Inter-organizational communication can be made reliably possible with the electronic information technology, which overcomes the limitations of distance barrier. However, in Nigeria the information technology approach is gradually spreading and obviously will take time to be fully integrated into the agricultural systems. The question that readily comes to mind in this regard is: are the areas of needs concerning the Information Technologies in extension? What are the types of information technologies needed by extension Managers and supervisors? The specific objectives of the study are to: identify the Information Technology needs of agricultural extension managers and supervisors in selected organizations in the study area; the study further determines whether there is a significant difference in Information Technology needs of private and public extension managers and supervisors. Also, the study determines whether there is any significant relationship between socio-demographic characteristics of respondents and their Information Technology needs

METHODOLOGY

The study area is the Niger Delta area of Nigeria which is made up of nine states comprising Rivers, Bayelsa, Imo Abia, Delta, Edo, Akwa Ibom, cross river and Ondo states. The target population Comprised agricultural extension managers and supervisors in extension based organizations in the study area. The extension-based organization was stratified into private and public. The public organization chosen for the study was primarily Agricultural Development Programme (ADP) while the private organization chosen was the multinational organizations which include the Green River Project (GRP) of Nigerian Agip Oil Company (NAOC) and the Agricultural Programme of Shell Petroleum Development Company (SPDC). The ADP was chosen because it is the main government organization responsible for extension work while the two multinationals were the most significant private extension – organization in the area.

Out of the 9 states that make up the Niger Delta region, 7 were involved in the study namely Imo, Rivers, Bayelsa, Delta, Edo, Ondo and Cross River. A purposive sampling technique was used to select respondents involved in the study. Only management level staff were involved to include directors, and their deputies, zonal managers, supervisors, extension Advisers and coordinators. Seventy five Extension Managers/Supervisors were identified in the public organizations but 60 participated in the study. On the other hand 32 Extensions managers/supervisors were identified in the private organization while 27, participated in the study. On the whole 87 respondents were involved in the study. The instrument used for data collection was a structured questionnaire which contained information on socio- personal characteristics, adequate access to information technology, attitude towards Information Technology. The instrument was tested for reliability and a reliability coefficient of 0.72 was obtained using a split-half method. Data analysis was by frequency, percentage, mean, z-test and Tobit regression.

Dependent variable: Information Technology Needs

Seventeen Information Technology (IT) types were listed and respondents identified the types needed. The IT types needed were measured based on a Yes or No response but each of the IT type was taken as a proportion of the total IT needed. In essence each information technology needed was summed up over the total number of information technology needed to give a fraction. This fraction was then used for analysis. The fraction was the dependent variable which means that the dependent variable, *Information Technology Need* cannot take on values below zero.

Independent variables

The independent variable include Socio-demographic characteristics of Extension Managers and supervisors, which are working experience, marital status, gender, age, educational qualification, field of specialization, knowledge of Information Technology. Both open and closed ended questions were used in obtaining the required information.

Model Specification

Z statistic was employed in testing differences in Information Technology Needs of Public and Private Agricultural extension Managers/Supervisors. The mathematical expression of Z-test is given as

$$Z_1 = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

where:

Z_1 = the value by which the statistical significance of the mean difference of the pair of variables is adjudged

X_1 = mean number of respondents in private Extension organization who need Information Technologies

X_2 = mean number of respondents in public Extension organization who need Information Technologies

S_1^2 = variance from the mean value of sample 1

S_2^2 = variance from the mean value of sample 2

n_1 = frequency of respondents in private extension organization

n_2 = frequency of respondents in public extension organization

The Tobit regression model was used to determine whether there is any significant relationship between socio-demographic characteristics of Extension Managers and Supervisors and their Information Technology Needs.

Information Technology Need was measured as a proportion of total Information Technologies Needed. This suggests that the proportion of Information Technology needed cannot take a value below zero, which means that the dependent variable, *Information Technology Need* has a truncated normal distribution, and the Tobit model is appropriate for this. The Tobit model combines the properties of multiple regression and probit/logit model (Rahji, 2000). It indicates the decision of whether or not Information Technology is needed, and also considers the intensity of need.

Adopting the notation of McDonald and Moffitt (1980), Shapiro, Brorsen and Doster (1992), Gujarati (1995) and Rahji (2000), the Tobit model is given as

$$\begin{aligned} Y_i &= X_i\beta + \mu \text{ if } X_i\beta + \mu > Y_0 \\ Y_i &= 0 \quad \text{if } X_i\beta + \mu \leq Y_0 \qquad (1) \\ i &= 1, 2, 3 \ldots, N \end{aligned}$$

where

Y_i is the probability of Information Technology Needed/Intensity of Information Technology Needed

X_i is a vector of explanatory variables

β is a vector of parameters

μ is the error term μ N $(0, \sigma^2)$

Y_i is continuous if $Y^*_i \geq Y_0$

$Y_i = 0$ if $Y^*_i \leq Y_0$

Y_0 is the non-observable threshold level

The total change in Y associated with a change in Xi can be decomposed into the change in the probability of Y being above zero and the change in the value of Y if it is above zero. This corresponds to the choice of whether or not Information Technology is needed and the proportion needed by extension Managers and Supervisors.

In calculating change in probability of Information Technology Needed, the notation is given as:

$$\frac{\partial F(Z)}{\partial Xi} = \frac{f(z)}{\beta i/\delta} \quad \ldots\ldots\ldots\ldots \quad (2)$$

In calculating change in intensity of Information Technology needed the notation is given as:

$$\frac{\partial F(Y^a)}{\partial Xi} = \frac{\beta i(1-zf(z)}{F(Z)} - \frac{f(z)^2}{F(Z)^2} \quad \ldots\ldots\ldots \quad (3)$$

In calculating total change or marginal effect of the explanatory variable on the expected value of the dependent variable, the notation is given as:

$$\frac{\partial E(Y)}{\partial Xi} = F(z)\beta i \quad \ldots\ldots\ldots\ldots \quad (4)$$

RESULTS AND DISCUSSION

Personal characteristics of respondents

Table 1 shows that majority of the respondents had working experience ranging from 5 to 15 years with a mean working experience of 15.52years. Most respondents were married, and were male. It was also found that majority of the respondents were between 40 and 45 years old, with mean age of 42.4 years. It was found that most respondents had an MSc degree.

Also, 62.10% of the respondents indicated that they have adequate access to information Technology, while 37.90% indicated that they do not. About 98 percent of the respondents agreed that they were aware about information technologies, while 2.3 percent were not. This means that most of the respondents were aware of information technologies especially as they concern Agricultural Extension work.

Table 1: *Personal characteristics of respondents*

Personal characteristics	Frequency	Percentage	
Working experience			
5 – 15years	56	64.37	
16 –25years	25	28.74	mean = 15.52 years
26 –35years	6	6.89	
Marital status			
Unmarried	8	9.20	
Married	78	89.70	
Widowed	1	1.10	
Gender			
Male	77	88.50	
Female	10	11.50	
Age			
Less than 40years	16	18.40	
40 –45 years	28	32.20	
46 – 50years	24	27.60	mean =42.40years
51 – 55years	14	16.10	
56 – 60years	5	5.70	
Academic qualification			
BSc	36	41.40	
MSc	43	49.40	
PhD	4	4.60	
Others (MPhil, PGD, HND)	4	4.60	
Knowledge of information technology			
Yes	85	97.7	
No	2	3.3	
Adequate access			
Yes	54	62.10	
No	33	37.90	

Types of Information Technologies needed

Table 2 shows that 98.9 percent of the respondents needed mobile phone for extension work, 81.6 percent needed E-mail, 64.4 percent needed worldwide web, 62.1 percent needed computer word processing, 54 percent needed data management with computer, 42.5 percent needed facsimile (Fax) and video conferencing, 32.2 percent needed desktop publishing and downloading vital information from the internet 28.7 percent of the respondents needed downloading software.

The findings suggest that respondents needed Information Technologies like mobile phone, E-mail, worldwide web, computer word processing, which are the commonest types of Information Technologies. Onaes (2003) observed that because of the speed with which activities need to be done, the e-mail continues to serve its clients to the fullest.

Table 2: *Distribution of respondents according to types of Information Technologies needed*

Types	Frequency*	Percentage
Mobile Phone	86	98.9
E-mail	71	81.6
Worldwide web (www)	56	64.4
Data generation from CD	23	26.4
E-library	21	24.1
Chat room	10	11.5
Newsgroups/Usenet	13	14.9
E-magazine	21	24.1
Computer word processing	54	62.1
Video conference	57	42.5
Facsimile	37	42.5
Data management with computer	47	54.0
Downloading software	25	28.7
Downloading vital info from internet	28	32.2
Desktop publishing	28	32.2
E-conference	15	17.2
E-workshop	14	16.1

Source: Field Survey data, 2003
**Multiple responses recorded*

Differences in Information Technology Needs of Public and Private Agricultural extension Managers/Supervisors

The z-test result as shown in Table 3 reveals that there is no significant difference in the Information Technology needs of both categories of respondents. The implication of this is that Private Extension Managers and Supervisors need Information Technology just as their Public counterparts. This further implies that both categories of Extension personnel appreciate the importance of Information Technology for agricultural development process in their respective organizations.

Table 3: *Analysis of differences in Information Technology needs between Private and Public Extension Managers and supervisors*

Category	N	Mean	df	SD	z-value
Private Public	27 60	26.5 0.379	85	4.73 3.79	0.958^{NS}

Source: Field survey data, 2003
NS = z-value Not significant at 0.05 level

Relationship between socio-demographic characteristics of Extension Managers/ supervisors and their Information Technology Needs

Table 4 is the Estimated Tobit model for the relationship between selected socio-demographic characteristics of respondents and Information Technology Needs. The result showed that number of associations belonged to, significantly influenced information technology needed by Extension managers and supervisors. The relationship is positive at 0.05 level. The implication of this is that the higher the number of associations belonged to, the more the information technologies needed and vice versa. This suggests that belonging to more associations enhances interaction with others and therefore more exposure to the use of IT. Adetunji , Oladeji and Olowu (2002) while supporting the establishment of professional association opined that this will increase mutual scientific collaboration and also academic interaction.

Educational qualification showed significant but negative relationship with information technology needed. This implies that the higher the educational qualification the less the information technologies needed and the lower the educational qualification the more the information technologies needed. It is possible that respondents with higher qualifications may have too many responsibilities to grapple with, hence may not have the time to appreciate more need for Information technologies. Training also showed significant and positive relationship with information technologies needed. This suggests that training in Information Technology has positive influence on Information Technologies needed by respondents. Among the benefits of training, Asiabaka (2002) noted that it helps to reduce the time it takes extension workers to reach acceptable levels of performance in their jobs. Category of organization (that is Private or Public) showed significant and positive relationship with information technologies needed. This implies that Extension managers and supervisors in one of the categories of organizations need more information technologies than the other. This is more applicable to the Private Extension organizations since information technology use is more functional than in the Public extension organization.

Table 4: *Estimated Tobit model showing relationship between information technology needs and socio-demographic characteristics*

Variables	Coefficient	Marginal effect (total change)	Change in prob-ability	Change in intensity
Marital	0.7217	0.007	0.0156	0.007
Gender	0.2059	0.020	0.00456	0.021
Numbassoc	0.4671*	0.0460	0.0100	0.0473
Qualification	-0.5553*	-0.0553	-0.0070	-0.0563
Training	0.5692*	0.0569	0.0123	0.0577
Knowledge	-0.1632	-0.002	-0.00034	-0.001
Adequate Access	0.1492	0.015	0.00325	0.015
Specialization	-0.2223	-0.057	-0.0123	-0.058
Age	-0.5102	-0.056	-0.01	-0.047
Category	0.4305*	0.0431	0.00932	0.0436

Source: Field survey data, 2003
** Significant at 0.05 level*

From Table 4, the Tobit model showed that a percentage increase in the number of associations belonged to, by Extension Managers and Supervisors leads to about 4.6% increase in Information Technology needed. This is decomposed into about 1% increase in probability of Information needed, and a 4.7% increase in intensity of Information Technology needed. The implication of this is that as the Extension Manager/Supervisor gets interacted with other members of the professional association, there is the likelihood of his being exposed to more information technologies which will to a great extent improve his skills and knowledge in Information Technology usage. This will eventually influence the need for Information technologies.

The effect of educational qualification on Information Technologies needed is more on the intensity of need. With a one percent increase (change) in educational qualification, Information Technology need decreased by 5.5%. This gave about 0.7% decrease in probability of Information Technology needed and about 5.6% decrease (change) in intensity of need. This suggests that as the respondent gets a higher educational qualification, he may not need more than what he already has concerning Information Technology because he may have acquired more before attaining that level over the years.

A one percent change in training received by respondent leads to 5.7% increase in Information Technology needed. This translates to about 1.23% increase in probability of Information Technology needed, and about 5.8% increase in intensity of Information Technology needed. This implication of this finding is that training in Information Technology increases the need for Information Technology. This is expected since the respondent may be curious to explore other areas that will further enhance his skill in Information Technology and ultimately his job function.

A percentage increase in Category of Extension organization belonged to by respondent however, increased Information Technology needed by 4.3%. This gives only 0.932% increase in probability of Information Technology needed, and a 4.4% increase in the intensity of Information Technology needed. This finding suggests that the category of Extension organization belonged to, influence the need for Information Technology. The Private organizations provide more functional facilities for Information Technology than the Public organizations so this will increase their need for Information Technology, especially as they have been very actively involved in agricultural extension services.

CONCLUSION AND RECOMMENDATIONS

Information Technologies are relevant to Extension Managers and Supervisors in the present era of global networking. This is of greater importance to them especially in information management and processing. This study has revealed that Extension Managers and Supervisors need Information Technologies for effective discharge of their managerial and supervisory functions. This is what will make their extension function complete and also more useful and viable. The study concludes that Information technology characteristics like training, awareness are prerequisites for sustainable extension delivery. It is opined that the information technology types to be available to Extension Managers and Supervisors should as much as possible be user driven for better adaptability to Information Technology applications.

Based on the findings of the study, the following recommendations are made:

1. Training in various areas of Information Technology should be enforced to further enhance the performance of extension managers in the discharge of their duties. The training should specifically be in the use of Internet, sending and receiving e-mails, surfing the web, using

chat rooms, newsgroups. This is to make the recipients ready to meet challenges in the contemporary global network of Information Technology.

2. Government through the Ministry of Science and Technology, and also the National Agency for Information Technology Development should as a matter of policy ensure that an adequate structure is put in place for Information Technology usage in the various Agricultural extension organizations. However, the authorities of the Non-Government organizations should liaise with the same establishments to provide similar structures where they are lacking or inadequate.
3. Extension Managers and Supervisors should be encouraged to belong to Professional Associations in their various disciplines. This should be made compulsory and possibly a condition for promotions so that it can be adhered to. Allowances should however be made available and regularly too, for such activities.
4. Extension Managers and Supervisors should be given available opportunity to use and apply Information Technologies regularly. This will expose them significantly and encourage a fuse into the global community.
5. There is need to make available The Essential Electronic Agricultural Library (TEEAL) as a means of getting adequate access to agricultural information by Extension Mangers and Supervisors in both private and public extension organizations.

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Millennial teachers: Student teachers as users of Information and Communication - A New Zealand case study

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ABSTRACT

Based on Brown and Duguid (1991) notion of interrelatedness of learning and work practices in which learners acquire "embodied ability to behave" in a certain manner, the paper argues that personal usage of ICT within student teachers own learning will form their models of teaching practices. This paper draws on a survey conducted in 2005 at a teachers' education college in New Zealand. The aim of the survey was to examine the ways in which students are using Web-based learning technology in their initial training period. Findings of the survey reveal insights into the perceptions of students for the use of ICT in their own studies. The findings provide a snapshot into the current situation of teachers' education in relation to the use of Internet technology and online learning systems. The findings have implication for teachers' education in the new millennium.

Keywords: *Teachers' Training; ICT; Education; New Zealand*

INTRODUCTION

A meta-survey on the use of technology in education claims that the development of the use of ICT in the New Zealand education system is largely reliant on the ability and skills of the teachers(Prebble, 2003). Since 1998 successive New Zealand governments have facilitated ICT training and support for teachers, providing a variety of professional development programmes, such as for example the ICT- PD Clusters (Prebble, 2003). However, initial teachers' training programmes seem to lack a specified provision for ICT training. The New Zealand ministry of Education has no specific requirements for the provision of ICT modules in teachers' training programmes, and there are increasing expectations of the personal competence and ICT related pedagogical knowledge from the beginning teachers(Mawson, 2003). This situation creates some difficulties in establishing the ability of New Zealand's future teachers to incorporate the use ICT in their classrooms.

Building on Brown and Duguid's(1991) argument that "practice is central to understanding work"(1991,p.40), and that "The development of technological skill improves students' capacity to absorb technology"(Kozma, 2005; OECD, 1999), the paper argues that developing and implementing ICT skills while being in training will define the student teachers future ICT practices as qualified teachers. The paper investigates the student teachers approach and application of ICT in their own learning as a projection of their approach and implementation of ICT in their future classrooms. The paper will focus on two of the key ICT issues identified by the New Zealand government and published in the ICT in schools strategy document titled "Digital Horizons"(Minedu, 2003):

1. Implementing a wider range of teaching and learning strategies, implying the use of the techno-constructivist paradigm aligned with the skills needed for participating in the information society
2. Effective administration and communication with the surrounding community

BACKGROUND AND CONTEXT

The paper builds on a survey administered at a teachers' college in New Zealand's South Island. The specific institution was chosen for two main reasons:

- Pedagogic underpinning of ICT infrastructure
- The model of ICT implementation

Pedagogic underpinning of ICT infrastructure

Since September 2001 the college has been using an open source computer network system called *Interact*, designed as a Learning Community Environment, primarily geared for facilitating collaboration and the construction of online communities. The pedagogy underpinning the development of *Interact* was based on socio- constructivist notions of collaborative knowledge construction such as those expressed by Vygotsky(1978). The model of learning advocated by social constructivists is that of collaborative negotiation of meaning rather than instruction, and control of the learners and the learning process (Jonassen, Davidson, Collins, Campbell, & Bannan Haag, 1995), and is aligned with the educational aspirations expressed by New Zealand Governments in the "Digital Horizons" document.

The model of ICT implementation

Interact has been implemented throughout all the sectors of the college to include faculty, students, and administration, and is used for supporting administrative, as well as teaching and learning functions. This implementation model provided a comprehensive insight into the ways in which student teachers are experiencing ICT use during their initial training.

ICT in the New Zealand educational system

Successive New Zealand governments encouraged by the Information and Communication industries accepted that the country's future lies in the Knowledge Economy. The Digital Strategy draft document published in 2004 by various New Zealand government agencies outlines the benefits of ICT for the New Zealand society in realising its economic, social, and cultural goals. The New Zealand Ministry of Education is keen to see schools integrating ICT more fully into curriculum practices, and encourage all learners to use ICT confidently and creatively in ways that will enable learners to achieve personal goals and fully participate in the emerging global knowledge society, in which New Zealand is expected to become increasingly active (Binde, 2005; Government, 2004; Minedu, 2003).

THEORETICAL FRAMEWORK

Twenty first century learners

Today's young generation are expected to become active participants in the surrounding Knowledge Society, using complex communication networks for rapidly developing and exchanging information (Kankaanranta, 2005). Integrating ICT and network technologies in schools will increase the opportunities for students to gain experience in the use of communication networks.

Twenty first century teachers

Teachers play a crucial role in the adoption and implementation of ICT in education, however, studies show that teachers lack the necessary ICT knowledge and skills (Pelgrum & Law, 2003).

A survey conducted across 16 European countries investigating teachers' professional development in ICT, found that in most countries, respondents referred to training programmes for in-service teacher, whereas initial teacher training was mentioned remarkably less. More than half of the countries pointed only to training programmes for in-service teacher training. Six countries included both initial and in-service training programmes in their statements. (Balanskat, 2005p.21-2). A national survey of the ICT skills and attitudes of students entering and graduating from teacher education institutions in Scotland (1996-7) revealed that students are extremely positive in their attitudes, their enthusiasm for ICT use in their professional work, however, their experiences during their period of training fell considerably short of their expectations(Simpson, Payne, Munro, & Lynch, 1998).

Initial Teacher Education institutions obviously have a key role in the development of ICT within schools. However, the implementation of training seems inconsistent as it tends to focus on in-service teachers while neglecting to introduce ICT programmes in initial teachers training programmes. New Zealand seem to be following the European trend, as the New Zealand Ministry of Education has not specified a requirement for the provision of ICT modules in initial teachers' training programmes.

In view of the situation this paper will investigate how student- teachers utilise ICT in their own learning. Following Brown and Duguid(1991) interrelatedness of learning and work practices, this paper explores the student's perceptions of what and how ICT should support their learning, suggesting that the experience student teachers gain during their student years, will impact on their ICT practices as teachers.

METHOD

A survey questionnaire was developed, and circulated among a number of staff members for review and feedback. Comments, recommendations, and requests conveyed by the reviewing staff were incorporated in the final version of the questionnaire. A random sample of the college students participated in the survey.

The survey included multiple -choice questions, and open -ended ones. The data obtained in the multiple choice questions was quantified. The open ended responses were analysed using Balbi and Di Meglio's(2004) Text Mining approach which uses Text Categorisation for identifying key words leading to the generation of contexts emerging from unstructured texts.
The survey questions encompassed issues of technology, its usability, effectiveness for users, and its ability to facilitate successful accomplishment of users' goals and learning needs.

The survey questionnaires were disseminated in three modes:
1. A random group of lecturers distributed them in class
2. All distant learning students received hard copy questionnaires and a stamped return envelope
3. Students in the ICT Diploma Programme were alerted to an electronic version of the questionnaire posted on their Website

Printed questionnaires were distributed to 313 students
Electronic questionnaires were available to 120 students.

A total of 108 students responded. The highest response rate (35%) of the three modes of dissemination was obtained through the distribution of questionnaires by lecturers in class time. Close behind at 32% was the mail out with the stamped return envelope sent to distance learners. The electronic version resulted in the lowest response rate with a mere 2.5%.

FINDINGS

This section illustrates the findings of the survey which was disseminated in 2005 at a teachers' college, which supports on campus as well as distance learning programmes. Of the total of the108 respondents to the survey, 41 (38%) were on campus students, and 67(62%) were distance students.

The findings outline the ways in which students make use of different types of media and technology, and illustrate personal testimonies of students describing the ways in which the technology supported their learning, their interactions with lecturers and other students, and the affects these had on the learning. In particular the findings attempted to highlight interactive and collaborative activities aligned with the New Zealand's government's aspirations as well as the theoretical underpinnings of the ICT system used by the respondents.

Computer access preferences

First, the survey attempted to establish computer access practices and preferences. Students were asked to indicate their preferred location for using computers either on campus or from home. 22 students, about half of the total of on campus students participating in the survey, noted that they prefer using the college computers. When asked about their reasons for preferring to work on the college computers, 11 out of the 22 (50%) indicated that it enabled them to work collaboratively with others. Table 1 below illustrates the distribution of the different reasons for using college computers.

Table 1: *Reasons for using collage computers*

N=22	Technological Standard	Connection speed	Ability to work collaboratively with others	Available help and support
	5	9	11	6

N=101

Representation of Learning Materials

The survey investigated the student teachers preferred format of representation of learning materials, and found that 75% preferred the printed format.

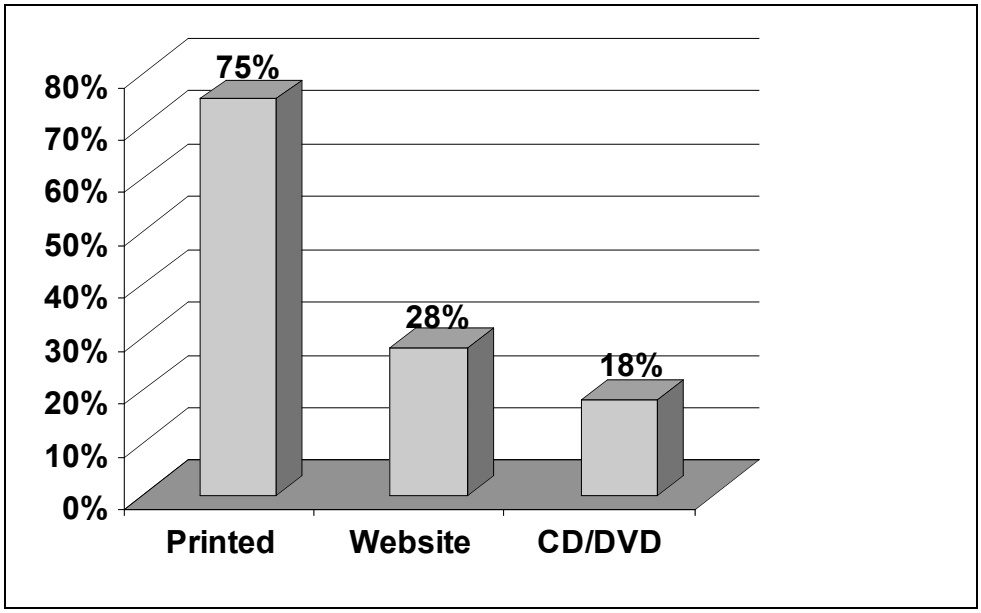

Figure 1: Preferred media

Students were asked to rate the effectiveness of multimedia features such as audio and video elements for their learning. 43% of the respondents indicated that it was helpful at times, only 13% found it very helpful.

N=93

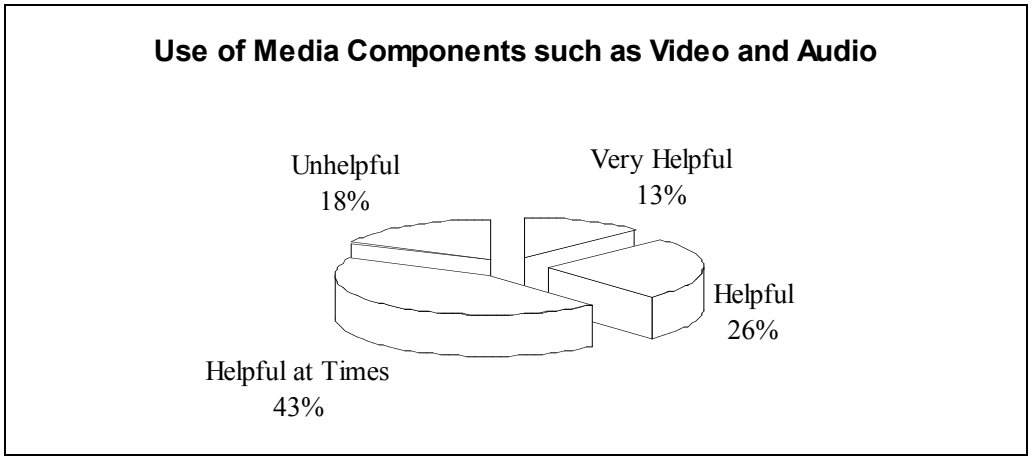

Figure 2: *Audio and Video*

Interactions, contributions, and collaboration

The participants were asked to describe their use of the sharing and collaborating features available through *Interact*, and quantify their level of contribution to online discussion forums using the following scale:

1. On several occasion =10 and above messages posted throughout a course
2. On some occasions=5-10 messages per course
3. On rare occasions=1-5 messages per course
4. Never = 0 messages

Table 2: *Interactions and Collaboration*

Interactions, and collaboration,	On several occasions	On some occasions	On rare occasions	never
Posting a message to discussion forums N=102	5%	20%	45%	30%
Exchanging information N=102	1%	4%	34%	61%
Contributing comments N=103	1%	4%	30%	65%
Sharing and receiving comments N=103	0%	8%	37%	55%

Table 2 identifies 4 types of interactions:

1. Posting a message: authoring a discussion forum message. This is done either in anticipation for a response of some kind or an exchange of information with others.
2. Exchanging information : responding to a message requesting some information
3. Contributing comments: responding to a message
4. Sharing and receiving comments: continues rapport with others where sharing and interchange of ideas takes place.

Table 2 indicates that 45% of the respondents contributed messages, however, only on rare occasions (1-5 messages per course). This finding raises questions as to why such a relatively high percentage of participants sustain such a low frequency of posting messages. One explanation to this query can be found in the words of one of the participants:

> *"I have been really frustrated by the number of people who read the questions or comments but don't respond. In the beginning I would post in each course, but it became apparent that other students were not using it as a means for dialogue, so I stopped doing it as I felt I was wasting my time".*

Table 2 describes a situation of an unfortunate loop in which people cease to participate in the online discussion and perceive it as a '*waste of time'* because '*other students are not using it as a means for dialogue'.* This loop phenomenon is fully realised when analysing all the other types of interactions shown in the table. Posting a message to a discussion forum is usually an invitation

to some type of interaction. According to table 2 a total of 70% (5% on several occasions 20% on some, and 45 on rare occasions) did initiate an invitation for interaction. However, 65% of the participants indicated that they have never contributed comments, 61% indicated that they never exchanged information. In other words, people initiated a conversation on the one hand, but refrained from responding to other people's invitations, resulting in breakdown of communication. This situation illustrates a discrepancy between what people expect from discussion forums and what happens in reality.

On the one hand participants noted:

Participant one:

> *"It [discussion forums] is good because you know that someone is going to see your posting and be able t help you out".*

Participant two:

> *"Using the forums is effective in getting responses from lecturers for all concerned. Students can also 'talk' to each other via Interact".*

In other words, students have an initial positive perception of ways in which online interactions can contribute to their learning, as participants indicate:

> "*When I had difficulty with course material it helps to be able to read what other students are saying. To be able to see lecturers comments or replies*
>
> *Posting questions and concerns on Interact enables the lecturers to respond and often their answers help many people with the same concerns. Communication with other students is a lot stronger than it would be without Interact. We are able to see others' postings and have the opportunity to share out thoughts".*

Other participant:

> *"Talk to others wouldn't normally[without the online system] get to. Process questions and comments also. Can leave class mates messages etc".*

However, in reality the practices exhibited, deter students from perusing their initially positive approach, and they turn to using other means, as one participant said:

> *"I prefer to get an email rather than spend ages on Interact looking for communications that aren't often there. Would be OK if lecturers posted things regularly".*

The need for better response and rapport with lecturers was mentioned by a number of participants saying:

Respondent one:

> *"I have made postings, and haven't had reply from my lecture….."*

Respondent two:

> *"I find it terrible how you often ask lecturer a question and they don't reply"*

Others mention the lack of response from both students and lecturers: "….. *lecturers and students not answering questions….."*

Supporting Learning

The survey reviewed the ways in which participants found the use of *Interact* as supportive to the learning.

Measuring the frequency of appearance of reoccurring words such as good' useful' 'support', 'communication', 'helpful', 'extra', 'fantastic', 'available', and 'easy' enabled the construction of a rough sketch of students' expectations of the system, and the level to which these expectations were met.

Most students (78%) found using *Interact* helpful to their learning in some way. 22% argued that *Interact* was not helpful at all to their studies. The hindering factors pointed out by the respondents related to network failure, bad website navigation, and lecturers failing to reply. Figure 7 illustrates the effectiveness of the system

N=86

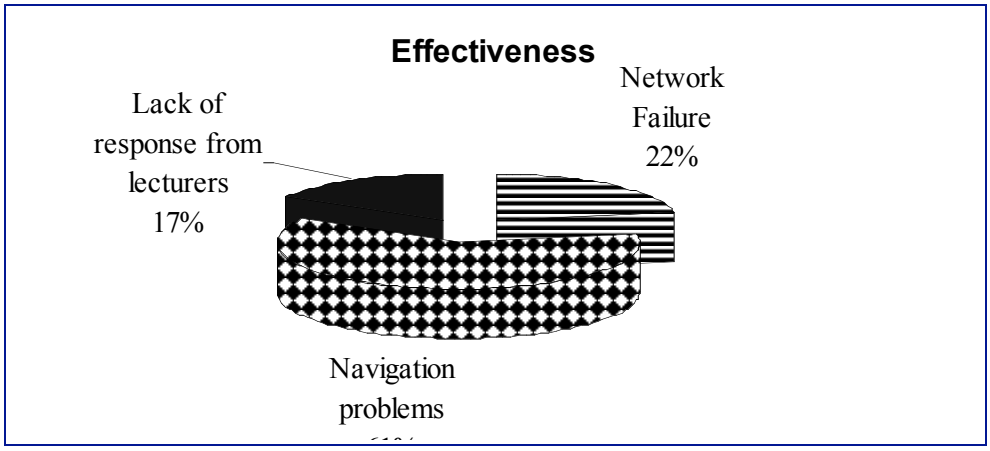

Figure 3: *Effectiveness*

To investigate the ways in which Interact supported learning, I used the Balbi and Di Meglio (2004) Text Mining approach of Text Categorisation and detected 5 categories of supportive factors:

1. Additional learning materials
1. Source of updated information
2. Administrative purposes
3. Communicating with other students
4. Communicating with lectures

N=86

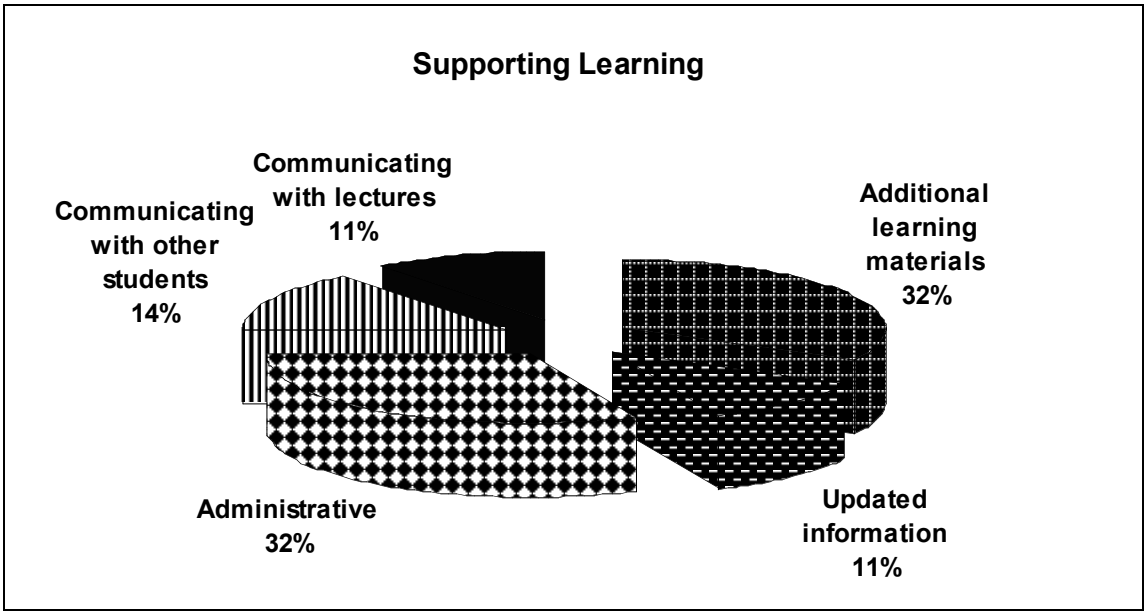

Figure 4: *Supporting learning*

32% respondents found the system helpful for its addition to learning materials
11% used it as an updating source of information
32% used it for administrative purposes
14% used it for communicating with other students
11% for communicating with lecturers

The findings indicate that the majority of the respondents perceive *interact* as a tool for disseminating learning materials, and administrative information. Furthermore, student's responses confirm the quantitative data:

> *"My use of the' interact' has mostly to locate information, assignments templates, etc. which has been most helpful to my learning".*
>
> *"keeping up –to-date with assignment requirements and due dates…."*

The findings indicate that students predominantly see the system as a source of information to be disseminated by the lecturer and course administrators.

The importance students attribute to the information provided through *interact* is summarised by one student saying:

> *"There is a wide variable amongst lectures who make good use of Interact as a form of communication. The course which were regularly updated and monitored gave the best support and the highest level of communication"*

ANALYSIS

The analysis section follows the same subtitles introduced in the 'findings' section.

Computer access preferences

The college's computer suits enable students to work together, view each other's computer screens, exchange comments, tips and help each other. 11 out of the 22 on- campus students chose to use the college computers for the opportunity of enjoying the company of their peers, indicating that the students' value the opportunity for sharing and collaborating with peers.

Representation of learning materials

28% of the students chose Web representation as their preferred medium of learning materials; however, 75% chose print. The scope of this study did not allow for further investigation of these findings, but some possible alleys for further investigation could look at reasons to do with:

1. Course design: are courses designed primarily around reading printed material?
2. Technology of e- documents and e-books: are the technological solution available providing satisfactory conditions for reading long electronic documents?
3. The culture of teaching and learning: are students and lecturers willing to explore non-traditional media of delivery?

43%of the students found the use of video and audio components as helpful at times. This rather ambivalent response is contrary to the wide use of visual and sound so ubiquitous in today's world. The scope of this study did not allow for further investigation of this finding, and further study is needed for identifying the reasons behind the phenomenon observed. Possible routes for explanations implied in literature will be discussed in the summary of this section.

Interactions, contributions, and collaboration

Summing up the personal experiences of the respondents with the use of discussion forums indicate that the low percentage of use seems to emanate from two key reasons:

1. Lack of consistent responses from lecturers
2. Lack of response from peers

When asked about the amount of information exchange, 61% of the respondents have never participated in such an activity. This finding could be interpreted in many ways;

1. The students were not asked to contribute and exchange information
2. The students were not provided with the technical proficiencies required to contribute information files
3. Lecturers are not using the interactive and collaborative features provided through interact

Ascertaining the reasons for the findings in this case is beyond the scope of this paper; however, the current findings shed some light into areas needing further investigation.

The survey showed very low levels of exchange, sharing contributing and commenting on each others materials. Once again the reasons for this could be similar to the ones I have outlined earlier. It may be that not enough preparation and exposure to these features was done in the level of lecturers or the students. The findings may well be an indication of the fact that lecturers,

as the ones responsible for designing and leading the courses, have not made the pedagogical shift and are not yet ready to implement current pedagogies where students will be more active, and the role of the teacher will become that of a facilitator rather than a transmitter of information(Duffy & Cunningham, 1996).

Supporting learning

Similar to issues raised in previous items in this section, the effective use of *Interact* was again attributed to lecturers' response. The need for lecturers' response has to do with students requiring lecturers' presence, and the assurance that someone, 'out there', is listening.

The low percentage of students who perceived interact as a tool for communicating with other students highlights a fundamental finding, indicating that learning is still perceived as teacher centred activity in which students receive information and instructions and act accordingly.

Concepts arising from the analysis

Two key issues seem to arise from the analysis of the findings illustrating the perceptions student teachers' have for using of ICT in a learning context:

1. The preferred medium
2. Interaction and collaboration using ICT

Preferred Medium -The overwhelming (75%) preference to print media implies a traditional approach to the presentation of learning materials. Further strengthening this finding could be attributed to the high percentage of response to the printed rather than the electronic version of the questionnaire disseminated for this study.

Interaction and collaboration -The relatively low use of the social collaborative features supported by the ICT system *interact,* may imply that the social learning pedagogy underpinning the design of *Interact* have not been widely implemented, and practices seem to fall back on the more traditional teachers' centred approach. This observation is supported by the findings shown in *figure 4* indicating a relatively high use of the system for obtaining learning materials and course administration information.

The two key findings stand in relative contrast to the general view that ICT use is rising, and that young people in particular are high users of audio visual functions supported through ICT(Oblinger & Oblinger, 2005), and are keen users of interactive social networking technologies such as MySpace or Facebook (Lenhart & Madden, 2007). A closer investigation of the nature of the use of technologies such as iPods, picture phones, and audio visual Web application such as YouTube, Flicker and others, and the various networking systems, reveal that they are all primarily used for entertainment purposes. It may be that student teachers do not perceive audio visual, and networking technologies to be related to work or study environments.

Differentiating between different contexts of use of the technology may provide a route for explaining the low levels of use of non- print media among the student teachers.

Bosah's (1998) work provides a differentiation of use of ICT suggesting a link between perceptions of use of ICTs, and the level of education and socio economic status. Bosah found that audio visual technologies are in relatively high use in the lower education and socio economic groups, and were mainly associated with the consumption of content, mainly for entertainment. However, the use of ICT in the higher level of education and socio economic status was attuned to the production as well as consumption of content, and that in this group ICT

was more often associated with work and study related activities. The preferred ICTs in this group were those which offered not only consumption but also production of content (Bosah, 1998).

The student-teachers in this study seem to dissociate audio visual content from study or work activities. Furthermore, although students indicated an appreciation of collaborative work when choosing to use the college computer suits where they could work face-to-face with colleagues, they seem to perceive ICT based communication as a mechanism for retrieving information rather than facilitating interaction and active production of content. According to Bosah both these findings would, point to low level of education and socio-economic status. Cameron and Baker(2004) found that there is a general belief that many people entering teaching are academically weak, indicating that student teacher may come from a background of low levels of education, usually associated with lower socio economic status, although this is inconclusive.

Although the survey looked at students' perceptions, the findings shed light on the way the system is applied by the college's staff, which in turn may have affected the students' perceptions and preferences in using the technology.

It may be that student teachers are willing to embrace features such as audio visual and collaborative learning enabled by the technology; however, they may lack guidance and modelling from their lecturers.

DISCUSSION AND CONCLUSION

Current pedagogies call for learning environments in which the student actively interacts with learning materials and participates in multilateral communication activities encompassing lecturers, and peers. The use students make of the technology and their comments about the practices of lecturers implies that the pedagogic shift has not yet been embraced widely. Low collaborative activities and the significant preference of print over other forms of presentation indicate the prevalence of traditional dynamics of teacher centred learning contexts where communication is uni-directional flowing from the teacher to the learner and learning materials are disseminated to the students in a print format. [1]

Initial teacher education institutions have a key role in training teachers along the key issues identified in the Digital Horizons document, calling for the implementation of techno -constructivist paradigm, and the communication with the surrounding community. However, it seems that initial teacher training is still primarily entrenched in the traditional models and the newly qualified teachers although introduced to new technologies, are enculturated along the traditional transmission modes of teaching and leaning.

Left unattended the situation will hinder the ability of the New Zealand educational system to support the skills identified by the government as supporting the country in its process of becoming a Knowledge society.

It is apparent from this study that the availability of the technology itself will not instigate the aspired goals. Cultural and pedagogic change should occur for the technology to be implemented to its full effectiveness and achieve the goals it was designed to fulfil.

Training the teachers of the new millennium in a way that would facilitate their experience of new technologies and current pedagogies in their own learning would as Brown and Dugid have suggested (1991), provide a key factor in enabling teachers to incorporate these in their practices as qualified teachers.

RECOMMENDATIONS

1. Develop an ICT learning programme for initial teacher training
2. Develop workshops and professional development programmes for teacher training staff to enable implementation of techno constructivist teaching and learning approach
3. Develop initial teacher training programmes that will include ICT as inherent part of the study
4. Develop an ICT based collaborative culture for teacher training staff
5. Develop ICT based collaborative culture among students
6. Introduce more diverse formats of media use for the presentation of teaching learning materials
7. Develop mechanisms to ensure robust implementation of the new programmes
8. Develop a reward mechanism for individuals and groups working towards changing work and study culture and incorporating ICT based collaboration in their daily practices

Endnote

[1] Some still advocate print materials as the approved and reliable source of information in comparison to Web sources.

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Academic computing at Malaysian colleges

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ABSTRACT

The paper describes the state of academic computing at Malaysian colleges. Three research questions are central to this study. What are the indicators for assessing academic computing? What are the general characteristics of academic computing at different levels of performance? What is the general performance of academic computing at colleges in Malaysia? In order to answer these questions, an academic computing survey was conducted involving 62 public and private colleges in Malaysia. The questionnaire used in the survey was based on the academic computing assessment framework developed by Mokhtar *et al.* (2006). The survey incorporated 46 rubric questions encompassing six academic computing areas: 1) ICT Vision, Plan, Policies and Standards; 2) ICT Infrastructure; 3) Teaching and Learning Using ICT; 4) Researching Using ICT; 5) Information Services; and 6) Institutional ICT Support. The findings of this study showed that a majority of colleges in Malaysia were implementing some aspects of academic computing. However the academic computing performances varied between areas and between colleges. As a comparison, a smaller percentage of Malaysian colleges achieved moderate or high academic computing performance compared with their counterparts in the United Kingdom.

Keywords: *Academic computing; higher education; assessment; survey.*

INTRODUCTION

Since the 1990s, information and communication technology (ICT) has advanced very rapidly in Malaysia. To a certain extent, what propels ICT to the forefront was Malaysia's intention to be a fully developed nation by the year 2020 – a concept now widely known as Vision 2020. To achieve this ambitious goal, the Malaysian government began to look to ICT to provide the required human resources through efficient education and training. Its impact on education, while not yet pervasive, has made considerable inroads. Various projects related to ICT implementation in education are implemented, including the Computer-in-Education project, Knowledge Resource Centre, Computer Aided Instruction and Computer Aided Learning project, and the Smart School Project (Gan, 2001).

At present, the ICT strategy in driving the Malaysian higher education towards excellence is described in a document entitled "Report by the Committee to Study, Review and Make Recommendations Concerning the Development and Direction of Higher Education in Malaysia" (Ministry of Higher Education Malaysia, 2006). The report discusses the role of ICT in achieving this excellence, focussing on the use of ICT in relation to and in support of the core areas of higher education, namely teaching-learning and research. Such scope of ICT use is aptly represented by academic computing (Prupis, 1989; Ferrer and Corya, 1990; Van Valey and Poole, 1994; Nielsen *et al.*,1995; Carleton University, 2001).

The report highlights the importance of higher education institutions in conducting ongoing assessment of standards and performance. It recommends the use of performance indicators and benchmarking in relation to all important areas of higher education. The instrument used for the assessment should be adapted to the specific needs of the Malaysian higher education institutions. A well-constructed instrument will provide substantial information on the performance

and quality of each aspect being assessed. The information can be pooled and utilised by interested parties and can enable the management of higher education institution to fully grasp and understand issues and problems, and make decisions that are reliable and accurate. Comparisons of performances can stimulate healthy competition amongst higher education institutions at the national level. In addition, the management can plan and organise detail strategies that can remedy weaknesses and reinforce efforts (Ministry of Higher Education Malaysia, 2006).

However, the implementation of ICT in higher education is generally autonomous and what has been achieved is relatively unknown (Gan, 2001). Research by UNESCO (2004) found that many Asia-Pacific countries including Malaysia lack the proper framework to assess ICT implementation in higher education. Therefore, initiatives to gather assessment information and data, either by a central body or higher education institutions themselves, are essential in achieving the ICT strategy (Ministry of Higher Education Malaysia, 2006).

The purpose of this study is to describe the state of academic computing at Malaysian colleges. Several research questions are central to this study. What are the indicators for assessing academic computing? What are the general characteristics of academic computing at different levels of performance? What is the general performance of academic computing at colleges in Malaysia? In order to answer these questions, an academic computing survey was conducted involving 62 public and private colleges in Malaysia. The questionnaire for the survey was based on the academic computing assessment framework developed by Mokhtar *et al.* (2006).

THE THEORETICAL FRAMEWORK

Before proceeding with the methodology of the study, this section provides a brief description of the theoretical framework in which the study is based on. The academic computing assessment framework was developed by Mokhtar *et al.* (2006) based on a qualitative study of higher education institutions in Malaysia. The framework adapts the value chain concept, initially proposed by Porter (1985) for the business field, to describe the relationships between academic computing activities. The framework consists of two groups: primary activities and support activities. The structure of the framework is shown in Figure 1.

Primary activities are directly concerned with the use of ICT in delivering the core higher education services. The primary activities are represented by two academic computing areas, namely *Teaching and Learning Using ICT* and *Researching Using ICT*. The use of ICT in teaching and learning is essential as it enhances the teaching and learning process, facilitates lifelong learning and enables borderless education. The use of ICT in research enables faster and higher precision data processing, simulation of complex systems, collaboration between researchers across time and space, and remote access to data and specialised research facilities (Mokhtar *et al.*, 2006).

The primary activities are linked to support activities that help to improve their effectiveness or efficiency. The framework categorises the support activities into four main areas, namely *ICT Vision, Plan, Policies and Standards*, *ICT Infrastructure*, *Information Services* and *Institutional ICT Support*. First and foremost, the role of ICT vision, plan, policies and standards is very important due to the long and expensive process of implementing academic computing. Higher education institutions must carefully consider all academic computing issues and employ the necessary policies to ensure successful academic computing implementation. Secondly, higher education institutions must provide the necessary ICT infrastructure as a foundation to academic computing. Its absence forms a barrier to institutions providing ICT-enabled education offerings, therefore gives an adverse effect on the quality of higher education as a whole. Thirdly, ICT

based information services allows easy access to information and knowledge in various disciplines, thus supporting the teaching process and enhancing the learning experience for students. Finally, institutional ICT support ensures the smooth and effective use ICT in teaching and learning through ICT training, maintenance of infrastructure and assistance to users (Mokhtar *et al.*, 2006).

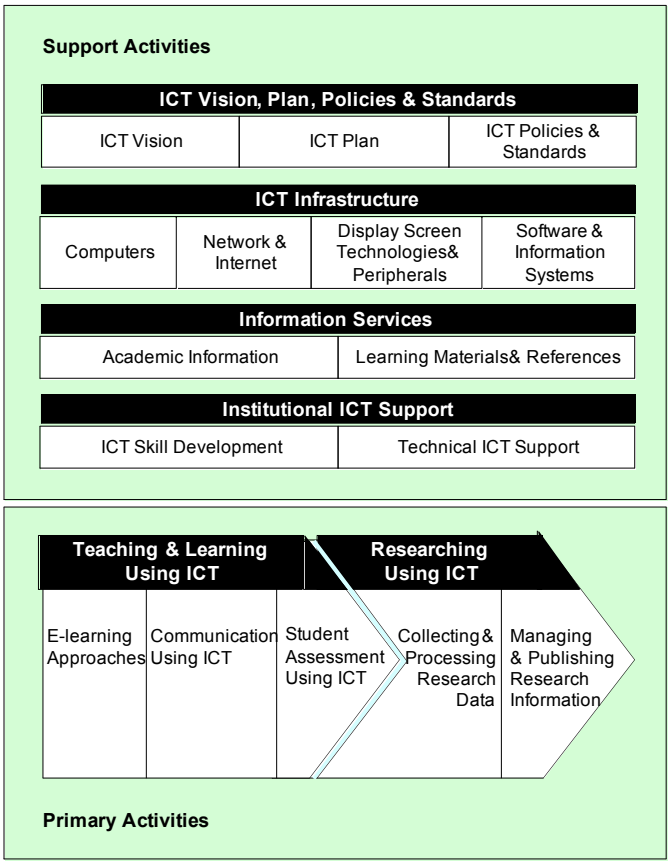

Figure 1: *The academic computing assessment framework. Adapted from Mokhtar et al. (2006).*

In the framework, the most basic building blocks are the performance indicators. Although some authors suggest that performance indicators must be something that is quantifiable, some others take a much wider view, and would include descriptive statements within the scope of indicators (Nuttall, 1994). The latter view is adopted by the *International Standards Organisation*, which defines a performance indicator as “a numerical, symbolic or verbal expression derived from statistics and data that characterises the performance of a service or facility” (International Standards Organisation, 1998). Mokhtar *et al.* (2006) adopts a similarly view, and incorporates both quantitative and qualitative measures in the framework. This allows performance indicators to portray the full richness and diversity of the academic computing activities.

To ensure the validity of the indicators, only indicators considered important by the ICT and academic management of the higher education institutions involved in the qualitative study were incorporated in the academic computing assessment framework. The indicators were also able to differentiate various levels of academic computing performance. For each of these indicators, at

least three different descriptions or values were extracted. These variations were arranged in a particular order that reflects the flow of academic computing development from a low level of performance to the highest level of performance. The variations for all the indicators were used to form the academic computing rubrics.

According to Pickett (1998), rubrics are sets of categories that define and describe the important components of the areas being assessed. Each category contains a gradation of performance levels with a score assigned to each level and a clear description of what criteria need to be met to attain the score at each level. As an assessment tool, rubrics are effective in evaluating institutional performance in areas that are complex and vague. Rubrics representing the low, moderate and high level of academic computing performance for each indicator are presented in Appendix A.

METHODOLOGY

As mentioned earlier, the purpose of this study is to describe the state of academic computing at Malaysian colleges. Colleges, in the context of this study, refer to non-university status higher education institutions registered with the Ministry of Higher Education. The colleges encompass polytechnics, community colleges, MARA colleges and private colleges. This study does not include teacher's training colleges and matriculation colleges, which are registered under the Ministry of Education.

To identify the state of academic computing at Malaysian colleges, a survey was conducted in 2006. Questionnaires and supporting documents were sent to the colleges. For each college, a management representative was asked to complete the survey based on inputs from the ICT and academic departments. The overall participation from colleges was encouraging. During the eight weeks of data collection, 62 colleges completed and returned the survey questionnaires. The types and number of colleges participating in the academic computing survey is given in Table 1.

Table 1: *The profile of participating colleges*

Types of Colleges	Public	Private	Overall
MARA Colleges	9	-	9
Community Colleges	11	-	11
Polytechnics	6	-	6
Private Colleges	-	36	36
Overall	26	36	62

The questionnaire of the survey incorporated 46 questions encompassing the six academic computing areas. The structure of the survey questionnaire is shown in Figure 2. The questionnaire used a form of categorical scales based on the academic computing assessment rubrics (see Appendix A). For each question, clear descriptions characterising the low, moderate and high performance levels were given. Respondents were required to select the option that best characterises the state of academic computing at their respective colleges.

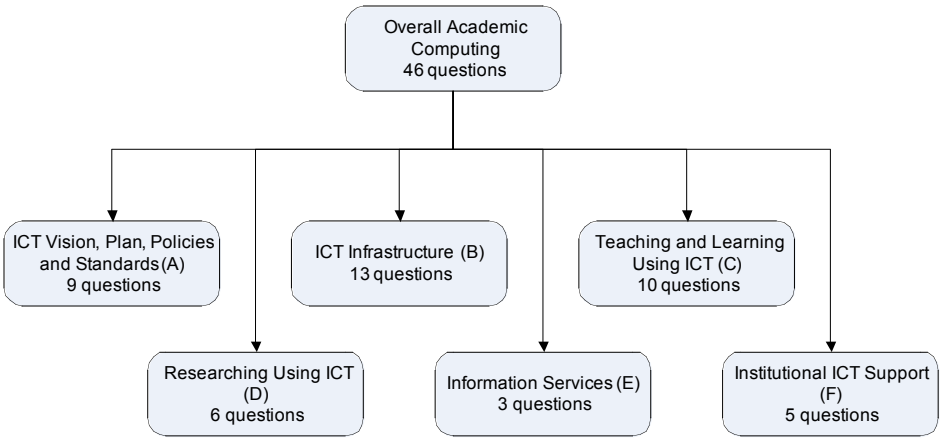

Figure 2: *Structure of the survey questionnaire*

Cronbach's alpha is the most common form of internal consistency reliability coefficient based on the correlation between variables. Cronbach's alpha coefficient ranges in value from 0.00 to 1.00. If the correlation is high, there is evidence that the questions are measuring the same underlying construct, therefore indicating a reliable scale. There is no set standard regarding the minimum acceptable threshold value of Cronbach's alpha, but Hair *et al.* (1998) suggest the values of 0.60 to 0.70 to be the lower limit of acceptability. According to Garson (2006), the alpha value should be at least 0.70 to achieve an "adequate" scale and 0.80 to achieve a "good" scale. To determine the reliability of the questionnaire used in this study, Cronbach's alpha values were calculated for the overall academic computing and the six academic computing areas. In general, all alpha values exceeded 0.70, thus indicating the reliability of the questionnaire. The values are shown in Table 2.

Table 2: *Reliability of the scale*

Construct	**Cronbach's Alpha**
Overall Academic Computing	0.947
ICT Vision, Plan, Policies and Standards (A)	0.791
ICT Infrastructure (B)	0.848
Teaching and Learning Using ICT (C)	0.886
Researching Using ICT (D)	0.902
Information Services (E)	0.804
Institutional ICT Support (F)	0.735

RESULTS

ICT Vision, Plan, Policies and Standards (A)

Figure 3 shows the performance of colleges in relation to the component ICT Vision (A1). In driving the ICT vision (A11), the top management provided leadership at 58% of colleges. As for the rest, the ICT vision was driven by lecturers and/or ICT specialists. The focus of the ICT vision (A12) varied, from the learning of ICT skills and the uses of technology (37%), to ICT infrastructure and the improvement of learning and management (34%), to ICT based learning environment and technology integration (29%). At 65% of colleges, efforts were underway to build greater awareness and understanding of the ICT vision by the campus community (A13).

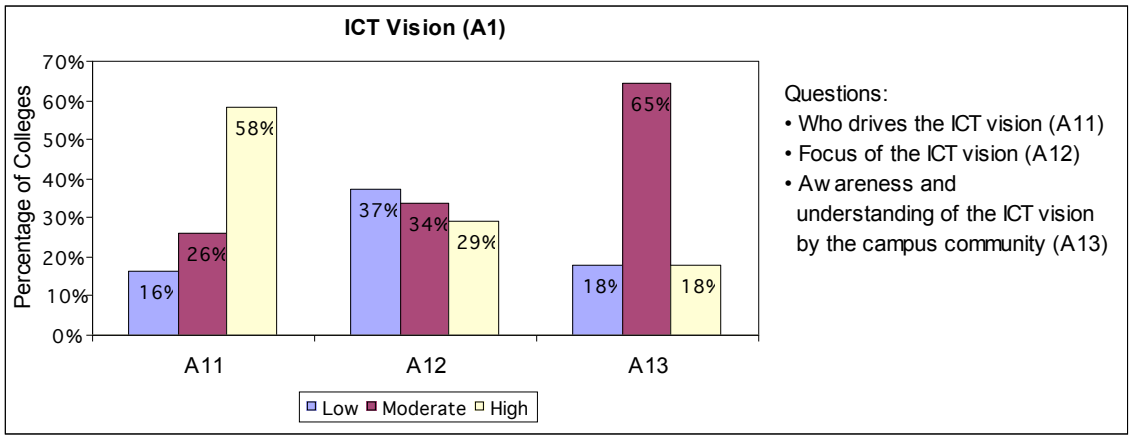

Figure 3: *Performance of colleges in relation to ICT Vision (A1)*

Figure 4 shows the performance of colleges in relation to the component ICT Plan (A2). At 48% of colleges, the scope of ICT plan (A11) encompassed ICT infrastructure, the use of ICT in teaching and learning and professional development. However, at 34% of colleges, the scope was limited to the acquisition of basic hardware and software. At most colleges, ICT specialists and lecturers participated in the development of the ICT plan (A22). However, only 44% of colleges developed their ICT plan based on the participation and input from the top management and students. In relation to the funding for implementing the ICT plan (A23), a majority of colleges reported either having a limited (50%) or a fair amount of funding (35%).

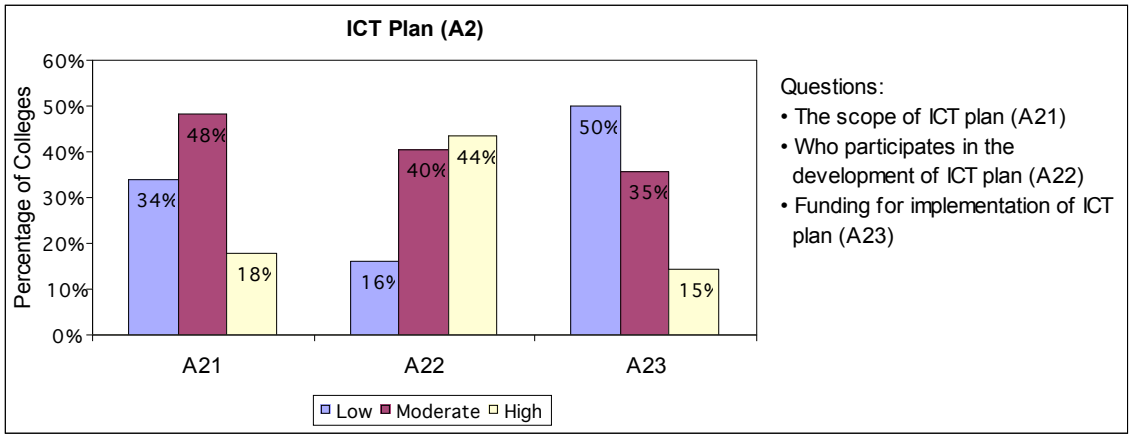

Figure 4: *Performance of colleges in relation to ICT Plan (A2)*

Figure 5 shows the performance of colleges in relation to the component ICT Policies and Standards (A3). The scope of ICT policies and standards (A31) varied, from the purchasing of equipments and access for students (39%), to the inclusion of information literacy, acceptable use and ethics (37%), and finally to encompass the use of ICT in teaching and learning, copyright and intellectual property, and ICT incentives (24%). Regarding the level of ICT policy development and implementation (A32), 35% of colleges reported having very few ICT policies. At 48% of the colleges, many of the ICT policies were in place, but they were inconsistently implemented. The review of ICT policies and standards (A33) at 44% of colleges were conducted from time to time based on the requests and recommendations of ICT specialists and lecturers. At 32% of colleges, no review was conducted.

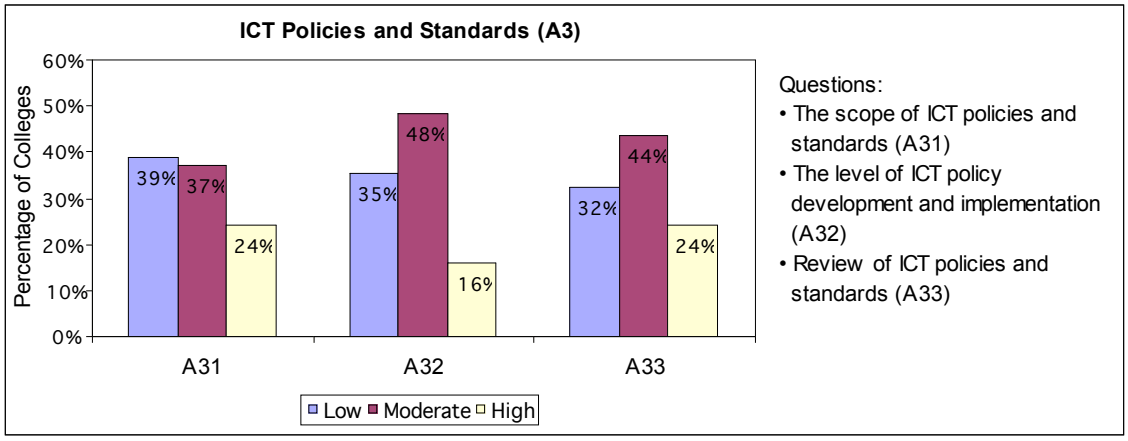

Figure 5: *Performance of colleges in relation to ICT Policies and Standards (A3)*

ICT Infrastructure (B)

Figure 6 shows the performance of colleges in relation to the component Computers (B1). The ratio of computers to students (B11 and B12) varied quite evenly between low (ratio at 1:9 or less), moderate (ratio between 1:8 and 1:4) and high (ratio at 1:3 or better) performance levels. The ratio of computers to lecturers (B13 and B14) was much better with the majority of colleges reported achieving either moderate (ratio between 1:4 and 1:2) or high (ratio 1:1 or better) performance levels.

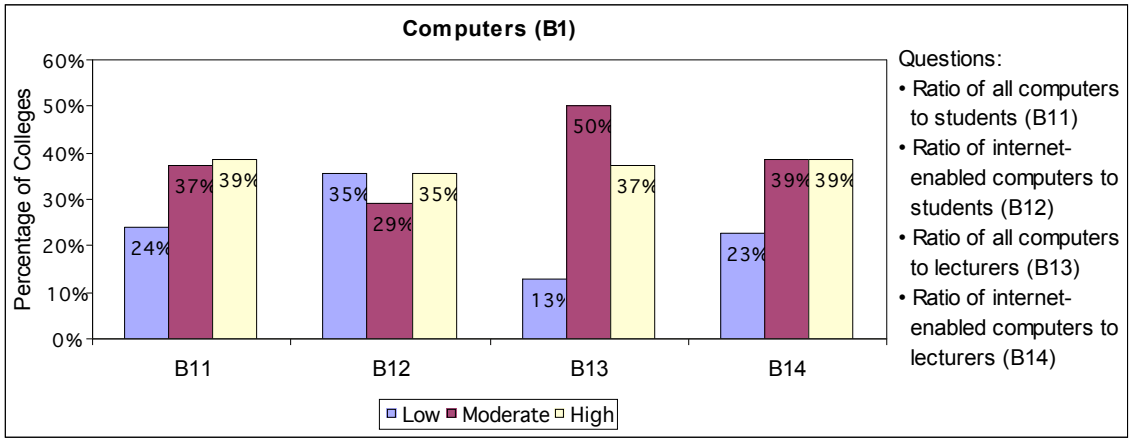

Figure 6: *Performance of colleges in relation to Computers (B1)*

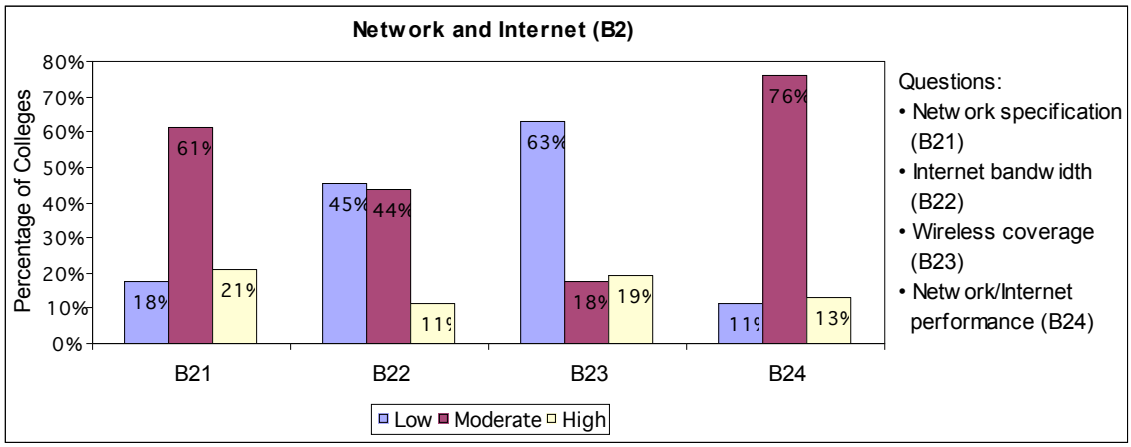

Figure 7: *Performance of colleges in relation to Network and Internet (B2)*

Figure 7 shows the performance of colleges in relation to the component Network and Internet (B2). At 61% of colleges, the network specification (B21) was 100 MB Ethernet. Only 21% of the colleges employ Gigabit Ethernet technology in their network infrastructure. To access the Internet, most colleges reported having an Internet bandwidth (B22) of 1 MBps or less (45%), or 2

to 7 MBps (44%). Wireless coverage (B23) was low at a majority of colleges, with 63% of the colleges reported having coverage less than 25 percent of the total learning area. As for network performance (B24), 76% of colleges reported having moderate performance: the network and the Internet generally worked well, but they were slow at busy times.

Figure 8 shows the performance of colleges in relation to the component Display Screen Technologies and Peripherals (B3). At 65% of colleges, less than 25 percent of classrooms were equipped with display screen technologies (B31). Regarding computer peripherals (B32), 63% of colleges reported having printers, scanners, digital cameras, and audio and video recorders. At 24% of the colleges, peripherals were limited to printers. Only 13% of colleges possessed peripherals such as portable devices, specialised devices for research and instructional purposes, and computer conferencing facilities.

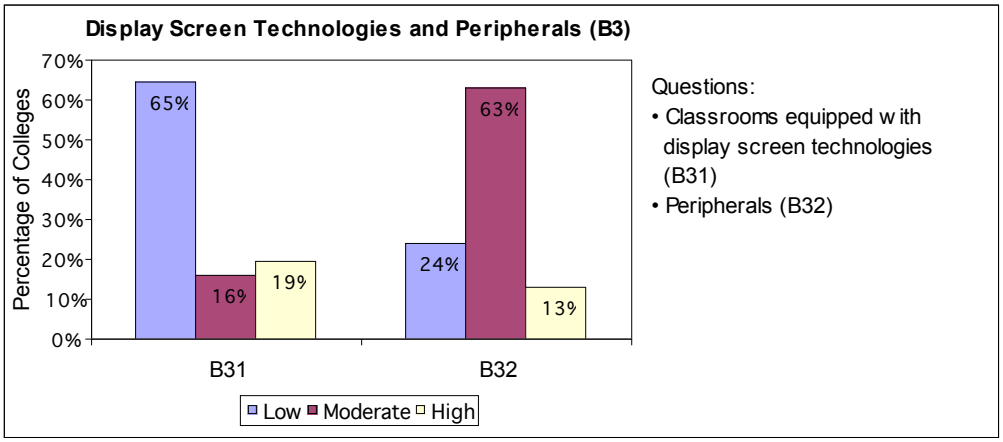

Figure 8: *Performance of colleges in relation to Display Screen Technologies and Peripherals (B3)*

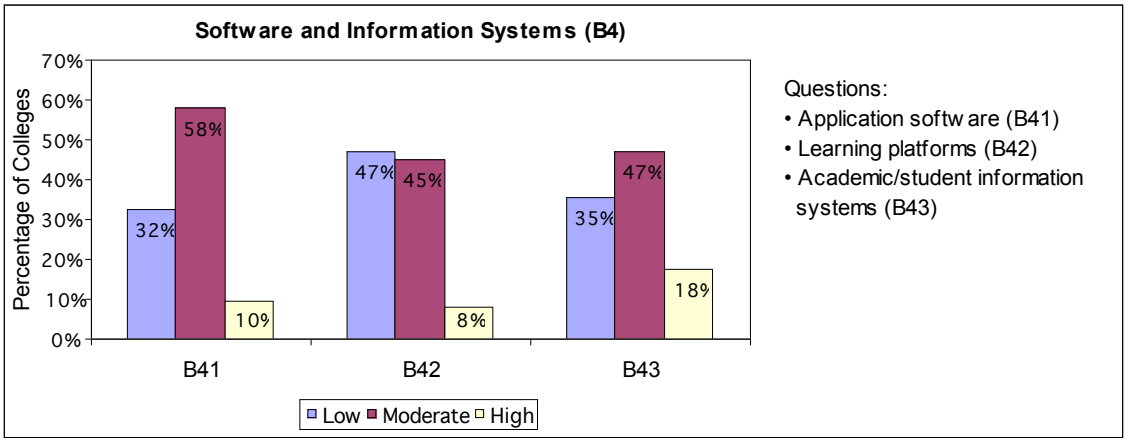

Figure 9: *Performance of colleges in relation to Software and Information Systems (B4)*

Figure 9 shows the performance of colleges in relation to the component Software and Information Systems (B4). At 58% of colleges, application software (B41) encompassed office applications, subject specific software, multimedia authoring tools, video and audio production, and web tools. At 32% of colleges, application software was limited to office applications. Only 10% of the colleges possessed specialised software for collaboration, instruction and research. In relation to the learning platform (B42), only 8% of colleges implement a commercial or a customised open source learning management system offering a wide range of functions. As for the rest, no learning platform was available or the learning platform was limited to web pages on the campus Intranet and learning material files stored in public folders on the network. Regarding academic/student information systems (B43), 47% of colleges reported having a system incorporating mainly registration and examination functions. Surprisingly, 35% of colleges still depended on spreadsheets and databases to store academic and student data.

Teaching and Learning Using ICT (C)

Figure 10 shows the performance of colleges in relation to the component E-learning Approaches (C1). In general, the performance levels for e-learning approaches were determined by the percentage of ICT use of courses or lecturers. Three e-learning approaches were more evident at a majority of participating colleges, namely using ICT as a source of information in preparing lesson plans and teaching material (C11), using ICT to support learning (C12) and using ICT in a role similar to traditional classroom tool (C13). Approximately 40% of colleges achieved high performance: the ICT use involved more than 50 percent of courses or lecturers. E-learning approaches such as using ICT in parallel with traditional learning (C14) and using ICT to enable flexible learning (C15) were less evident: colleges achieving high performance were at 19% and 11% respectively.

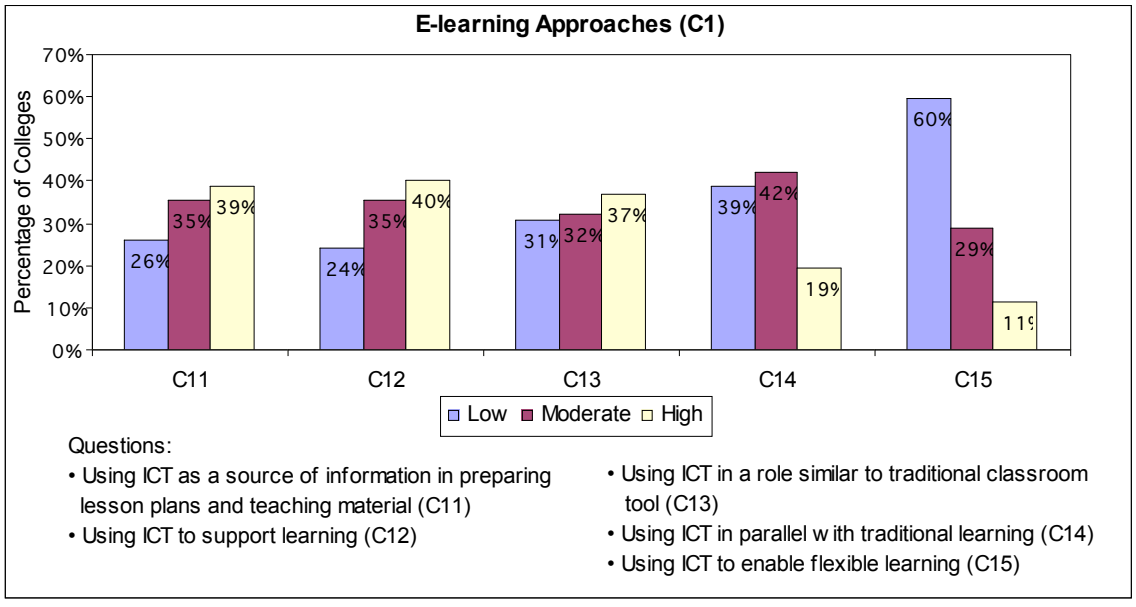

Figure 10: *Performance of colleges in relation to E-learning Approaches (C1)*

Figure 11 shows the performance of colleges in relation to the component Communication Using ICT (C2). In general, the performance levels in relation to using ICT as a means of academic related communication/discussion were determined by the percentage of ICT use by students and lecturers. As a whole, the use of ICT to facilitate communication between students and lecturers (C21) and between lecturers (C22) was still low. The ICT use involved less than 25% of students and lecturers at about 50% of colleges.

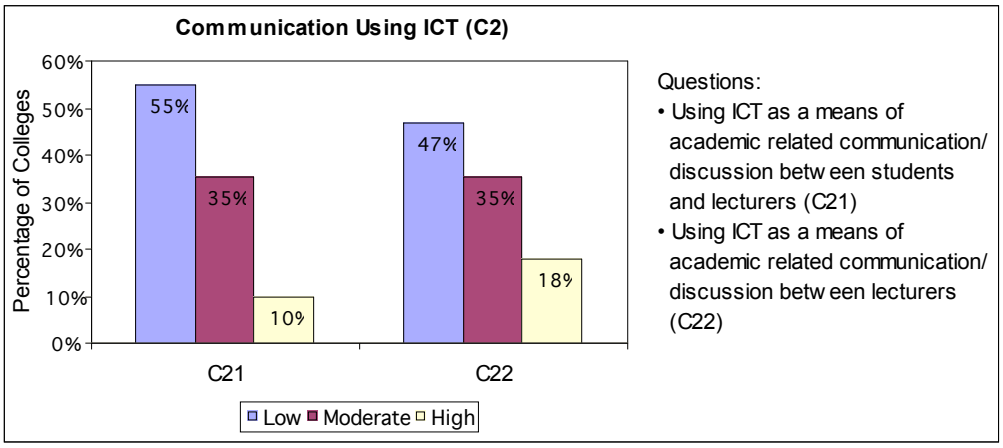

Figure 11: *Performance of colleges in relation to Communication Using ICT (C2)*

Figure 12 shows the performance of colleges in relation to the component Student Assessment Using ICT (C3). In general, the performance levels were determined by the percentage of ICT use involving courses. As a whole, most colleges reported having low performance in relation to online submission of work (C31), e-portfolio/e-presentation (C32) and online test/examination (C33), with the percentage of low performance exceeding 75% of colleges.

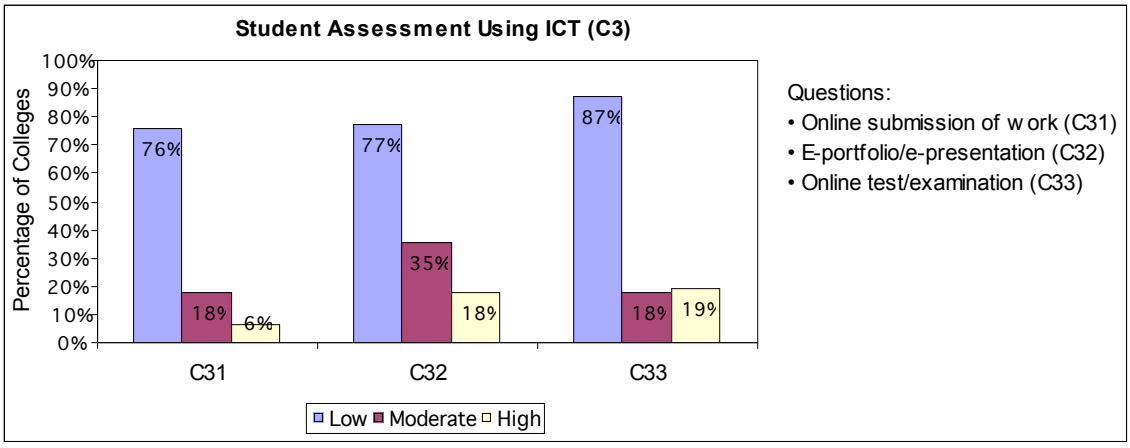

Figure 12: *Performance of colleges in relation to Student Assessment Using ICT (C3)*

Researching Using ICT (D)

Figure 13 shows the performance of colleges in relation to the component Collecting and Processing Research Data (D1). The analysis is based on 10 colleges that were active in academic research. In relation to using Internet and online resources as source of research information (D11), the performance level was high with 50% of colleges used ICT involving more than 75 percent of research projects. Regarding the use of ICT as a means to collect data (D12), the performance was generally moderate with 50% of colleges use ICT involving 25 to 50 percent of research projects. As for using ICT (computer hardware and software) to process/analyse research data (D13), the performance levels were more evenly distributed between low, moderate and high performance levels.

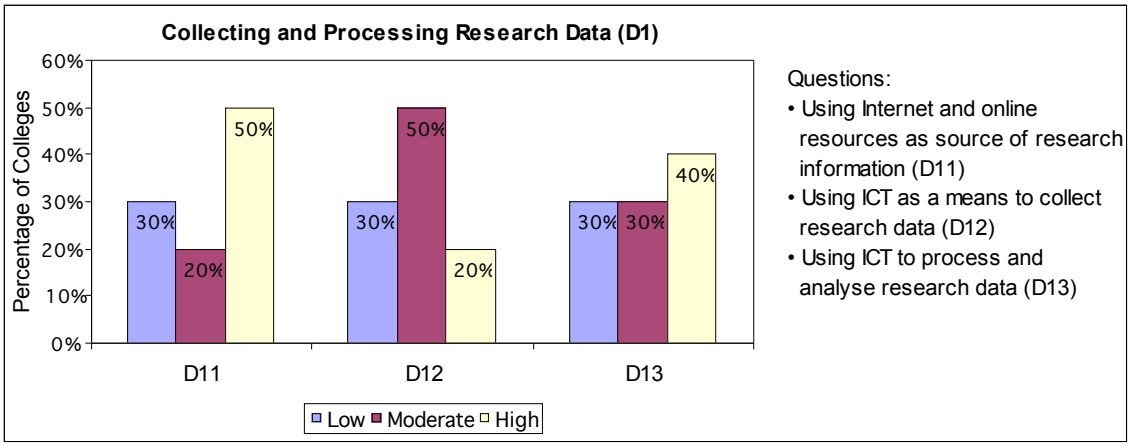

Figure 13: *Performance of colleges in relation to Collecting and Processing Research Data (D1)*

Figure 14 shows the performance of colleges in relation to the component Managing and Publishing Research Information (D2). The analysis is based on 10 colleges that were active in academic research. In relation to using ICT to manage and document research projects (D21) and to communicate and collaborate between research project members (D22), a majority of colleges reported having either high or low performance. As for using ICT to share, disseminate and publish research data/findings (D23), the distribution of performance levels was close to normal. 50% of colleges reported having moderate performance: the ICT use involved 50 to 75 percent of research projects.

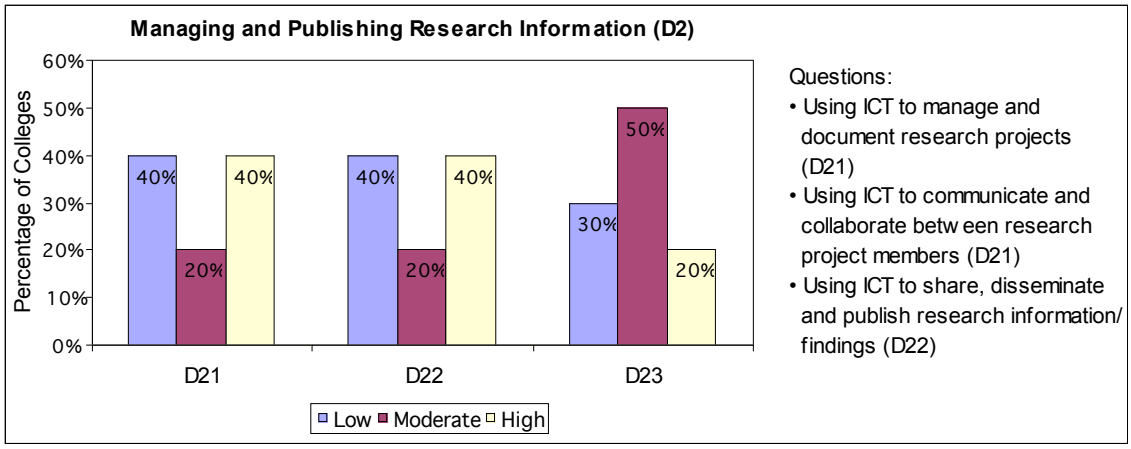

Figure 14: *Performance of colleges in relation to Managing and Publishing Research Information (D2)*

Information Services (E)

Figure 15 shows the performance of colleges in relation to the area Information Services (E). In relation to academic/student information accessible online (E11), a majority of colleges reported having low or moderate performance. The institutional website at 40% of colleges provided only a very brief listing of academic programmes being offered. At 39% of colleges, the institutional website provided general academic information such as programme structure and requirements, and description of courses. At 74% of colleges, learning support materials accessible online (E21) involved less than 25 percent of courses. At 69% of colleges, online journals and databases (E22) were very limited and they were accessible only from the library.

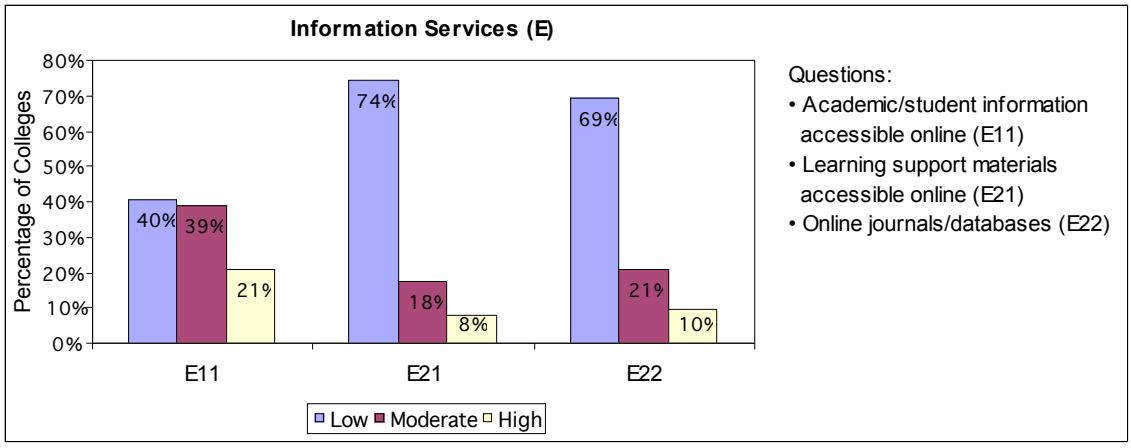

Figure 15: *Performance of colleges in relation to Information Services (E)*
Institutional ICT Support (F)

Figure 16 shows the performance of colleges in relation to the component ICT Skill Development (F1). Regarding the integration of ICT literacy in the curriculum (F11), the performance levels were distributed towards low and moderate performance. 84% of colleges included ICT literacy as a separate unit or course in the curriculum and it was compulsory for some or many of the programmes being offered. Only 16% of colleges made ICT literacy compulsory for all of the programmes being offered. As for ICT skill development for lecturers (F12), only 21% of colleges successfully achieved high performance, involving more than 75 percent of lecturers.

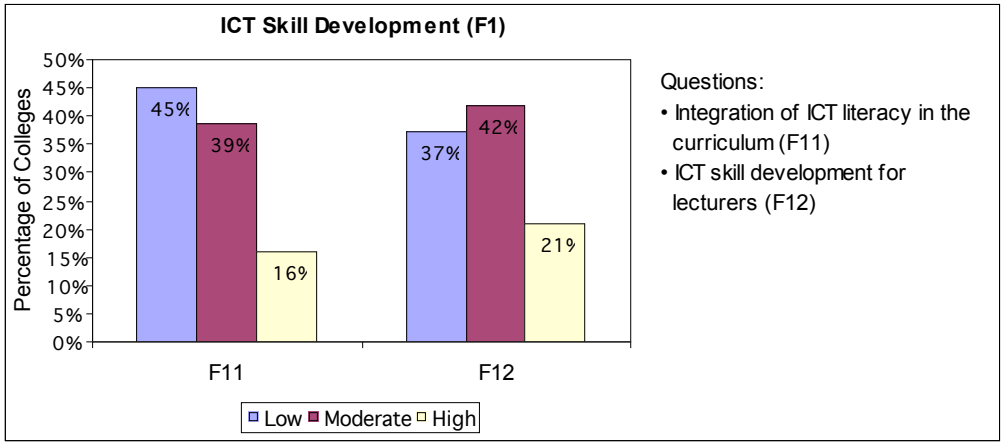

Figure 16: *Performance of colleges in relation to Institutional ICT Support (F1)*

Figure 17 shows the performance of colleges in relation to the component Technical ICT Support (F2). The ratio of technical ICT support staff to computer labs/areas (F21) was at 1:6 or less at 58% of colleges. Regarding the efficiency of technical ICT support (F22), ICT tasks and problems were seldom or not always resolved in a timely and efficient manner at 73% of colleges. 27% of colleges successfully achieved high performance: ICT tasks and problems were always resolved in a timely and efficient manner.

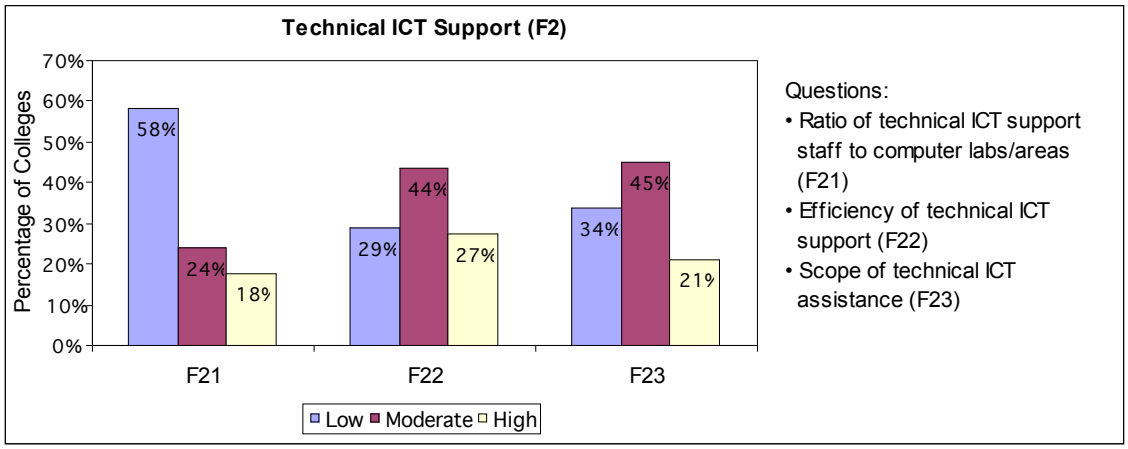

Figure 17: *Performance of colleges in relation to Technical ICT Support (F2)*

As for the scope of technical ICT assistance (F23), 45% of colleges reported having moderate performance: ongoing support for ICT users was readily available, but it was limited to resolving hardware problems, software installations, and general ICT use in common applications. However, only 21% of colleges successfully achieved high performance: ongoing support for ICT users was readily available, encompassing hardware, software, general ICT use, and specific ICT development and use in teaching, learning and research environment.

CONCLUSION

ICT vision, plan, policies and standards provided direction and a basis for decision-making in relation to academic computing at Malaysian colleges. An increasing number of the top management were involved in the development of ICT policy and strategy and provided leadership in driving academic computing initiatives. Throughout the colleges, efforts were underway to build greater awareness and understanding of the ICT vision by the campus community. The focus was changing towards the improvement of learning processes and management. The funding for implementing the ICT plan varied between colleges. However, only a small number of colleges reported having significant funding.

The extent of ICT infrastructure at Malaysian colleges indicated the level of capacity and sophistication in promoting more accessibility to technologies and in supporting the core areas of higher education. The availability of computers for students varied between low, moderate and high performance levels. However, the availability of computers for lecturers was much better, with ratios indicating moderate and high performance. The network infrastructure generally worked well, but they were slow at busy times. Wireless network was still in its infancy with limited coverage at most colleges. While a majority of colleges reported using academic/student information systems to manage academic processes, the use of learning management systems was still not widespread.

In relation to teaching and learning, ICT was more commonly used as a source of information, to support learning and in a role similar to traditional classroom tool. E-learning approaches such as using ICT in parallel with traditional learning and using ICT to enable flexible learning were less evident at Malaysian colleges. The use of ICT to facilitate communication between students and lecturers, and between lecturers was still not widespread at many colleges. As for the use of ICT in student assessment, the practice was almost non-existent at most colleges. Regarding the use of ICT to facilitate research, less than 20% of the Malaysian colleges in the study were actively involved in academic research. Therefore, due to the small sample, it was difficult to generalise the findings. However, it was clear from the analysis that certain colleges displayed high performance in relation to the use of ICT in research. At some colleges, the performance was moderate while the performance was low at other colleges.

ICT-based information services at Malaysian colleges were very important due to the fact that they were important producers of information and knowledge. However, such services were clearly lacking. Information on academic programmes and courses were limited. Learning support materials were still scarce and access to online journals and databases was very limited. To develop ICT skills for students, ICT literacy courses have been included in the curriculum at most colleges. ICT training was also given to lecturers, although it involved only a certain groups of lecturers. There were also insufficient technical support services to maintain the computer labs at a number of the colleges. In addition, the scope of ICT support was limited to resolving hardware problems, implementing software installations and assisting users on general ICT use in common applications.

As ICT plays an important role in driving the Malaysian higher education towards excellence and in achieving Malaysia's aspiration to be a fully developed nation, it is interesting to see how academic computing performance at Malaysian colleges compares with the performance of colleges in a developed nation. In this study, the academic computing performance of colleges in the United Kingdom (UK) is used as a benchmark. A report entitled "ICT and e-learning in further education: management, learning and improvement" (Becta, 2006) describes ICT implementation at UK colleges. The report encompasses all academic computing areas except researching using ICT and involves approximately half of the questions from the Malaysia survey questionnaire. The Malaysia-UK comparison is summarised in Table 3. In general, a lower percentage of Malaysian colleges successfully achieved moderate or high academic computing performance levels compared with their UK counterparts. The largest differences of performance were related to ICT vision plan, policies and standards, ICT infrastructure and institutional ICT support.

Implementing academic computing is a long and expensive process. It may take many years for Malaysian colleges to be successful and to be on par with colleges in developed countries. Although funding is an important factor, many other factors must be taken into account before and during the implementation of academic computing initiatives. Failure to address important issues may result in wasted resources and ineffective implementation. Due to the high costs of investment, it is important for Malaysian colleges to be selective and undertake academic computing initiatives that give the most return. Serious consideration must be given to ensure quick adoption of academic computing and later sustain it once it is adopted.

Based on the study, it can be said that a majority of colleges in Malaysia were implementing some aspects of academic computing. As for the future of academic computing, the potential for growth at large colleges, with significant funding, purpose-built campuses with state-of-the-art teaching-learning and research facilities, is generally good. However, it is difficult to see the smaller colleges, housed at shop lots with limited facilities, to invest much in academic computing. These colleges normally charge a lower fee due to the lack of infrastructure and attract a smaller number of students, many of them from the lower income families. As long as the smaller colleges exist, and without the support of the government, there will always be a digital divide between the large and the small colleges in Malaysia. Although academic computing has the potential to drive higher education in Malaysia towards excellence, it may also create the problem of equity between the rich and the poor in Malaysia.

As for future research, this study can be extended to include other types of colleges such as teacher's training college and matriculation colleges, as well as university type higher education institutions in Malaysia. A comparison between different types of institutions would help identify academic computing trends and would give a more comprehensive picture of academic computing in Malaysian higher education.

Table 3: Comparison of academic computing performances in Malaysia and the United Kingdom

Item of comparison	Related question	% of colleges	
		Malaysia	UK*
ICT Vision, Plan, Policies and Standards			
Participation by the top management in driving the ICT initiatives	A11	58%	85%
E-learning in the ICT strategy/plan	A21	56%	97%
Regular review of ICT strategy/policy	A33	24%	86%
ICT Infrastructure			
Ratio of computers to students (1:8 or better)	B11, B12	76%	93%
Ratio of computers to lecturers (1:1 or better)	B13, B14	37%	Mean ratio at 1:1
Gigabit Ethernet for network	B21	21%	73%
Internet bandwidth 2 MBps or greater	B22	56%	100%
Substantial wireless coverage	B23	19%	12%
Smooth network performance	B24	13%	61%
Substantial display screen facilities in classrooms	B31	19%	33%
Learning management systems	B42	8%	82%
Teaching and Learning Using ICT			
Widespread use of ICT to support learning	C12	40%	52%
Widespread ICT use as a traditional classroom tool	C13	37%	34%
Widespread ICT use in parallel with traditional learning	C14	19%	31%
Widespread ICT use to enable flexible learning	C15	11%	25%
Widespread ICT use to facilitate communication between lecturers and students	C21	10%	25%
Widespread online submission of work	C31	6%	9%
Widespread online test/examination	C33	19%	9%
Information Services			
The use of ICT to disseminate academic information	E11	60%	72%
Substantial learning material accessible online	E21	8%	34%
Institutional ICT Support			
ICT skills development for students	F11	84%	85%
ICT skills development for lecturers	F12	21%	99%
Support for ICT development in teaching-learning	F23	21%	68%

** Source: Becta (2006)*

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Appendix A

Table A1: *Rubric for ICT Vision, Plan, Policies and Standards (A)*

ICT Vision (A1)	**Levels of Performance**		
	Low	**Moderate**	**High**
Who drives the ICT vision (A11)	Driven by enthusiastic lecturers.	Driven by ICT specialists and lecturers.	Driven by the top management by providing leadership.
Focus of the ICT vision (A12)	Focus on the learning of ICT skills and the uses of technology.	Focus on the infrastructure and improvement of learning and the management of learning.	Focus on ICT based learning environment based on ICT and technology integration.
Awareness and understanding of the ICT vision by the campus community (A13)	Generally unaware of any ICT vision.	Efforts are underway to build greater awareness and understanding	Good awareness and are well informed.
ICT Plan (A2)	**Levels of Performance**		
	Low	**Moderate**	**High**
The scope of ICT plan (A21)	Limited to the acquisition of basic hardware and software.	Encompasses infrastructure, the use of ICT in teaching and learning and professional development.	Encompasses infrastructure, the use of ICT in teaching, learning and research, professional development and support.
Who participates in the development of ICT plan (A22)	Developed by ICT specialists.	ICT specialists and lecturers contribute to the development of the plan.	Developed with participation from the top management, lecturers, staff and students.
Funding for implementation of ICT plan (A23)	Limited amount.	Fair amount.	Significant amount.

ICT Policies and Standards (A3)	**Levels of Performance**		
	Low	**Moderate**	**High**
The scope of ICT policies and standards (A31)	Confined to the purchasing of equipments and access for learners.	Encompasses infrastructure, learner access, information literacy, acceptable use and ethics.	Encompasses infrastructure, learner access, information literacy, teaching and learning, acceptable use, ethics, copyright, intellectual property and incentives.
The level of ICT policy development and implementation (A32)	Very few are in place.	Many are in place, but are inconsistently implemented.	Many are in place and consistently implemented.
Review of ICT policies and standards (A33)	None.	Reviewed from time to time based on requests and recommendations of ICT specialists and lecturers.	Reviewed regularly based on the recommendations and feedback from ICT specialists, lecturers and students.

Source: Mokhtar et al. (2006)

Appendix A

Table A2: *Rubric for ICT Infrastructure (B)*

Computers (B1)	**Levels of Performance**		
	Low	**Moderate**	**High**
Ratio of all computers to students (B11)	1:9+	1:8 to 1:4	1:3 or better
Ratio of internet-enabled computers to students (B12)	1:9+	1:8 to 1:4	1:3 or better
Ratio of all computers to lecturers (B13)	1:5+	1:2 to 1:4	1:1 or better
Ratio of internet-enabled computers to lecturers (B14)	1:5+	1:2 to 1:4	1:1 or better
Network and Internet (B2)	**Levels of Performance**		
	Low	**Moderate**	**High**
Network specification (B21)	10 MB Ethernet or less.	100 MB Ethernet.	Gigabit Ethernet or better.
Internet bandwidth (B22)	Dialup or broadband up to 1 MBps.	Broadband, 2 to 7 MBps.	Broadband, 8 MBps or better.
Wireless coverage (B23)	Less than 25% of learning area.	25% to 50% of learning area.	More than 50% of learning area.
Network/Internet performance (B24)	Slowness/unreliability a frequent problem.	Generally works well, but slow at busy times.	Always smooth without appreciable delay.
Display Screen Technologies and Peripherals (B3)	**Levels of Performance**		
	Low	**Moderate**	**High**
Classrooms equipped with display screen technologies (B31)	Less than 25% of classrooms.	25% to 50% of classrooms.	More than 50% of classrooms.
Peripherals (B32)	Mostly printers.	Printers and other peripherals such as scanners, digital cameras and audio/video recorders.	A wide range of peripherals such as printers, scanners, digital cameras, audio/video recorders, portable devices, specialised devices for research and instructional purposes, computer conferencing facilities.

Software and Information Systems (B4)	**Levels of Performance**		
	Low	**Moderate**	**High**
Application software (B41)	Office applications (word processing, spreadsheets, databases and presentation software).	Office applications, subject specific software, multimedia authoring and video/audio production, web tools.	Office applications, subject specific software, multimedia authoring and video/audio production, web tools, collaborative and conferencing, and specialised software for instruction and research.
Learning platforms (B42)	None available.	Web pages on campus Intranet and learning material files stored in public folders on network.	Commercial or customised open source learning management system offering a wide range of functions.
Academic/student information systems (B43)	Academic/student data are stored mainly in spreadsheets and databases.	Academic/student information systems are limited to mainly registration and examination functions. Access is largely limited to administrative staff.	Academic/student information systems encompass a variety of academic/student functions. Some of the functions have become paperless. Specific functions can be access by staff and students from the Intranet/Internet.

Source: Mokhtar et al. (2006)

Appendix A

Table A3: *Rubric for Teaching and Learning Using ICT (C)*

E-learning Approaches (C1)	**Levels of Performance**		
	Low	**Moderate**	**High**
Using ICT as a source of information in preparing lesson plans and teaching material (C11)	ICT use involves less than 25% of courses/lecturers.	ICT use involves 25% to 50% of courses/lecturers.	ICT use involves more than 50% of courses/lecturers.
Using ICT to support learning (C12)	Infrequent ICT use (once a month or less) and it involves less than 25% of courses/ lecturers.	Regular ICT use (once every two weeks) and it involves 25% to 50% of courses/lecturers.	Frequent ICT use (once a week) and it involves more than 50% of courses/lecturers.
Using ICT in a role similar to traditional classroom tool (C13)	Infrequent ICT use (once a month or less) and it involves less than 25% of courses/ lecturers.	Regular ICT use (once every two weeks) and it involves 25% to 50% of courses/lecturers.	Frequent ICT use (once a week) and it involves more than 50% of courses/lecturers.
Using ICT in parallel with traditional learning (C14)	ICT use involves less than 25% of courses/ lecturers.	ICT use involves 25% to 50% of courses/ lecturers.	ICT use involves more than 50% of courses/ lecturers.
Using ICT to enable flexible learning (C15)	ICT use (at least for specific modules) involves less than 25% of courses.	ICT use (at least for specific modules) involves 25% to 50% of courses.	ICT use (at least for specific modules) involves more than 50% of courses.
Communication Using ICT (C2)	**Levels of Performance**		
	Low	**Moderate**	**High**
Using ICT as a means of academic related comm./ discussion between students and lecturers (C21)	ICT use involves less than 25% of students/ lecturers.	ICT use involves 25% to 50% of students/ lecturers.	ICT use involves more than 50% of students/ lecturers.
Using ICT as a means of academic related communication/discussion between lecturers (C22)	ICT use involves less than 25% of lecturers.	ICT use involves 25% to 50% of lecturers.	ICT use involves more than 50% of lecturers.

Student Assessment Using ICT (C3)	**Levels of Performance**		
	Low	**Moderate**	**High**
Online submission of work (C31)	ICT involves less than 25% of courses.	ICT involves 25% to 50% of courses.	ICT use involves more than 50% of courses.
E-portfolio/e-presentation (C32)	ICT involves less than 25% of courses.	ICT involves 25% to 50% of courses.	ICT use involves more than 50% of courses.
Online test/examination (C33)	ICT involves less than 25% of courses.	ICT involves 25% to 50% of courses.	ICT use involves more than 50% of courses.

Source: Mokhtar et al. (2006)

Appendix A

Table A4: *Rubric for Researching Using ICT (D)*

Collecting and Processing Research Data (D1)	**Levels of Performance**		
	Low	**Moderate**	**High**
Using Internet and online resources as source of research information (D11)	ICT involves less than 50% of research projects.	ICT involves 50% to 75% of research projects.	ICT use involves more than 75% of research projects.
Using ICT as a means to collect data (D12)	ICT involves less than 25% of research projects.	ICT involves 25% to 50% of research projects.	ICT use involves more than 50% of research projects.
Using ICT (computer hardware and software) to process/analyse research data (D13)	ICT involves less than 50% of research projects.	ICT involves 50% to 75% of research projects.	ICT use involves more than 75% of research projects.
Managing and Publishing Research Information (D2)	**Levels of Performance**		
	Low	**Moderate**	**High**
Using ICT to manage and document research projects (D21)	ICT involves less than 50% of research projects.	ICT involves 50% to 75% of research projects.	ICT use involves more than 75% of research projects.
Using ICT to communicate and collaborate between research project members (D22)	ICT involves less than 25% of research projects.	ICT involves 25% to 50% of research projects.	ICT use involves more than 50% of research projects.
Using ICT to share, disseminate and publish research data/findings (D23)	ICT involves less than 50% of research projects.	ICT involves 50% to 75% of research projects.	ICT use involves more than 75% of research projects.

Source: Mokhtar et al. (2006)

Table A5: *Rubric for Information Services (E)*

Academic Information (E1)	**Levels of Performance**		
	Low	**Moderate**	**High**
Academic/student information accessible online (E11)	Institutional website provides only a very brief listing of academic programmes on offer.	Institutional website provides general academic information such as programme structure and requirements, and description of courses.	Institutional website provides a wide variety of information, including a detail description of programmes and courses, as well as other academic/ student related information such as academic calendars, activities and announcements.
Learning Materials and References (E2)	**Levels of Performance**		
	Low	**Moderate**	**High**
Learning support materials accessible online (E21)	Learning support materials accessible online involve less than 25% of courses.	Learning support materials accessible online involve 25% to 50% of courses.	Learning support materials accessible online involve more than 50% of courses.
Online journals/databases (E22)	Access to online journals and databases is very limited and they are accessible only from the library.	Access to online journals and databases covers many related fields of study and they are accessible from the library and certain computers within campus.	Access to online journals and databases covers all related fields of study and they are sufficiently accessible by staff and students from within and outside campus.

Source: Mokhtar et al. (2006)

Appendix A

Table A6: *Rubric for Institutional ICT Support (F)*

ICT Skill Development (F1)	**Levels of Performance**		
	Low	**Moderate**	**High**
Integration of ICT literacy in the curriculum (F11)	ICT literacy is included as a separate unit/ course in the curriculum and is compulsory for some of the programmes being offered.	ICT literacy is included as a separate unit/ course in the curriculum and is compulsory for many of the programmes being offered.	ICT literacy is included as a separate unit/ course in the curriculum and is compulsory for all of the programmes being offered.
ICT skill development for lecturers (F12)	ICT skill development involves less than 25% of lecturers.	ICT skill development involves 25% to 75% of lecturers.	ICT skill development involves more than 75% of lecturers.
Technical ICT Support (F2)	**Levels of Performance**		
	Low	**Moderate**	**High**
Ratio of technical ICT support staff to computer labs/areas (F21)	1:6+	1:3 to 1:5	1:2 or better
Efficiency of technical ICT support (F22)	ICT tasks and problems are seldom resolved in a timely and efficient manner.	ICT tasks and problems are not always resolved in a timely and efficient manner.	ICT tasks and problems are always resolved in a timely and efficient manner.
Scope of technical ICT assistance (F23)	Support for ICT users is available when requested, but limited to resolving hardware problems and software installations.	Ongoing support for ICT users is readily available, limited to resolving hardware problems, software installations and the general ICT use in common applications.	Ongoing support for ICT users is readily available, encompassing hardware, software, general ICT use and specific ICT development/use in teaching-learning and research environment.

Source: Mokhtar et al. (2006)

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New technologies for teaching and learning: Challenges for higher learning institutions in developing countries

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ABSTRACT

The application of Information and Communication Technologies (ICTs) is already changing the organization and delivery of higher education. The pedagogical and socio-economic forces that have driven the higher learning institutions to adopt and incorporate ICTs in teaching and learning include greater information access; greater communication; synchronous and asynchronous learning; increased cooperation and collaboration, cost-effectiveness and pedagogical improvement. However, 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. This paper discusses new learning and training technologies considering their pedagogical, cost and technical implications. It also discusses challenges for integrating these technologies in higher learning institutions with examples from Tanzania, and giving best practice approaches for addressing each of the challenges.

Keywords: *information and communication technology, e-learning, teaching and learning technologies, higher learning institutions, developing countries*

INTRODUCTION

Developments in Information and Communication Technologies (ICTs) have impacted all sectors of society, including the education sector. In higher education, application of ICTs in form of e-learning is already changing teaching and learning processes. There are many pedagogical[1] and socio-economic factors that have driven higher learning institutions to adopt e-learning. These include greater information access; greater communication via electronic facilities; synchronous learning; increased cooperation and collaboration, cost-effectiveness (e.g. by reaching different students and in greater numbers) and pedagogical improvement through simulations, virtual experiences, and graphic representations. Both trainers and learners can choose more appropriate applications which are flexible in time, in place, personalized, reusable, adapted to specific domains and more cost-efficient (Fisser, 2001; Pelliccione, 2001).

On the other hand, there are a number of challenges that face universities in developing countries as they seek to implement the e-learning systems. AAU (2001) asserts that African universities which should be in the forefront of ensuring Africa's participation in the ICT revolution, they are themselves unable and ill-prepared to play such a leadership role. This is because of the information infrastructure of African universities which is poorly developed and inequitably distributed.

This paper discusses the application of ICTs in teaching and learning by reviewing the e-learning context, and then focuses on the pedagogical, cost and technical implications of different ICTs that can be used for e-learning purposes. Few examples are also picked from some universities in Tanzania. Challenges for integrating these technologies in higher learning institutions in developing countries are discussed, giving best practice approaches for addressing each of the challenges.

E-LEARNING IN CONTEXT

E-learning refers to the use of ICTs to enhance and support teaching and learning processes. It is the instructional content or learning experiences delivered or enabled by electronic technologies and it incorporates a wide variety of learning strategies and technologies. E-learning ranges from the way students use e-mail and accessing course work online while following a course on campus to programmes offered entirely online (Commission on Technology and Adult Learning, 2001; OECD 2005). It is thus an alternative solution, which enlarges accessibility to training and becomes essential to complement the traditional way of teaching (i.e. face-to-face).

E-learning encompasses a continuum of integrated educational technologies. At one end are applications like PowerPoint, which have little impact on learning and teaching strategies or the organization. At the other end are virtual learning environments (VLEs), and managed learning environments (MLEs), which can have significant impact upon learning and teaching strategies, and upon the organization (OSU, 2003; Julian *et al,* 2004). Broadly, OSU (2003) views the continuum of e-learning as the educational technology from the supplemental use of technology in the classroom, through blended or hybrid uses comprising a mix of face-to-face and fully online instruction, to fully online synchronous and asynchronous distance learning environments delivered to remote learners.

In the supplemental use of ICTs to complement traditional learning experiences, the instructor teaches all sessions in the classroom but with the occasional use of technology, such as Web-based activities, multimedia simulations, virtual labs, and/or online testing (Arabasz and Baker, 2003). Blended learning denotes a solution that combines several different delivery methods, such as collaboration software, web-based courses, computer communication practices with traditional with traditional face-to-face instructions (Mortera-Gutierrez 2005). On the other hand, distance learning is conducted solely online where interaction may be synchronous or asynchronous (OSU, 2007). Synchronous learning requires the teachers and students to interact at the same time though they may be dispersed geographically. On the other hand, asynchronous learning allows teachers and students to interact and participate in the educational process at different time irrespective of their locations (Chen *et al.,* 2004). Actually, the use of synchronous with asynchronous activities is determined by the available technology, cost, and maintenance and is adjusted to suit each course, instructor and audience (Graziadei *et al.,* 1997).

E-LEARNING TECHNOLOGIES

Functionally, e-learning includes a wide variety of learning strategies and ICT applications for exchanging information and gaining knowledge. Such ICT applications include television and radio; Compact Discs (CDs) and Digital Versatile Discs (DVDs); video conferencing; mobile technologies; web-based technologies; and electronic learning platforms. This section discusses what these ICTs entail and their pedagogical, technical and cost implications.

Television (TV) refers to a receiver that displays visual images of stationary or moving objects both live or pre-recorded and mostly accompanied by sound which is electronically captured, processed and re-displayed. Likewise, this applies to the term radio – both live generated sound as well as pre-recorded sound. Both TV and radio can improve teaching and learning process in different ways such as by showing processes and activities that may not otherwise be available to the learner. However, digitalization has taken over analog audio and video systems.

Compact Discs (CDs) and Digital Versatile Discs (DVDs) are based upon laser technologies for writing and reading data. They provide a way in which a large amount of multimedia training

material can be stored and made available to end-users: CD-ROM can store up to 1GB while DVD can store up to 17 GB. CD-ROM and DVD-based products can be linked with online information sources. This hybrid approach provides the user with access to media-rich up-to-date information.

Video conferencing is a system where two or more participants, based in different physical locations, can see and hear each other in real time (i.e. live) using special equipment. It is a method of performing interactive video communications over a regular high-speed Internet connection. A videoconference can be either two-way (point-to-point) or multipoint, linking three or more sites with sound and video. It can also include data sharing such as an electronic whiteboard where participants can draw on, or text based real time 'chat'. Interactive whiteboard is simply a surface onto which a computer screen can be displayed, via a projector (Department for Education and Skill, 2004).

Mobile e-Learning (sometimes called 'm-Learning') is a new way to learn using small, portable computers such as personal digital assistants (PDAs), handheld computers, two-way messaging pagers, Internet-enabled cell phones, as well as hybrid devices that combine two or more of these devices into one (Hunsinger, 2005). These technologies have enormous potential as learning tools.

World Wide Web (WWW) is set of software tools and standards that allow users to obtain and distribute information stored on a server and connected to Internet. WWW is a decentralized information system, in which anyone can add new information whenever he/she wants. Lecture notes and other teaching materials are placed on the WWW and linking useful websites to these resources for students to access. In the recent years, web and Internet technologies have matured significantly by providing a uniform access media for both asynchronous and synchronous learning. This phenomenon has significantly increased the popularity of on-line learning (Chen *et al.,* 2004). The usage of web technologies in e-learning are further enhanced with the web 2.0, which is a set of economic, social, and technology trends that facilitate a more socially connected Web where everyone is able to add to and edit the information space (Anderson, 2007). These include blogs, wikis, multimedia sharing services, content syndication, podcasting and content tagging services (Anderson, 2007).

E-learning platforms (sometimes called learning management systems (LMS)) are applications used for delivery of learning content and facilitation of learning process. They are developed for administration and teaching in tertiary education. This software enables the administrators and lecturers to treat enrolment data electronically, offer electronic access to course materials and carry out assessments (OECD, 2005). The activities managed by the LMS vary from instructor-led classroom training to educational seminars to Web-based online training. In addition to managing the administrative functions of online learning, some systems helps create, reuse, locate, deliver, manage, and improve learning content. These systems are called Learning Content Management Systems (LCMS) (Rengarajan, 2001). LCMS actually provide tools to deliver instructor-led synchronous and asynchronous online training. The LCMS provides tools for authoring content as well as virtual spaces for learner interaction (such as discussion forums and live chat rooms). Rengarajan (2001) emphasizes the importance of integrating both LMS and LCMS because they share different levels of administrative interests in the same entities. Lack of smooth integration between the products results in a broken solution with administrative conflicts.

Many e-learning platforms (both LMS and LCMS) currently available are based on either proprietary e-learning software (PES) or open source e-learning software (OSS). OSS usage in implementing e-learning systems is more emphasized in developing world due to the challenges faced when implementing the PES. Coppola (2005) describes two characteristics of PES that

make it ill-suited: (1) the rapidly escalating cost of proprietary software leaves too little of an institution's ICT budget available for creative exploration, once the software has been installed and minimally supported; (2) reduced flexibility to adapt to institutional culture, teaching practices, and disciplinary uniqueness occurs when software development is driven by mass market economics.

Open source software offers the potential to reduce the cost of the software while providing the universities greater control over its destiny. Elimination or reduction of license leaves more budgets available to invest in adapting and managing the software; offers reliability, performance and security over proprietary software due to the availability of the source code, which allows vulnerabilities to be identified and resolved by third parties and it is easy to customize (Wheeler 2003; Coppola, 2005). Some of the widely used open-source e-learning software programs are the Claroline and Moodle.

PEDAGOGICAL, TECHNICAL AND COST IMPLICATIONS OF E-LEARNING TECHNOLOGIES

e-learning technologies	**Pedagogical implications**	**Technical implications**	**Cost implications**
TV/Radio	Effective use of TV/radio depends on three key moments in the application: before, during and after the viewing session and give instructions, explanations, questions or evaluation before and after each moment	Equipments are needed depending on the objectives and the scope of the training application, which includes audiocassette, video camera, PCs, editing software, distribution channel and receiving and displaying equipment.	Costly in terms of TV/radio production, which includes, animation and graphic designers, hardware, access to the broadcast network
CD/DVD	• Simulation for self-study • Used with the presence or remote support of the trainer	Hardware that meets their specifications - graphic screens, MPEG[2] cards, CD or DVD reader and appropriate software	Costs are higher than for printed materials - replication downloading free products or buying ready-made products can lower the costs.
Web-based technologies	Permanent accessibility (24 hours, all days of the week), speed, direct communication, links to related topics and up-to-date notes.	• Fast computers with sound cards and reliable Internet connection are required. • The following team is needed for implementing web-based training: (a)	Hardware, technical expertise and Internet subscriptions costs

		Instructional designer familiar with computer delivered instruction; (b) A programmer or author to use the authoring tool; (c) A graphic artist; (d) A subject matter expert; (e) A webmaster for maintaining the programme on the server.	
videoconferencing	• New pedagogical methods required to provoke interaction • Require small groups • Both trainers and learners require some basic training	Required equipment : (i) Sound proofing and controlling the lighting conditions; (ii) Audio-visual peripherals – TV monitor or video projector, camera(s), microphone(s) and sound playback; (iii) Videoconferencing codec (Rollabout) (iv) Multimedia PC (with PCI-based as well as software based videoconferencing codec) and (v) More bandwidth is needed for higher-quality images	There are two types of costs: setting up the videoconferencing system and operational costs.
e-learning platforms	▪ Adding and changing content as course is progressing. ▪ Template for inclusion of course content. ▪ Support multimedia presentation of course content while others are text based. ▪ Complex	(i) Server platform hardware requirements; (ii) Client platform hardware requirements; (iii) Operating system/cross platform; (iv) organization/ registration/ administration; and (v) The learning content should be in	▪ Hardware cost implications ▪ Cost for maintenance ▪ Operational costs (technical and administrative support) ▪ License fee (annual fee).

	structuring of content allowing for multiple links and cross-reference possibilities.	standard formats that can easily be stored, accessed and distributed. Such formats include HTML, PDF, RTF, GIF, JPEG and MPEG.	

E-LEARNING AT HIGHER LEARNING INSTITUTIONS IN TANZANIA

As it is the case with other African countries, the implementation of e-learning platform in Tanzanian universities is still very low despite of the opportunities that are provided by the open source technology and the conducive environment created by the government. In 2003, the Tanzania government enacted National ICT policy and the Tanzania Communications Regulatory Authority Act (URT 2003). These two major actions made it possible that by 2007 licenses for two basic telephone service provider, four land cellular mobile telephone operators, one global mobile personal communication service (GMPCS), eleven public data communication companies, nine private (dedicated) data services companies, and 24 public Internet service providers (ISPs) were issued (TCRA 2007). The government has also abolished all taxes related to computers and allied equipment, and reduced license fees and royalty payable by the telecommunication operators (Mutula and Ahmadi, 2002; National Committee for WSIS Prepcom II 2003; URT 2003).

In the case of higher education, among ten universities, only the University of Dar es salaam (UDSM) has managed to implement the e-Learning platform in Tanzania. UDSM has implemented e-learning platform by using WEBCT and Blackboard, which are e-learning proprietary software. While, other universities such as Sokoine University of Agriculture (SUA), Mzumbe University and Open University of Tanzania (OUT) possess basic ICT infrastructure such as Local Area Network (LAN), Internet, computers, CDs and DVDs facilities that form the basis for the establishment of e-learning platform.

UDSM implemented the e-Learning system through the financial support from the Flemish University Council. The major problem that UDSM face in the implementation of TEIL project is the issue of software license. It is from this fact that University of Western Cape (UWC) in South Africa initiated a KEWL (Knowledge Environment for Web-Based Learning) project for developing e-learning platform. Currently the UWC has started another project called KEWL - NextGen project under AVOIR (African Virtual Open Initiatives and Resources). AVOIR is a network of African universities working on Open Source applications. Their primary work at the moment is in developing a next-generation of the KEWL learning management software originally developed at the University of the Western Cape in South Africa. The University of Dar es ealaam and Sokoine University of Agriculture are partners in this project. Video conference facility (available at UDSM Computing Centre and Tanzania Global Learning Centre (TGLC) also offers open and distance learning to university students and community at large in Tanzania.

Sokoine University of Agriculture (SUA) has also started implementing e-learning platform by using Moodle software. Moodle is a course management system (CMS) - a free, open source software package designed using sound pedagogical principles, to help educators create effective online learning communities. Moodle is also a CMS designed to help educators who want to create quality online courses. The software is used all over the world by universities, colleges, schools and organizations.

Another Tanzanian university, the Open University of Tanzania (OUT) provides an alternative to conventional university education and gives opportunity to those who are working full time and those with household commitment to acquire higher education. Although the university has the basic ICT infrastructure (such as Internet, computers, local area network), it still uses traditional way with face to face meeting to impart knowledge to its students who are spread in all regions of Tanzania. OUT has enacted its own ICT policy, which guides on how to use ICT to fulfill the functions of the university that are teaching, research and consultancy. Currently, there are some initiatives to use an Open Source learning management system called Atutor for students, starting with the B.Sc (ICT). If the pilot implementation will be successful then other degree programmes will also be offered through the blended e-learning and distance learning.

ICT IMPLEMENTATION CHALLENGES IN HIGHER LEARNING INSTITUTIONS

Despite of the achievements revealed by some of the Tanzanian universities in implementing ICT for teaching and learning processes, these universities still face a lot of challenges in undertaking such a process.

Lack of systemic approach to ICT implementation: Integration of ICTs in the functions of any organization is a complex process that needs to be fully conceptualized and defined from the beginning. However, this is not the case in many higher learning institutions in developing countries as most of them have embraced the ICT integration process without clear plans to guide the way. The institution ICT policy and strategic plan should be defined to provide a framework for the development and implementation of specific ICT projects. The diversity and competing interests of different stakeholders in the institution should be recognized when developing ICT policy and a strategic plan. The following issues, amongst others, should be taken into consideration: (i) ICT infrastructure already in place; (ii) ICT skill levels in the institution; (iii) number of staff and students in each department and projected growth; (iv) academic management process: curriculum development, assessment methods and administration; (v) cost-effectiveness analysis (including hidden costs) and the choice of proper technologies for the needs of the institution; and (vi) staff development in new technologies

Awareness and attitude towards ICTs: It is important for all stakeholders in the institution to know the existing ICT facilities and services and their importance in relation to their specific tasks. However, according to Tusubira and Mulira (2004), there tends to be some vague knowledge about ICTs, some interpreting them as simply advanced technologies that require a lot of money and very advanced skills. They are not appreciated as a means of creating efficiency and cost-effectiveness. Lack of awareness goes along with attitude. Positive attitude towards ICTs is widely recognized as a necessary condition for their effective implementation (Woodrow 1992). Full involvement of all stakeholders in the implementation process is a key to addressing awareness and attitude problem. Formally organized awareness programmes, visits to similar institution where success has occurred, and short trainings can contribute to raise the awareness and change the attitude of stakeholders towards facilities and services.

Administrative support: Administrative support is critical to the successful integration of ICTs into teaching and learning processes. Administrators can provide the conditions that are needed, such as ICT policy, incentives and resources. The commitment and interest of the top management and other leaders at every level is the most critical factor for successful implementation of ICTs. According to Cameron and Ulrich (1986), a transformational leadership is a leadership that involves a process of fundamental change which is required for the institutions to adapt to changes brought about by the information society[3]. Dwyer *et al* (1997) emphasize that for the integration of ICTs to be effective and sustainable, administrators themselves must be competent

in the use of the technology, and they must have a broad understanding of the technical, pedagogical, administrative, financial, and social dimensions of ICTs in education.

Technical support: This includes issues like installation, operation, maintenance, network administration and security. This is an important part of the implementation and integration of ICT in education system. In most cases however, technical support is not available, which implies that trainers and students require some basic troubleshooting skills to overcome technical problems when using ICTs. However, in most of the developing countries including Tanzania there are very few technical experts to implement and maintain ICTs (Bakari *et al.*, 2001; National Committee for WSIS Prepcom II 2003). Appropriate strategies should be in place to ensure that integration of ICTs in teaching and learning process goes together with the recruitment, training, retaining and retention of required staff.

Transforming higher education: Many institutions fail to integrate ICTs into teaching and learning because they are using ICTs to replicate their traditional practices, content and control. Their plans appear to be driven by ICTs and not by pedagogical rationale and focus (Ehrmann 1995). However, effective integration requires a transformation process where all stakeholders are involved to re-examine their existing structures and practices, as pointed out by Bates (2000: 13), if universities and colleges are to successfully adopt technologies for teaching and learning, many more than minor adjustments in current practice will be required. Indeed, the effective use of technology requires a revolution in thinking about teaching and learning. Part of that revolution necessitates restructuring universities and colleges – that is, changing the way higher education institutions are planned, managed and organized.

Staff development: Integration of ICT in teaching and learning does not only deal with introduction of new hardware and software, but both trainers and the students have to adopt new roles, and change their ICT behaviors and ways of teaching and learning. As Farrell (1999) points, training and workshops are needed not only to improve the skills of the instructors, but also as a means of getting them involved in the process of implementing and integrating ICTs in teaching and learning. For example, faculty staff require training not just in the choice and use of appropriate technologies, but more fundamentally in how people learn and in instructional design (Bates 1997). Pelgrum (1999) recommends staff training to be a continuous process for regular updates with the development of ICTs.

Lack of ownership: It is critical that all stakeholders contribute to and own the policy and the plan. Institution-wide consultations are necessary in the identification of challenges, and in proposing areas for ICT application. Stakeholders must agree on the projects to be implemented, including their role therein. Employees must see ICTs as tools rather than as competitors for their jobs. A related challenge is getting stakeholders in an organization to think for the organization, rather than the natural tendency of considering the interests of their particular departments.

Inadequate funds: Financial resources form a key factor to the successful implementation and integration of ICTs in education. It is obvious that countries with higher financial resource bases stand a good chance than those with limited resources to reap benefits offered by ICTs. In addressing the problem of limited funds and sustaining donor funded projects, higher learning institutions can do the following: (i) adopt freeware and open source software for teaching and learning activities; (ii) continuously press for more funds from their governments; and (iii) diversify sources of funds to have a wide financial base.

CONCLUSIONS AND RECOMMENDATIONS

ICTs provide great opportunity for universities in developing countries to improve their teaching and learning processes. So far most of the universities in developing countries possess basic ICT infrastructure such as Local Area Network (LAN), internet, computers, video, audio, CDs and DVDs, and mobile technology facilities that form the basis for the establishment of e-learning. It is argued that, universities in developing countries should adopt e-learning technologies to improve teaching and leaning processes. Pedagogical, technical and cost issues should be taken into account for each specific technology when integrating ICTs in teaching and learning practices.

Endnotes

[1] The strategies, techniques, and approaches that trainers use to facilitate learning.

[2] Moving Picture Experts Group. The standard for compression and storage of motion video, for example, videos available though the World Wide Web.

[3] A society in which economic and cultural life is critically dependent on information and communications technologies.

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Problems of policy formulation and implementation: The case of ICT use in rural women's empowerment in Ghana

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ABSTRACT

This paper sheds some light on the logic of designing a disaggregated ICT policy to empower rural women using information from selected rural areas in Ghana. The study uses survey data from three regions in Ghana to determine the factors influencing rural women's' choice of information delivery technology. The three regions are the Upper East, Ashanti, and Greater Accra. The basic hypothesis in the study was that the wide differences in the socio-economic status of rural women households' influences their choice of information delivery technology and also their willingness to pay for a selected technology. This basic hypothesis was addressed using data from a survey instrument administered to 100 households from each of the three designated regions. The study concludes that there is the need to examine ICT use in empowering rural women within a 'holistic' context. The results point to a merit in allocating considerable authority to regional and local authorities in setting priorities and approaches to empowering rural women through the use of ICT.

Keywords*: ICT-women-rural women-radio-extension-policy-empowerment*

INTRODUCTION

The United Nations supported Millennium Development Goals (MDGs) and Ghana's own Poverty Reduction Strategy Program (GPRSP) emphasizes the *empowering of women* as a goal to address the problem of poverty. One study has defined 'empowerment' as,

> *"a process whereby women become able to organize themselves to increase their own self-reliance, to assert their independent right to make choices and to control resources which will assist in challenging and eliminating their own subordination" (Karl 1995, p.190).*

The use of Information and Communication Technology (ICT) is now considered a critical element in the effort to empower rural women because empowerment entails the ability and freedom to make choices in the social, political, and economic arenas. In turn, choice-making is driven by both the quality and quantity of information delivered to women in rural households. The challenge facing a developing country like Ghana is how effectively information could be made available to rural households to enhance choice-making. In attempting to respond to this challenge, policy makers must address a formidable question. Given the budget restrictions facing developing countries, is it possible to disaggregate implementation of ICT policies so as to respond to the unique needs of rural women, or are countries perpetually tied to the implementation of "one-size-fit-all" ICT policies to empower rural women?

SCOPE OF STUDY

This paper sheds some light on the logic of designing a disaggregated ICT policy to empower rural women using information from selected rural areas in Ghana. Specifically, the study uses survey data from three regions in Ghana to determine the factors influencing rural women's' choice of information delivery technology. The three regions are the Upper East, Ashanti, and

Greater Accra. The information delivery technologies considered are private radio, community radio, and extension agents who distribute printed materials.

The Greater Accra Region where the capital city, Accra, is located is the most urban followed by Ashanti Region which has the second largest city of the country, Kumasi. On the contrast, Upper East Region is one of the three poorest regions in the country and therefore has a wider rural coverage. There are marked rural urban differences in Ghana which is generally reflected in all the regions of the country. The Ghana Living Standard Survey 4 (GLSS 4 2000) indicates that household expenditure is almost 60% higher in urban areas than in rural areas, while per capita expenditure is just over 80% higher. In the rural areas, per capita expenditure is higher in the forest zone, (*where Ashanti Region is located*) than in the coastal zone (*where Greater Accra Region is located*), which in turn is higher than in the savannah zone (*which covers Upper East Region*). Table 1 shows a profile of the three regions surveyed. The table gives a description of the proportion of adults who have been to school, by sex and locality; mean annual household and per capita income; and household expenditure on food. Among the three regions being discussed, the Greater Accra Region, being the Region with the capital city has the over all highest proportion of adults who have been to school (85.6%) and even the highest among males and females. This is followed by Ashanti Region and then Upper East Region. A similar trend goes for mean annual household and per capita income. The results on food which takes highest percentage of household expenditure revealed that, the Upper East Region which happens to have the lowest household income had the highest percentage on expenditure on food (61.4%) followed by Ashanti and Greater Accra Regions, 53% and 43% respectively. The rural and urban expenditure on food also provides similar information. This gives an indication that the regions and for that matter households with limited human resource development (education) and financial resources tend to spend more income on food.

Table 1: *Regional educational and economic data*

Region	Education (%)			Economic		
	Male	Female	All	Mean annual household income (cedis(¢)*	Mean annual per capita income (cedis)	Expenditure on food (%)
Greater Accra	92.6	79.1	85.6	3,356,000	932,000	48.0
Ashanti	90.2	72.1	80.0	2,550,000	622,000	53.0
Upper East	35.7	16.9	26.3	1,446,000	321,000	61.4

*Source: GLSS 4 (2000); *¢9,300. = US$1.00*

The basic hypothesis in this study is that the wide differences in the socio-economic status of rural women households' influences their choice of information delivery technology and also their willingness to pay for a selected technology. This basic hypothesis is addressed using data from a survey instrument administered to 300 households from the three designated regions. Beyond the issue of whether an aggregate rural empowerment ICT policy would be appropriate, the outcome of this exercise has important program planning and implementation applications. For example, since Ghana receives considerable funding and technical support from development partners, the results from this study could be used to channel and target donor support to identifiable needs in rural areas so as to minimize waste and duplication of effort. For the

government's own resource allocation, a disaggregated ICT policy could lead to significant policy efficiency gains.

THE ICT ENVIRONMENT IN GHANA AND THE RURAL SECTOR

Ghana has responded to the ICT challenge. In 2003, the country announced the *Ghana Integrated ICT for Accelerated Development* (ICT4AD) *Policy*, which summarized the vision of Ghana in the information age. While the policy outlines a broad array of objectives, it is clear that the core of the policy is to use ICT to achieve Ghana's vision of becoming a middle-income country by the year 2020 (Ghana, 1996). Ghana's ICT policy is supported by a slew of supporting laws, programs, and initiatives such as, the National Initiative concerning the ICT and Education and Training (NISI), the African Information Society Initiative (AISI), and the Science and Technology Policy Research Institute (Ghana 2003. Despite the wide recognition of the role of ICT in national development, a successful ICT program planning and implementation to accelerate empowerment of women in Ghana is beset by several institutional, technical, political, economic and social challenges. As an institutional matter, ICT policy planning and implementation is spread among several ministries, institutes, research centers, and private agencies. This increases the potential for institutional dissonance and 'turf battles' that could lead to waste and duplication of effort.

As a political and social matter, there are concerns that the uneven access to education would translate to a 'gender digital divide' in Ghana unless explicit and credible policies are put in place to address the situation. Having some level of literacy obviously enhances one's capabilities and gives one an advantage in the use of ICT facilities. A cursory glance at the educational situation as presented in the GLSS 4 (2000) will show that 50% of adults in Ghana are literate in English or a local language. There are substantial differences between the sexes, and between localities, with regard to basic literacy. A little over 6 out of every 10 men, but fewer than 4 out of every 10 women, are literate. More than two-thirds (66%) of adults in urban areas are literate, but in rural areas only 41% are literate. This reflects in school attendance as well. Not only are a higher proportion of urban dwellers of school going age actually in school, but also attendance rates rise with increased urbanisation. For example, 95% of all boys in Accra (the regional capital) aged 6 to 11, and 91% in other urban areas, were enrolled in school as at the time of the survey, whereas in rural savannah (where Upper East Region is located) the corresponding figure is only 66%. A similar pattern is noticeable in respect of school attendance among girls. The proportion of females in school is significantly lower in all localities and for all ages (apart from age group 6-11 in rural coastal where Greater Accra region is located) when compared with their male counterparts. Table 2 highlights the substantial differences in school attendance, both between the sexes and between the south (represented by Greater Accra and Ashanti Regions) and the north (represented by Upper East Region) of the country. In terms of the sexes, male attendance rates are in general higher than the rates for females throughout the country and across age groups. School attendance here also increases with urbanisation, and female attendance is consistently lower than that of male attendance. Another notable observation is the differences between males and females' rates in urban areas, as compared to the variation in rural areas. The situation for females in this case is worse in rural areas than in urban areas. There is even higher school attendance among rural males than urban females though the percentage of urban female school attendance is higher than that of rural female school attendance. This implies that females no matter their location, whether urban or rural face a critical education situation. However the situation of rural females is the worse of all.

Table 2: *Proportion of adults in each region who have been to school, by sex and locality (%)*

	Urban			Rural		
Region	Male	Female	All	Male	Female	All
Greater Accra	93.0	80.4	86.6	85.8	61.9	72.5
Ashanti	92.6	82.6	86.7	88.8	64.8	75.5
Upper East	85.7	50.0	66.7	29.6	12.3	21.0

Source: GLSS 4 (2000)

Probably the most daunting task facing policy makers in Ghana is making ICT available to a large segment of the population, especially for educational purposes in the rural areas. Some point to the difficult choice between resource allocation to meet immediate needs such as food, shelter, and health as against investing these resources in computers and ICT infrastructure. This 'bread or computers' debate is misplaced because it fails to recognize the symbiotic relationship between ICT and rural households' empowerment to improve their welfare.

Also, ICT policies and programs are expensive to design and implement. Resources are needed for infrastructure and operational purposes. Given the pressure on the government's budget, it may be necessary to solicit contributions from rural households, a rather difficult proposition given the low household income levels in rural areas. It is also well established that technology adoption and use depend on the socio-economic characteristics of rural households. Yet the ongoing policy debate concerning ICT in empowering rural households seems tilted to the belief that all Ghana needs is to make ICT available and rural households will jump at the opportunity. A credible and sustainable ICT policy to empower women in rural Ghana should consider the socio-economic characteristics of households, including a determination of their willingness to pay for alternative ICT technologies. This paper attempts to provide such information for ICT policy and program planning and implementation.

Rural Poverty, Status of Rural Women, and ICT in Ghana

> The basic document summarizing the state of poverty in Ghana, strategies to defeat poverty, targets, constraints, and projections is the Ghana Poverty Reduction Strategy paper (GPRS 2003). The GPRS defines poverty as "unacceptable physiological and social deprivation." (p. 3) and lists participation in decision making, health, education, environmental sustainability, lack of political power as some of the critical considerations in defining poverty.

According to the GPRS, five out of ten regions had more than 40% of their population living in poverty in 1999. The three northern regions (Upper East, Upper West and Northern Regions) are the hardest hit with nine out of ten people in the Upper East; eight out of ten people in the Upper West, and seven out of ten people in the Northern Regions classified as poor in 1999 (GPRS 2003). Ghana has experienced some success in reducing poverty. Overall poverty decreased between 1991/92 and 1998/99 from 51.7% to 39.5%. Extreme poverty declined from 36.5% to 26.8% over the same period. However, unchecked population growth threatens potential gains in poverty reduction since population growth during the decade of the nineties far outstripped the rate of decline in poverty levels (GPRS 2003).

The high incidence of poverty among women presents a major barrier to ICT adoption. The Ghana Living Standards Survey (GLSS 4 2000) concluded that women form over 70% of food crop farmers, and 90% of those in internal agricultural distribution, marketing and processing.

About 80% of Ghanaian women in the labor force are employed in small, semi-formal and informal undertakings.

There are other constraints that could limit the employment of ICT in empowering rural women. Women constitute the higher percentage (42%) of adult illiterate population (Defined in the GLSS 4 as people who are 15 years and above, and can read and write at least a sentence) in Ghana. Studies have shown that women experience greater poverty, have heavier time burdens, lower rates of utilization of productive resources and lower literacy rates (GLSS 4 2000). School participation rate for basic and second cycle schools is 77% for men and 38% for women. Due to socio-cultural factors like early marriage, teenage pregnancy and child labour that affect women this discrepancy widens as one ascends the educational ladder (Ghana 1995, p. 6, Ghana 1996). Prospects for a change in the near future are not bright given record of current recruitment into the literate class. Dropout rates remain high at about 20% for boys and 30% for girls at Primary School and 15% for boys and 30% for girls at Junior Secondary School. Programs targeting empowerment of rural women through ICT applications must take into account the targeted population to use the technology.

There are also major barriers to introducing ICT to rural women due to the political context within which rural women function in Ghana. In a true sense, the idea of empowerment' is captured by the participation of rural women in all phases – design, implementation, and evaluation - of policies and programs that affect them. The literature is replete with calls for 'stakeholder ownership' of development policies and programs to ensure success. Unfortunately, the participation of women in decision-making is the weakest link in the fight against poverty. The GLSS concluded that women are poorly represented at all levels of decision-making. Within the household, culture and norms designate men as heads of households and therefore the principal decision-makers. At the highest level of government, women are again disadvantaged (Ofei-Aboagye 2000). Considering these, policies and programs to promote ICT in empowering women in rural areas have to be undertaken with due considerations of the broader socio-economic environment within which women function in Ghana.

Another consideration is the availability of complementary inputs such as computers, voice and video systems, and in some cases, physical access to rural locations. The current infrastructure for telecommunication broadcast to regions in Ghana is limited to serving the major regional centers and capitals. Resources for expanding the reach of the telecommunication infrastructure may be quite limited in the light of the findings of a recent survey of budget allocations to the ICT sector. According to the report, majority of government ministries and public sector organizations have less than 10% of their total budget on ICT (including acquisition of hardware, software, training, maintenance of ICT systems, etc.). Close to 60% indicated that their ICT expenditure as a percentage of their total expenditure is below 10%. Close to 34% of the organizations reported devoting about a quarter of their total expenditure on ICTs. On the whole, most of the organizations in all the sectors spend less than half of their annual budget on ICT (Ghana 2003).

BACKGROUND LITERATURE AND METHODOLOGY

There exists an extensive and diverse literature on the potential role of ICT in poverty alleviation, and more specifically on rural women's empowerment in Sub-Sahara Africa and other developing areas. The literature cuts across disciplines, methodologies, theories, and motivations. The literature has been reviewed along theoretical and empirical studies.

Theoretical Literature

Policy documents from domestic sources, international conferences and meetings, speeches, presentations, and private research initiatives have generally contributed to (1) defining the concept of ICT use in rural adult education, and (2) understanding the factors influencing ICT use in rural adult education. There are not many formal models of the interface between ICT and empowerment of rural women through adult education. Rather, researchers have focused on the formal relationship between technology, education and poverty alleviation generally. A typical study in this context was conducted by Wagner and Kozima (2003) of the International Literacy Institute – National Centre on Adult Literacy, University of Pennsylvania. The study, *New Technologies for Literacy and Adult Education: a Global Perspective* emphasizes the need for a refined concept of adult education that meets the needs of the modern era and takes advantage of technology opportunities. The authors defined ICT as: "A set of potential delivery and instructional tools that can be used to help people acquire the skills associated with the traditional notions of literacy" (p.15). The authors' view of the role of ICT in adult education is built around the notion that literacy, technology, and development must be considered as an integrated set of tools. Literacy is defined broadly beyond text. They identified two approaches by which technology could improve literacy. One approach is to use capabilities of technology to deliver instruction in support of the cognitive skills needed to read and understand text. The second approach focuses on how technology could be used to efficiently support the use of text and developing literacy skills for learning at a distance when instruction and other resources might not otherwise be available. These approaches are best suited to a society that has computers and related equipment and power systems to access information. Looking at the level of infrastructural development this may not be readily accessible to majority of the people in developing countries like Ghana. However if Government initiatives for improving ICT infrastructure is hastened, the nation will soon have the systems to harness all the potentials that ICT offers.

Holmes (2004) presents a rich framework for understanding ICT and rural development. Holmes has examined the relationship between ICT and adult education. In defining ICT for development, Holmes adopted the Association for Progressive Communications definition of ICT as

> *"Technologies and tools that people use to share, distribute, gather information, and to communicate with one another, one on one, or in groups, through the use of computers and interconnected computer networks. They are mediums that utilize both telecommunication and computer technologies to transmit information" (Holmes 2004, p. 24).*

Holmes makes several important observations. For example, the author emphasizes that ICTs are tools that facilitate sharing information and foster communication. Also ICT include both new and traditional information and communication technologies, and even though there is often an emphasis on the new personal computers, the Internet, World Wide Web, mobile phones, satellite and wireless technologies, an African ICT tool kit for development also encompasses traditional media including, telephone, radio, television, print media (e.g. newsletters, cartoons and graphic posters) and community communication initiatives (e.g. listening groups and community theatre). Even though Holmes' framework focuses on the role of ICT on a specific sector (governance of the economy), it still offers valuable insights to understand how good governance and the various strategic actors and their roles influence women's empowerment in other contexts. One such context is rural women's empowerment through ICT. The framework points to the comprehensiveness and complexity of the empowerment problem given the many stakeholder interests that must be reconciled to achieve an efficient policy outcome. The model also indicates that empowerment may entail the expenditure of considerable human and financial resources. For example, what the author refers to as "gender budgeting" ensures that resources available serve the needs of all women, especially rural women. A second example to illustrate the need

for human and financial resources is the need to have the relevant information to guide policy making. Holmes' framework emphasizes the need to collect gender and location (urban/slum/rural) disaggregated data to evaluate government policy and develop new policies that support the empowerment of women. One important conclusion from Holmes' framework is the extent of resources needed to develop programs to empower women through the use of ICT. It is in this context that a study of sustainable ICT use in rural empowerment must pay some attention to the sources of funding to implement programs.

Nath (2001) has presented a formal model of the role of ICT in empowerment of women. The author explains that,

> *"ICT in the context of knowledge societies is understood as building the ability and skills of women to gain insight of actions and issues in the external environment which influence them and to build their capacity to get involved and voice their concerns in these external processes, and make informed decisions" (Nath 2001).*

The author adds that this entails building the capacities of women to overcome social and institutional barriers, and strengthening their participation in the economic and political processes to improve their quality of lives. Nath's model implies that women's access to strategic information leads to their empowerment. Though the model takes cognizance of the various conceptualisation processes that information goes through in the women's system, it does not take into consideration various inhibiting factors and obstacles that could affect women's empowerment. For example, the model does not point one to how the socio-political milieu could affect the availability of information. Also, the implicit assumption that access to strategic information automatically empowers a rural household is suspect given the set of hierarchical cultural structure within which rural women function. That means women's access to strategic information does not lead to automatic empowerment. Furthermore, there is no indication of how the needed information is to be acquired and who is to pay for it. Nath's model does not indicate a feedback loop so that access to information is seen as a unidirectional process. The essence of empowerment is the ability to use information in making choices that supposedly would influence future participation in policy to alleviate poverty. Despite these observations about the model, it must be pointed out that Nath is one of the few authors to rigorously define the theoretical underpinnings of ICT and rural adult education.

A theoretical framework explaining the relationship between information technologies for empowerment of rural women through adult education must at a minimum address five important issues. First, the framework must address the process of information technology policy formation and implementation. Second, the model must explore alternative information delivery technologies recognizing the cost and sustainability implications of the alternatives. Third, there is a need to recognize that rural households' choice of information technology is not only a technical issue but more importantly depends on the socio-economic characteristics of the household, especially the willingness and ability to pay for the technology. Fourth, the framework must point to selected indices that are general enough to capture the broad meaning of the concept of 'empowerment', and finally, the framework must contain a feedback loop that highlights the critical role of information in the 'learning' process. This last characteristic of the framework emphasizes the need to treat information availability and decision-making as an ongoing process, and not a one-shot discrete event that is unrelated to the future choices made by rural households. The outcome of the 'learning' process is reflected in the decisions made by households to achieve their empowerment goals (participation in the political process, improved income, increased job opportunities, good health etc). More significantly, the lesson from the 'learning' process becomes an input in subsequent policy planning and the generation of new information that informs future decisions made by rural households. Thus, there is the need for a 'feedback' loop that goes back to the policy planning level. This makes 'learning' an important component of the empowerment process.

Empirical Studies

There are two strands of the empirical literature relevant to the study. First, there is the literature that examines the cost of establishing ICT systems in different cultural contexts, and second, there is the literature that summarizes the impact of introducing identifiable ICT interventions on rural households, for example, the effects of age, gender, income, educational level, etc on a households' choice of ICT. An example of the first strand of empirical literature is the study by (Perraton 2000). The author provides some data on cost of some adult basic education projects from several countries to show the economic advantage that distance education has over face-to-face. One is likely to break-even if the product is highly accessed. In any case the type of media is also a factor. For instance, Perraton explains that studies have revealed that radio offers a moderate cost for distance programmes for adults in health and agriculture. Radio has a large audience, moderate cost of production and delivery leading to a lower cost per learner.

The concern over sustainability of ICT use in rural areas raises a second policy issue concerning the choice of ICT infrastructure to adopt in a given location. Given that there are several ICT protocols (personal radio, community radio, telephone, television, etc), what factors could influence a household's choice of a protocol? The literature suggests that cost is probably the driving factor. The idea of the 'community radio' for example, seems targeted directly to reducing the cost of delivering information to rural households. The major international development agencies have spearheaded the community radio efforts. For example, the FAO Rural Radio and Simbani have developed training partnerships that use rural radio to raise awareness about issues critical to rural development.

Studies on the use of radio in rural learning dominate the second strand of the literature on empirical studies. In a study by Abbey-Mensah (2001) entitled, *'Rural Broadcasting In Ghana'* exemplifies this literature. The author concluded that radio is the most useful and efficient medium available to the Ghanaian rural population, and recommended radio broadcasting as one of the vehicles through which national aspirations could be pursued. Westoff and Bankole's (1997) study, *'Impact Data - Accessing Mass Media on Reproductive Behavior - Africa'* arrived at a similar conclusion as Abbey-Mensah about radio use in rural education. The authors conducted demographic and health surveys, in Burkina Faso, Ghana, Kenya, Morocco, Madagascar, Namibia and Zambia to study the impact of mass media on people's reproductive health decisions. Controlling for the effects of such variables as household income, socio-economic status, age, gender, and geographic location, the authors found that there is a persistent and frequently strong association between exposure to the mass media and reproductive behavior change in Africa. The findings from Westoff and Bankole's study reinforce the need to focus on the use of radio in rural education in Ghana. Even if some reasonable measure of cost could be obtained, there is still the issue of households' ability and willingness to pay for the information. This issue has been part of the structural reform and market-led policies initiated in Ghana and in several other African countries in the early 1980s. Researchers have addressed the broader question of households' willingness to pay for public services through the imposition of user charges, Thobani (1983), Tan, Lee and Mingat (1984) for education; Boadu (1993) for rural water supply; Haba 2004 for rural extension information. While these studies do not address user charges in the context of ICT in rural education, the findings from the studies are useful in understanding how socio-economic factors influence households' decisions regarding user charges for public goods in general.

The findings in Haba and Boadu's studies are especially relevant to the current research. Haba studied rural Rwandan households' willingness to pay for selected technologies – farmer-to-farmer, expert visit, radio, television, and print in the delivery of extension information. The author hypothesized a household's willingness to pay for technology to depend on several socio-

economic factors including income, age of head of household, gender, and education. Using simple regression analysis, the author found very little impact of the selected socio-economic variables on a household's willingness to pay for extension information. The most significant finding from Haba's study is that most farmers preferred the farmer-to-farmer approach to delivering information. This result is not surprising given that the study targeted coffee growers who are more likely to feel comfortable sharing experiences with fellow growers. Boadu's study on the other hand found a positive and significant relationship between income, education, distance to nearest water source and a household's willingness to pay for water. Both studies suggest the need to focus on household's characteristics in formulating policies to implement a user charge regime in the provision of public goods such as information. Thus the socio-economic characteristics (gender, age, income, education, occupation, location, etc) of rural households are important in rural households' decision-making. Utilizing information from this literature search, a survey instrument was developed and tested in the three targeted Regions of Ghana.

Research Methodology

The information from the literature survey was combined with key elements of the general framework to develop a survey instrument that was used to collect the primary data for estimating the quantitative impact of the variables hypothesized to influence households' willingness to pay for information. Some of the critical socio-economic characteristics of households and their potential implication for a household's technology choice are discussed below.

Income

It is difficult to predict the effect of income on the willingness to pay for ICT in rural households. Generally, a positive relationship between income and the willingness to pay for ICT is expected. Households with high incomes tend to spend a smaller proportion of income on food while poorer households spend a higher proportion of income on food. Thus, one would expect the effect of income on ICT to be positive in the relatively richer regions. Furthermore, one would expect households with high incomes to use private radios instead of community radios in receiving information.

One could argue that even though poorer households spend a higher proportion of income on food, their interest in obtaining information to 'kick' out poverty may encourage them to be willing to pay for ICT information. In essence, there are no statistically significant differences in households' willingness to pay across regions. In this sense, it is difficult to predict the exact sign (positive or negative) on the income variable, and the issue is left to empirical determination. An indirect approach was used to obtain measures of income from rural households. Households were first asked to list the major sources of income, and then inquired about their expenditure patterns. This was done due to the difficulty in obtaining direct income figures from households and also to capture the effect of transfers. These expenditure amounts were used as proxies for income. Studies of willingness to pay for amenities in rural households have found direct rural income measures to be unreliable and have resorted to proxies to estimate income (Boadu 1993).

Education

Rural females have lower school attendance rates across all regions with the lowest rates recorded in the Upper East. Generally, it is hypothesized that educated households will be willing to pay for any ICT media given the premium on information in decision making. While an illiterate

household naturally would depend on the radio and extension visits for information, a literate household has the additional source of information delivered through extension bulletins, and other printed sources.

Age

It is hypothesized that older households will be more willing to pay for community radio systems and extension visits. There are good reasons for this expectation. First, older households are likely to belong to community organizations and hence more comfortable with sharing the media. On the other hand, a young household is also likely to be less involved in community organizations, and would be willing to pay for their own private radio system.

Household Size

The household is defined to include all persons who are under the direct responsibility of the female respondent. At a given income level, large households are less likely to pay for private radios given the cost of these radios. Thus, large households will be more willing to pay for community radios and extension services, while small households are more likely to be willing to pay for private radios.

Membership in Community Organizations

It is hypothesized that households who belong to a community organization will be willing to pay for information delivered via community radio. Community radio is cheaper than a private radio and more importantly, these households have cultivated the spirit of sharing through their membership in an organization. Results of the GLSS 4 (2000) indicate that rural households make more contribution to community initiatives than do urban households. By analogy, it is hypothesized that households in the more deprived areas, especially in the Upper East Region will be more willing to pay for community radio and extension services compared to those rural communities located near the urbanized regions such as Greater Accra, and Ashanti.

Marriage

Married women are likely to be more willing to use and pay for private radio media. The reason for this assertion is that married women are more confined to private life. Several socio-cultural factors affect their level of participation in public life and interaction with *strangers*. In addition child care, home care and other domestic activities form the priority of married women's engagements. These limit their ability to engage in leisure and other empowering socio-economic activities. Limited by these inhibiting factors they are likely to prefer to have their own private radios. Another contributing factor to married women's willingness to use and pay for private radios could be that married women may have higher income (spouses combined income) and could therefore afford the more expensive media for information delivery.

These hypothesis were tested using data from the three regions. The data used in this study was based on a contingent valuation [1] survey instrument administered in several villages in Ghana in a face-to-face interview. The survey was divided into two main parts. The first part sought information on basic characteristics of households - age, education, dependents, occupation, expenditures, and membership in community organizations. The second part consisted of a bidding game for alternative information delivery technologies. Three main information delivery technologies were considered – community radio, private radio, and extension agent (who disseminate printed materials). The main distinguishing feature of these technologies is price. For example, information delivery by community radio is considered the cheapest since several

households contribute to the purchase and maintenance of the system. Extension agents are considered the next cheapest of the three technologies considered because the government pays these agents. The idea was to explore the extent to which a part of the cost of extension information delivery could be shifted to households and lessen the burden on government. The most extensive delivery technology is the private radio since a household owns it individually and pays full amount for it.

Bidding took the form of a series of specific questions. For example, a respondent was asked whether she would be willing to pay ¢1,000 (approximately ten cents) per year to use a community radio. If 'yes' the question was posed again with an increase in the amount to ¢2,000 (approximately twenty cents). The process continued until 'No' was the answer. The final amount to which the respondent answered 'yes' was recorded as the maximum amount the respondent was willing to pay to have the community radio installed in the village. For extension agents, the beginning bid was at ¢5,000 (approximately fifty cents), while for private radios, the beginning point was ¢10,000 (approximately US$1.00). Respondents were also asked to state an amount they will be willing to pay for each of the information delivery technologies.

Field data was collected with the assistance of Regional Officers of the Institute of Adult Education. These officers are located in the Regional Centers of the Institute which is established in all the ten Regions of Ghana and are constantly engaged in community programs with the local people. These field officers were recruited for this survey because they are in partnership with the community members and over time have won the confidence and trust of the rural households. They have good knowledge of the regional demographics and have established mutual working relationship with the women in the local communities. They are also able to communicate in the language that the people understand. Their accumulated community research and training experience, residence in the regions, and effort helped to do rapid field data collection.

The interview was conducted face-to-face where the interviewer had the opportunity to explain the purpose of the survey and the need to obtain truthful responses from the respondent. The interviewers were quite familiar with the villages and based on their experiences understood the need to interview in a manner that did not impair the integrity of the effort. As a strategy, they interviewed the female household head in every other house. Respondents were also cautioned not to discuss their responses with other households. There was broad agreement among field staff that respondents took the process seriously and were willing to offer truthful information to assist in achieving the objectives of the survey.

STATISTICAL ESTIMATION AND RESULTS

A multiple linear regression relationship was assumed between the dependent variable and the independent variables. The mathematical expression of the relationship for households in each region is as follows:

1. $(WTP)_{ijt} = a_0 + a_1 (AGE) + a_2 (EDUC) + a_3 (MARS) + a_4 (DEPEND) + a_5 (EXPEND) + a_6 (MEMBR) + U_{i,}$

Where

$(WTP)_{ijt}$ is the willingness to pay by a household (i) in region (j) for information delivery technology (t),

AGE is age of respondent measured in years,

EDUC is the educational level of respondent. For analytical purposes the educational level was broken into levels, up to primary and above primary.

MARS is the marital status of respondent, and was measured using a *dummy* variable equal to 1 if respondent is married, and zero for otherwise.

DEPEND is the number of dependents of respondent,
EXPEND is the aggregate of all expenditures reported by the respondent measured in Ghana Cedis, and
MEMBR is the membership of respondent in a community organization. Membership was measured as a *dummy* variable, equal to 1 if the respondent belonged to a community organization and zero, otherwise.
The term U is a random error term assumed $N(0, \sigma^2)$.

Equation 1 was estimated for each individual region using the Newey-West estimator. The results of the estimation procedures are presented below.
Table 3 lists the means of selected independent variables for the three regions in the study, and the mean bids for extension services, community radio, and private radio. Mean household size and expenditures are also provided. Consistent with expectation, mean bids for private radio is highest, followed by mean bids for extension information, followed by community radio.

Table 3: *Means of independent variables compared to means from GLSS 4*

	Household bids in Ghana Cedis					
Region	Extension information	Community radio	*Private radio*	Number of dependents	Expenditure: survey	Expenditure: GLSS 4
Gt. Accra	10202	3656	21162	2.83	11,495,487	6,777,000
Ashanti	8480	3360	22300	3.61	11054650	
Upp. East	8595	3141	21262	3.04	4,059,460	1,793,000

Source: Survey and GLSS 4 (2000) and Survey Data (2004/5)

Ashanti Region

Other than the expected low coefficient of determination when using cross-section data, only the expenditure variable of the regression results for Ashanti Region (Tables 4a, 4b, and 4c) was found to be significant for all information delivery media. Even though the estimated coefficients for the expenditure were small (2.34E-06 for community radio; 3.49E-05 for private radio; 9.31E-06 for extension services), they were all highly significant at the 1% level. Two other variables were found to be mildly important in explaining the variation in households' willingness to pay. Table 4a shows a positive relationship between the number of dependents and households willingness to pay for information delivered via community radio. The estimated coefficient was significant at the 10% level. This outcome is consistent with the hypothesis in this study since households with a large number of dependents spend more on household maintenance and would opt for the cheaper media (community radio) for information delivery. The results for community radio also shows that households with education above the primary level are not willing to pay for information delivered via community radio. The estimated coefficient of –1.89 is significant at the 10% level. It is not immediately clear why this outcome was obtained because one would have expected that since there is a positive relationship between expenditure and willingness to pay for information delivered via any media, educated households would value information and hence be more willing to pay.

Table 4a: *Regression results for households' willingness to pay for community radio: Ashanti Region*

Variable	Coefficient	t-Statistic
Constant	3369.005	11.43
Age (Up to 20)	-666.53	-1.51
Age (Above 20)	158.97	0.67
Married	-117.85	-0.37
Dependants	70.29	1.72
Educ. (Primary)	-526.86	-1.02
Educ. (Above Primary)	-378.76	-1.89
Expenditure	2.34E-06	2.51
Membership	105.99	0.27
R-squared 0.12	N = 100	

Source: Survey Data 2004/5

Table 4b: *Regression results for households' willingness to pay for private radio: Ashanti Region*

Variable	Coefficient	t-Statistic
Constant	21702.51	6.11
Age (Up to 20)	5181.99	1.39
Age (Above 20)	-2787.089	-1.43
Married	-1200.54	-0.45
Dependents	-506.98	-1.14
Educ. (Primary)	-1873.002	-0.28
Educ. (Above Primary)	2771.096	1.25
Expenditure	3.49E-05	4.21
Membership	5696.46	1.83
R-squared	0.14	N = 100

Source: Survey Data 2004/5

Table 4c: *Regression results for households' willingness to pay for extension agent: Ashanti Region*

Variable	Coefficient	t-Statistic
Constant	9077.58	6.50
Age (Up to 20)	1863.68	1.43
Age (Above 20)	-1083.80	-1.57
Married	-536.63	-0.54
Dependents	-52.75	-0.38
Educ. (Primary)	472.70	0.18
Educ. (Above Primary)	424.38	0.31
Expenditure	9.31E-06	3.74
Membership	690.14	0.72
R-squared	0.084	N = 100

Source: Survey Data 2004/5

Greater Accra Region

All three regression equations (Tables 5a, 5b, and 5c) estimated for the Greater Accra Region yielded very low R-squares (13%), thereby making the explanatory power of the regressions very weak. What is interesting about the results for the Greater Accra Region is the consistency in the relationship between income and women's willingness to pay for information delivered via any of the three technologies. In all three cases, the proxy for income is statistically significant at the 5% level. Furthermore, the results show that educated households are more willing to pay for information delivered via a private radio or an extension agent (10% level of significance). The results for the willingness to pay for information via community radio is quite interesting since it is contrary to what was obtained for the other regions. For the Greater Accra Region, younger women (below twenty years) are more willing to pay for information delivered via community radio (5% level), and also when the number of dependents is large (5%).

A plausible explanation for this outcome is as follows. The Greater Accra Region is a more urbanized region where one finds considerable number of youth programs, especially to address issues of urban poverty. It may well be that the significant coefficient for the 'below twenty' variable is capturing this youth effect. Also, it may be the case that the high cost of living in these urban-impact rural areas makes women with a large number of dependents more willing to pay for information delivered via community radio since it is the cheapest information delivery technology examined in this paper.

Table 5a: *Regression results for households willingness to pay for community radio: Greater Accra Region*

Variable	Coefficient	t-Statistic
Constant	2785.18	6.10
Age (Up to 20)	1002.97	2.66
Age (Above 20)	248.82	0.89
Married	63.817	0.27
Dependants	103.07	2.19
Educ. (Primary)	44.57	0.17
Educ. (Above Primary)	-30.12	-0.15
Expenditure	3.34E-05	2.19
Membership	-329.51	-1.44
R-squared	0.13	N = 100

Source: Survey Data 2004/5

Table 5b: *Regression results for households willingness to pay for private radio: Greater Accra Region*

Variable	Coefficient	t-Statistic
Constant	13399.44	4.68
Age (Up to 20)	5352.52	1.22
Age (Above 20)	-813.63	-0.34
Married	2727.96	1.18
Dependants	354.42	0.69
Educ. (Primary)	2091.77	0.83
Educ.(Above Primary)	3175.58	1.68
Expenditure	0.00035	2.20
Membership	-2272.74	-1.03
R-squared	0.139253	N = 100

Source: Survey Data 2004/5

Table 5c: *Regression results for households willingness to pay for extension agent: Greater Accra Region*

Variable	Coefficient	t-Statistic
Constant	6051.91	5.17
Age (Up to 20)	41.61	0.04
Age (Above 20)	-844.26	-1.06
Married	216.41	0.28
Dependants	200.41	1.04
Educ. (Primary)	762.70	1.08
Educ. (Above Primary)	1121.74	1.50
Expenditure	0.00	2.54
Membership	-204.13	-0.27
R-squared	0.13	N = 100

Source: Survey Data 2004/5

Upper East Region

The overall explanatory power of the regression for the Upper East Region is low. The highest R-square is 19%. Here also, there are no major surprises given that cross-sectional data is being used in the regressions. There seems to be a consistent pattern in the results for this region in the sense that income seems to be the driving factor for the willingness to pay for information delivered via the three technologies under consideration in this paper. In all cases income is statistically significant at the 5% level. The results also show that as expected, women with a large number of dependents are less likely to pay for information technologies. The theoretical exploration suggested that large households spend more on food and the basic necessities of life, especially health and shelter. It is not surprising that in all the technologies examined, there is a negative relationship between the number of dependents and households' willingness to pay for information. In all cases the estimated coefficient is significant at the 10% level. See tables 6a, 6b, and 6c.

Table 6a: *Regression results for households willingness to pay for community radio: Upper East Region*

Variable	Coefficient	t-Statistic
Constant	2644.48	5.60
Age	597.10	1.67
Marital Status	-51.419	-0.17
No. of Dependents	-159.88	-3.01
Primary Education	-339.16	-1.04
Above Primary Educ.	-188.24	-0.67
Expenditure	0.000012	2.66
Membership	257.79	0.99
R-squared	0.16	(N) = 100

Source: Survey Data 2004/5

Table 6b: *Regression results for households' willingness to pay for private radio: Upper East Region*

Variable	Coefficient	t-Statistic
Constant	11718.43	2.87
Age (Above 20)	2738.82	0.97
Marital Status	1422.34	0.52
No. of Dependants	-763.68	-1.94
Age (Up to 20)	1203.67	0.46
Educ. (Above Primary)	2107.70	0.76
Expenditure	0.0014	2.96
Membership	3785.22	1.58
R-squared	0.19	N = 100

Source: Survey Data 2004/5

Table 6c: *Regression results for households' willingness to pay for extension agent: Upper East Region*

Variable	Coefficient	t-Statistic
Constant	5633.82	3.82
Age (above 20)	1910.57	1.66
Married	-184.53	-0.20
Dependants	-266.84	-1.84
Educ. (Primary)	-604.51	-0.61
Educ. (Above Primary)	66.42	0.07
Expenditure	0.00042	2.95
Membership	1180.72	1.73
R-squared	0.18	N = 100

Source: Survey Data 2004/5

POLICY IMPLICATIONS

The overriding conclusion that emerges from this study is the need to examine ICT use in empowering rural women within a 'holistic' context. No single socio-economic factor emerged as the dominant variable in planning policies and programs to introduce ICT use in information delivery to rural women. Likewise, no single information delivery technology emerged as 'the' technology to use in delivering information to rural women.

The overall results from this study point to household expenditures (used as proxy for income), household education, and membership in community organizations as the principal factors influencing rural women's willingness to pay for the various technologies used in information delivery to women in rural areas. The income variable was found to be statistically significant in explaining the variation in the willingness to pay for information delivered under the selected media for all the regions. The education variable was found to be statistically significant only in the Ashanti while the community membership variable was found to be statistically significant in the Upper East and Greater Accra Regions. Age was found to be significant in explaining the variation in willingness to pay for any media in the Ashanti, and the Upper East Regions. Likewise, the number of dependents variable yielded inconclusive results. Also, the marital status of women did not play a significant role in explaining the willingness to pay for any of the technologies in any of the regions.

Despite the lack of consistency in the regression results several important policy and planning options are suggested by the results from this study.

Need to Disaggregate Policy Planning and Implementation Process

Even though the government sets the overall national ICT policy, the results from this study suggest some merit in allocating considerable authority to regional and local authorities in setting priorities and approaches to empowering rural women through the use of ICT. This is due to the different impacts the socio-economic factors had on different regions. It is in this context that the government must put 'teeth' into the Local Government Act 1988, PNDC Law 207 and the instructions under Article 35 of Ghana's 1992 constitution. It states that the state shall make democracy a reality by decentralizing the administration and financial machinery of government to regions and districts and by providing all possible opportunities to the people to participate in decision making at every level of national life and in government. The results of the study point to a need to cast rural empowerment policies and programs within the broader poverty reduction policies of the government and also within the attainment of the Millennium Development Goals (MDGs).

Improving Rural Incomes

The results show that the attainment of this vision would boost ICT use in delivering information to rural households since income was found to be consistently statistically significant in explaining rural women's willingness to pay for information. There are two important issues to address in the context of the relationship between incomes and ICT use to empower rural women.

First, the relationship between ICT use and income must be seen as bi-directional. While high incomes make it possible for rural women to pay for the information delivery technology of choice, the delivered information, in turn, is intended to empower women to be able to make those decisions that would improve their welfare and incomes. These observations lead to the conclusion that knowledge of the importance of incomes in ICT use in information delivery is not

enough. There is also a need to emphasize the learning component that allows rural women to better utilize received information in decision making to further improve their incomes.
A second implication of the statistical significance of the income factor is the need to broaden policies to enhance the many possible sources of income available to rural women. Even though the popular view has been to focus on agriculture as the primary source of raising incomes of rural women, the survey results point to a need to broaden the scope of an income policy in rural areas.

Education

Another factor that emerged as important in explaining households' willingness to pay for information is education. The significance of the education factor supports the need to plan and implement ICT policies for rural empowerment in a holistic context. Education is one of the major components of Ghana's poverty reduction program and the MDGs. The survey results show that the government has a major hurdle to clear in its effort to empower rural women using ICT to deliver information. Formal educational attainment appears to be very low among the female rural household heads. The survey showed that about 45% of the household heads had no formal education. Only 1.1% had attained tertiary education. Thus, even though rural women who had some education had expressed a strong willingness to pay for information, policy and program planners have to undertake *specially designed* adult education programs to benefit rural women. The results also imply that information would have to be delivered to rural households in a language they understand and a medium that they would be comfortable with. The significance of the education variable also points to a need to emphasize 'local' content in designing rural information programs.

Community Organizations

The statistical analysis also point to an important role that community organizations could play in the delivery of information to empower rural women. Women who belong to some form of community organizations are more willing to pay for information delivered via the three ICT media examined in the study. The survey showed that slightly more than half (50.3%) of rural women belonged to a community organization and cooperatives. This strong sense of communalism has important policy and program planning implications. For example, the government may want to take advantage of the spirit of communalism and focus on programs that could be delivered to a group as a way to reduce costs and hence be able to extend programs to cover a larger population group. It also means that there is a need to design effective feedback mechanisms since in a group context it may not be possible to easily address individual concerns. A format for a program on information delivery may emphasize discussion as a way to sustain group interest. It is important for the government to allow rural organizations to define their own rules to check practices such as 'free riding' and 'shirking.' Attempts by government to interfere in group organization may be counterproductive.

Need to Develop a Disaggregated Funding Strategy

In addition to disaggregating the policy and planning process in using ICT to provide information to rural women, the results also point to a need to formulate policies and programs to prevent duplication of efforts. This study has helped to identify factors that influence rural women's willingness to pay for different information delivery technologies. The many factors have different effects in different regions. This opens the door for policy and program planners to allocate resources among different agencies and development partners.

Need for the Critical "Political Will"

The Government of Ghana has expressed its commitment to provide information through the use of ICT to empower rural women through various policy pronouncements and position papers. Government's commitment however must be examined within the broader context of the allocation of budgetary resources to rural education programs and ICT development. Over 70% of government ministries spend less than 10% of their budgets on ICT related activities. With the global trend towards e–government, government may want to signal its commitment by increasing its own use of ICT. Furthermore several indicators point to the possibility of significantly expanding ICT use in information delivery to empower rural women.

CONCLUSIONS

This paper looked at the need to design a disaggregated ICT policy to empower rural women using information from selected rural areas in Ghana. Data was collected from 300 respondents from three regions: Upper East, Ashanti, and Greater Accra in Ghana to determine the factors influencing rural women's' choice of information delivery technology. The information delivery technologies considered were private radio, community radio, and extension agents. The basic hypothesis in the study was that the wide differences in the socio-economic status of rural women households' influences their choice of information delivery technology and also their willingness to pay for a selected technology. This basic hypothesis was addressed using data from a survey instrument administered to 300 households from the three designated regions.

Beyond the issue of whether an aggregate rural women's empowerment ICT policy would be appropriate, the outcome of this exercise has important program planning and implementation applications. Even though the government sets the overall national ICT policy, the results from this study suggest some merit in allocating considerable authority to regional and local authorities in setting priorities and approaches to empowering rural women through the use of ICT. The overriding conclusion that emerges from this study is the need to examine ICT use in empowering rural women within a 'holistic' context. No single socio-economic factor emerged as the dominant variable in planning policies and programs to introduce ICT use in information delivery to rural women. Likewise, no single information delivery technology emerged as 'the' technology to use in delivering information to rural women. The results also point to a need to cast rural empowerment policies and programs within the broader poverty reduction policies of the government and also within the attainment of the Millennium Development Goals (MDGs). The results again indicate the need to formulate policies and programs to prevent duplication of efforts and the need for critical "Political Will".

Endnote

[1] Contingent valuation is a survey-based economic technique for the valuation of non-market resources, typically environmental areas and services. It can be used to estimate both use and non use values, and it is the most widely used method for estimating non-use values. While these resources do give people utility, certain aspects of them do not have a market value (price) as they are not directly sold. Example, people receive benefit from a beautiful view of a mountain, but it would be tough to value. Contingent valuation surveys are one technique which is used to measure these aspects. The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services. In some cases, people are asked for the amount of compensation they would be willing to accept to give up specific environmental services. It is called "contingent" valuation, because people are asked to state their willingness to pay,

contingent on a specific hypothetical scenario and description of the environmental service (Ecosystem valuation n.d.; Wikipedia the free encyclopedia n.d).

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Study of diffusion and adoption of Male Annihilation Technique

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ABSTRACT

The Nuclear Institute of Agriculture (NIA) with the collaboration of the International Atomic Energy Agency (IAEA) has introduced "Male Annihilation Technique" (MAT) to control the fruit fly. MAT is economical, non-polluting, non-hazardous, environment friendly, less laborious technology that fulfills the demands of WTO for exporting agricultural commodities. Despite all these advantages offered by MAT, it has failed to reach at the maximum level of adoption among the growers of Pakistan particularly of Sindh province. Therefore, the researchers studied and identified barriers in the rate of adoption of MAT. The study also identified the information sources that have created trust among farmers resulting in the dissemination of MAT on a larger scale.

Key words: *Male Annihilation Technique; Agriculture Extension; Diffusion/Adoption*

INTRODUCTION

Pakistan possesses such a variety of soil and climate where all kinds of field and horticultural crops can be grown. Among horticultural crops, fruits are of immense importance because of its economic value and return. Fruits are also important due to their nutritional value. In Pakistan, the total area under fruit cultivation is 672.4 thousand hectares with the yield of approximately 5891.7 thousand tones out of which only 259.9 thousand tones of fruits was exported which is worth of 4575 million rupees (Anonymous, 2001). In Sindh and particularly in Hyderabad, fruits such as Mango, Banana, Guava, Sapota, papaya, Jujube and many other fleshy fruits are cultivated on larger scale. However due to insect pests and diseases, farmers sustain heavy economic losses. In Pakistan rather worldwide, the most destructive pest among other is fruit fly.

The major hosts of fruit flies are Guava, Mango, Jujube, Sapota, and vegetables. About 4500 species of fruit flies are distributed throughout the tropical, sub-tropical and temperate regions of the World (Hardy, 1988). Almost 800 species of fruit flies are reported from oriental regions, including 300 species from South and South East Asia. (Singh, 1988). The melon fruit fly (***Dacus cucurbitae***) normally causes 20 to 75% damage to melon production, where as about 80% of guava fruit in market is infested by oriental fruit fly (***Dacus dorsalis***). High infestation of guava has resulted in abandoning production of this popular fruit crop in southern Pakistan and export of this fruit has declined by about 50% (Kafi, 1986).

To forestall further infestation, the MAT was introduced in Sindh. The Male Annihilation Technique (MAT) is a fruit fly control method that removes male insects, thus reducing the male population, by distributing an appropriate amount of male attractant combined with poison in the entire target area continuously for a given length of time. This reduces the insect's chances of mating, and the females produce very few progeny. As a result, the wild population in the target area declines and the insects are eradicated in the end. The male attractant for the oriental fruit fly is methyl-eugenol. Fiberboard squares that have been soaked in lure-toxicant, a mixture of an attractant (methyl-eugenol) and an insecticide (BRP) are distributed manually in targeted areas.

The rate of adoption of MAT is slow as farmers are still relying on pesticide use. Rate of adoption is determined by many factors. According to Rogers (1995), perceived attributes of an innovation are one of the most important explanations of the rate of adoption of an innovation. From 49-87% of the variance in the rate of adoption is explained by five attributes, which are as under:

1. Perceived Attributes of Innovations, i.e. Relative advantage, Compatibility, Complexity, Trailability, and Observability

In addition to these five perceived attributes of an innovation, other variables also affect the rate of adoption of an innovation (Rogers, 1995) which are as follows:

2. Types of innovation-decision
3. Communication channels
4. Nature of the social system
5. Extent of change agent's promotion efforts

Agricultural extension in Pakistan is involved in disseminating agricultural practices to farmers through various means including taluka extension agents. One of the strength in using taluka extension agents is that he/she personally contact with the farmers at their fields and help them to solve their farm problems. If the problem is sophisticated, taluka extension agents bring that problem back to research station for its solutions. Thus the role of taluka extension agents is like a bridge between research and farmers (Khan, 1997).

With the introduction of insecticides, entomologists were very optimistic and assertive in advocating that they found an everlasting solution against insect pests. But in recent past, the scientists have encountered a new growing concern related to the indiscriminate use of pesticides. The pesticide application is not only polluting the environment but also disturbing the natural eco-system of beneficial insects. The chemical control of fruit flies is not very effective because maggots (harmful stage of fruit fly i.e. larvae) live inside the fruit. Therefore, any insecticide that may be applied both in the forms of dust and spray destroys them at a very modicum rate because it has not the capacity to go inside the fruit and kill larvae (Qureshi, 1983).

Considering such constraints which are associated with the use of insecticides as far as the control of fruit fly is concerned, the entomologists of NIA (Nuclear Institute of Agriculture), Tando Jam have introduced a new technology with the collaboration of IAEA (International Atomic Energy Agency) to control fruit fly successfully, named as "Male Annihilation Technique" (MAT). MAT was introduced way back in mid 80^{s} and has a reputation that it is economically cheaper (74% less than insecticidal control).

Lack of knowledge is considered one of the most important attributes of learning of an innovation. Knowledge of an innovation and its use can help farmers to increase farm income. Knowledge can be transferred by various means. Agricultural extension uses three common approaches to technology transfer i.e., Individual method (face to face, telephonic call, farm visit etc), Group method (Demonstration plots, group meetings etc), and Mass method (Electronic and print media etc). Other factors which impede the rate of adoption according to Supe (1987) are characteristics of innovation (economic cost, consistency with values, complexity etc), characteristics of adopters (age, education, income, use of information sourcs etc), and constraints of a system (values and norms, authority system, feudalism etc).

Little efforts have been made to understand the causes of slow rate of adoption and very few studies focused on the barriers associated with the slow rate of adoption of modern agricultural practices in Pakistan (Saleem, 1990; Jalvi, 1996). The knowledge gap invoked researcher to undertake the study which determines the farmers' level of knowledge regarding the use of MAT and identify barriers affecting its rate of adoption in District Hyderabad, Sindh.

This research will help officials (policy makers), implementers (agriculture extension, NIA etc) and adopters (farmers) and will also be beneficial for organizations working in agricultural sector such as Non-Government Organizations (NGOs) and Farmers Organizations (FOs).

Objectives of the Study

Following objectives were set forth for the study:
1. To determine the perceptions of farmers and NIA's scientists regarding the attributes related to MAT,
2. To determine the level of knowledge of farmers regarding the use of MAT,
3. The determine the use of information sources and trust of farmers and NIA's scientists place on information sources involved in dissemination of MAT, and
4. To identify the barriers in the adoption of MAT as perceived by farmers.

Methodology

Hyderabad district is well known area in cultivating a variety of fruits and this study was limited to Guava, Mango and Jujube fruits. The population consisted of farmers who received technical assistance from NIA for the use of MAT and entomologists who were involved in diffusing MAT to the farmers. There were 416 farmers in the vicinity of Hyderabad district who used MAT on their holdings (NIA records). Among them, 60 farmers were taken as sample for research using McCall (1980) table with the 90% confidence level. All four (4) entomologists of NIA were also interviewed which makes the total sample of 64. Both the farmers and the entomologists of NIA were personally interviewed from July to September 2005 through a structured questionnaire. The response rate was 100% since the farmers who were randomly selected from the list provided by NIA were in touch with NIA for further assistance on various issues concerning agriculture productivity. The collected data were analyzed by using descriptive statistics.

RESULTS AND DISCUSSION

1. Demographic Information

The data in Table-1 show that majority of farmers (50%) and NIA scientists (75%) belonged to the age group of 41-60 years. About 22% of the farmers received graduate level of education whereas only 13.3% of farmers were illiterate. All NIA's scientists received post-graduate level of education. Majority of farmers (56.7%) had 16 and above years of farming experience and 28.3% of farmers had 11-15 years of farming experience. Seventy-five percent of NIA's scientists had more than16 years of professional experience.

Table 1: *Demographic Information of the Respondents*

Demographic Characteristics		Farmers (n = 60)		NIA Scientists (n = 04)	
		Frequency	Percentage	Frequency	Percentage
Age in Years	Up to 40	1	1.7	0	0.0
	41-60	30	50.0	3	75.0
	61 and above	02	3.3	1	25.0
Education	Illiterate	08	13.3	0	0.0
	Primary	11	18.3	0	0.0
	Secondary	09	15.0	0	0.0
	Higher	12	20.0	0	0.0
	Graduate	07	11.7	0	0.0
	Above	13	21.7	04	100.0
Experience in Years	1-5	06	10.0	0	0.0
	6-10	03	5.0	1	25.0
	11-15	17	28.3	0	0.0
	16 and above	34	56.7	3	75.0

2. Attributes related to the MAT

According to Rogers (1995), perceived attributes of an innovation are one of the most important explanations of the rate of adoption of an innovation. From 49-87% of the variance in the rate of adoption is explained by five attributes which were included in the study and results are presented in Tables 2 to 6 (Appendix). Both farmers and NIA scientists perceived that the MAT has relative advantages over other technologies because it is compatible, simple to use, can be used on trial basis, and the results are observable.

3. Farmers' Level of Knowledge

The knowledge level of farmers regarding the use of different techniques involved in MAT was inquired and the replies are presented in Table 7.

Table 7: *Perception of farmers regarding the use of recommended practices associated with the use of MAT (n = 60)*

Practices/Techniques	Recommended		Not-Recommended	
	f	%	f	%
No of Traps per acre	10	16.7	50	83.3
Height of Traps	18	30.0	42	70.0
Color of Traps	60	100.0	0	0.0
Preparation of Solution	59	98.3	01	1.7
Canopy of Plant	17	28.3	43	71.7
Cleaning of Traps	18	30.0	42	70.0
Dispose off Killed Flies	36	60.0	24	40.0

Results indicated that not all practices were followed as recommended by the NIA scientists for the use of MAT. Only color of traps practice was adopted completely by all farmers and 98.3% farmers prepared recommended solution. Number of traps were not followed according to the recommendation (83.3% did not use the recommended number of traps). Seventy percent did not follow the recommended height of the traps.

4. Sources of Information

Farmers were asked to rank the information sources they have used to adopt the MAT. According to the results presented in Table 8, farmers placed Entomologist of NIA at rank 1 (mean = 3.78), Neighbor or Friend at rank 2 (mean = 3.12), and Family members at rank 3 (mean = 2.78). Taluka Extension agents were ranked at 10 (mean = 1.08). The reason that farmers placed NIA at rank 1 was the fact that the MAT has been introduced and diffused by NIA scientists themselves as stated by NIA scientists. The role of taluka extension agents is limited here, however, may be the fact that the NIA scientists involved themselves to disseminate that technology to the farmers directly.

Table 8: *Farmer's ranking of the use of information sources in the diffusion of MAT (n=60)*

Sources		Mean*	SD	Rank
1.	Advertising Circular, Label etc	1.02	0.13	12
2.	Agriculture Supplier	1.07	0.41	11
3.	Banker or Lender	1.00	0.00	13
4.	Taluka Extension Agent	1.08	0.46	10
5.	Print Media	1.20	0.58	7
6.	Entomologists of NIA	3.78	1.24	1
7.	Family Members	2.78	1.32	3
8.	Farm Business Management Instructors	1.45	0.85	5
9.	Agriculture Teacher	1.10	0.30	9
10.	Electronic Media	1.17	0.46	8
11.	Paid Agriculture Consultant	1.10	0.35	10
12.	Professional Agriculture Literature	1.67	1.17	4
13.	Neighbor or Friend	3.12	1.14	2
14.	University Extension specialists	1.35	0.66	6

Note. * Mean based on scale of 1=never, 2=seldom, 3=often, 4=almost always, and 5=always

Another aspect of the study was to collect the information regarding the "Trust" farmers placed on the information sources involved in dissemination of MAT. In this regard, farmers trusted Entomologist of NIA as the most reliable source of information regarding MAT (mean = 4.65, rank = 1). Family members were placed on second with mean score of 4.07 followed by the Neighbor or Friend with mean score of 3.73 and was ranked third. Taluka Extension agents were again ranked ninth with the mean score of 2.22. Results are presented in Table-9.

Table 9: *Trust of Farmers on Information Sources used in the adoption of MAT (n=60)*

Possible Sources	Mean*	SD	Rank
Advertising Circular, Label etc	2.25	1.17	8
Agriculture Supplier	1.95	0.89	11
Banker or Lender	1.18	0.72	14
Taluka Extension Agent	2.22	1.11	9
Print Media	2.63	1.26	5
Entomologists of NIA	4.65	0.84	1
Family Members	4.07	0.90	2
Farm Business Management Instructors	1.78	1.03	12
Agriculture Teacher	2.05	0.95	10
Electronic Media	3.25	1.32	4
Paid Agriculture Consultant	1.25	0.81	13
Professional Agriculture Literature	2.30	1.59	7
Neighbor or Friend	3.73	1.01	3
University Extension specialists	2.53	1.20	6

Note. * Mean based on scale of 1=little, 2=some, 3=much, 4=very much, and 5=an exceptional amount

Table 10: *Perception of NIA scientists regarding the use of information sources in the diffusion of MAT*

Sources	Mean*	SD	Rank
Advertising Circular, Label etc	1.75	.50	08
Agriculture Supplier	1.00	.00	12
Banker or Lender	1.00	.00	12
Taluka Extension Agent	1.25	.50	11
Print Media	2.50	.58	4
Entomologists of NIA	4.75	.50	1
Family Members	2.75	.50	3
Farm Business Management Instructors	2.25	1.50	7
Agriculture Teacher	1.50	1.00	10
Electronic Media	2.50	.58	4
Paid Agriculture Consultant	1.75	.96	9
Professional Agriculture Literature	2.50	1.29	5
Neighbor or Friend	3.25	.96	2
University Extension specialists	2.05	1.26	6

Note. * Mean based on scale of 1=never, 2=seldom, 3=often, 4=almost always, and 5=always

The Entomologists of NIA were asked to rank the information sources used for diffusion of MAT. Results in Table-10 revealed that like farmers, Entomologists of NIA, Neighbor or Friend, and Family members were ranked first, second, and third with mean score of 4.75, 3.25, and 2.75 respectively. Taluka Extension agents were ranked 11 (mean = 1.25).

Entomologists of NIA were asked to place trust on the information sources used for diffusion of MAT. Results in Table-11 reflect that respondents trust Entomologist of NIA as the most reliable

source of information regarding diffusion of MAT (mean = 4.75). Electronic media were ranked second with mean score of 4.50 and Print media were ranked third as the most reliable source of information regarding diffusion of MAT (mean = 3.50). Taluka Extension agents again did not find a place and were ranked 12th (mean = 1.25).

Table 11: *Trust of NIA scientists' on Information Sources used in the diffusion of MAT*

Sources	**Mean***	**SD**	**Rank**
Advertising Circular, Label etc	3.25	.96	05
Agriculture Supplier	3.0	2.16	08
Banker or Lender	2.50	2.34	10
Taluka Extension Agent	1.25	.50	13
Print Media	3.50	.58	3
Entomologists of NIA	4.75	.50	1
Family Members	3.25	.96	4
Farm Business Management Instructors	2.00	.82	11
Agriculture Teacher	2.00	.82	11
Electronic Media	4.50	.58	2
Paid Agriculture Consultant	3.00	1.15	7
Professional Agriculture Literature	3.00	.82	6
Neighbor or Friend	2.50	.58	9
University Extension specialists	3.00	.82	6

Note. * Mean based on scale of 1=little, 2=some, 3=much, 4=very much, and 5=an exceptional amount

5. Barriers affiliated with the adoption of MAT

Table 12: *Barriers faced by Farmers in adoption of MAT*

Barriers	Not at all		To some extent		To a greater extent	
	f	%	f	%	f	%
Expensive	52	86.67	08	13.33	00	00.00
Financial constraints	54	90.00	06	10.00	00	00.00
Laborious	50	83.34	05	08.33	05	08.33
Large farm area	20	33.33	25	41.67	15	15.00
Inaccessibility from road	29	48.34	23	38.33	08	13.33
Un-availability of inputs	40	66.67	12	20.00	08	13.33
Ineffective inputs	47	78.33	08	13.33	05	08.33
Effect of chemicals to human & crop	59	98.33	01	01.67	00	00.00
Afraid of loss	44	73.34	14	23.33	02	03.33

Farmers were asked to identify the barriers they have faced in the adoption of MAT. The responses were recorded on a Likert-type scale (1 = Not at all, 2 = To some extent, and 3 = To a greater extent). Reponses are presented in Table-12 which show that large farm area, inaccessibility from roads, and afraid of loss were perceived as barriers of adoption by a number of farmers.

CONCLUSIONS

MAT is a sustainable agricultural practice which can reduce the cost of production without damaging and disturbing the flora and fauna. The adoption of sustainable practice can help prevent health and economic damages to the farmers as well as preserving our natural balance and resulting in poverty alleviation from rural masses.

The results are promising and MAT has relative advantages over other technologies because it is compatible, simple to use, can be used on trial basis, and the results are observable (see Tables 2-6 in the Appendix). Farmers' level of knowledge regarding the use of different practices related to the MAT was however not satisfactory. The researchers found that the farmers used their own intuition in using MAT ignoring the recommendations of the NIA scientists (Table 7).

Lack of proper use of MAT can be viewed as the barrier of adoption of MAT by other fruit growers. Such practices should be avoided and the use of information sources must be made effective. Farmers and NIA scientists perceived that Entomologists of NIA were the better sources of information over others.

The use of information sources should be maximized by involving Taluka Extension Agents since they are in close contact with the farmers of their area. Mass media can also be utilized for the cost effectiveness. Large farm area, inaccessibility from roads, and afraid of loss were perceived as barriers of adoption for a number of farmers in the studied area.

RECOMMENDATIONS

Based on the findings of the study, following recommendations were made;

- NIA should involve Agriculture Extension for diffusion of MAT.
- Follow-up should be made to farmers' field for further assistance and clarification about the use of MAT.
- Seminars on a wider scale should be organized and the use of Mass media must be encouraged for mass adoption of MAT.
- Further studies may be carried out in other districts of Sindh Province of Pakistan as to validate and update the findings of the present study.

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Appendix

Table 2: *Relative Advantage*

Relative Advantage	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Worse	0	0.0	0	0.0
Somewhat Worse	0	0.0	0	0.0
Somewhat Better	9	15.0	1	25.0
Better	51	85.0	3	75.0
Do not Know	0	0.0	0	0.0

Table 3: *Compatibility*

Compatibilty	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Incompatible	0	0.0	0	0.0
Somewhat Incompatible	0	0.0	0	0.0
Somewhat Compatible	5	8.3	0	0.0
Compatible	54	90.0	4	100.0
Do not Know	1	1.7	0	0.0

Table 4: *Complexity*

Complexity	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Simple	56	93.3	4	100.0
Somewhat Simple	1	1.7	0	0.0
Somewhat Complex	1	1.7	0	0.0
Complex	02	3.3	0	0.0
Do not Know	0	0.0	0	0.0

Table 5: *Trialability*

Trialability	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Easy	53	88.3	3	75.0
Somewhat Easy	6	10.0	1	25.0
Somewhat Difficult	1	1.7	0	0.0
Difficult	0	0.0	0	0.0
Do not Know	0	0.0	0	0.0

Table 6: *Observability*

Observability	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Unobservable	0	0.0	0	0.0
Somewhat Unobservable	0	0.0	0	0.0
Somewhat Observable	10	16.7	0	0.0
Observable	50	83.3	4	100.0
Do not Know	0	0.0	0	0.0

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Challenges and opportunities in ICT educational development: A Ugandan case study

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ABSTRACT

This case study examines an organization which is partnering to provide ICT solutions for secondary schools in Uganda. Based on interviews and observation, we identify nine key transitions in this organization's development. Each transition is characterized by a challenge that was faced and a solution that was implemented or attempted. We draw broader "lessons learned" from the results to inform similar development organizations. This study intends to contribute to the dialogue concerning ICT, education, and development and aims to expose some ways to build bridges across the so-called digital divide.

Keywords: *Uganda; Computers for Africa; ICT; computer donation; educational development*

INTRODUCTION

The ubiquitous term "digital divide" is used to describe a wide range of disparate outcomes demonstrating a gap in technology resources, information, and education. Perhaps nowhere is this divide more apparent, or more discussed, than in sub-Saharan Africa (e.g., Langmia 2006). Policy makers in Africa and elsewhere have put forth technology, technical competence, and computer and information literacy as solutions for many of these problems. Indeed, ICT solutions may help to solve problems related to education such as teacher shortages, low achievement, high drop-out rates, lack of opportunity, and lack of materials (Wims & Lawler 2007). In response to these opportunities, organizations from around the world have implemented projects across the spectrum of ICT delivery. Prevalent among these are organizations which are somewhat new to international development, that are relatively small, and that do not originate in Africa.

Despite the best of intentions, many of these projects ultimately fail. There are many reasons for this: technology may not be the appropriate solution in the first place, projects may be poorly-implemented, equipment may be improperly used, there may be a lack of follow-up, stakeholders may not receive adequate training to support the program, or it may simply be difficult to create and sustain a project within a shifting social and political context. New, small, and/or foreign organizations face specific challenges in the delivery of ICT solutions for education in an international development context. The purpose of this paper is to present a case study of one such organization operating in Uganda which is succeeding in these efforts, to examine the challenges that were and are faced by that organization, and to extrapolate lessons learned for similar organizations. This study intends to contribute to the dialogue concerning ICT, education, and development and aims to expose some ways to build bridges across the so-called digital divide.

BACKGROUND AND CONTEXT

Uganda is home to about 28 million people in East Africa. The various urban areas and cities of Uganda are densely populated but Uganda is primarily an agricultural country and rich in natural resources. The seventeen year conflict in the north of Uganda has displaced between 1.3 and 2 million people. This has had devastating consequences for education, technology, and development in the northern regions, but has also taxed the entire country. For the East African region, only about .3% of the population owns a computer (Akst & Jensen 2001) and the percentage for all of sub-Saharan Africa is less than 1% (Chinn & Fairlie 2004; World telecommunication indicators database 2006).

Ugandan education takes places in a country comprised of more than 20 ethnic groups where the common language of instruction is English. Though presented with a number of technical and developmental challenges to education in addition to those mentioned above, 69.9% of Ugandans over the age of 15 are literate. President Lt. Gen. Yoweri Museveni created a system of free Universal Primary Education (UPE) for children age four and up in 1997, in response to the global call for Education for All (EFA) (Murphy 2003). This has had some success, though truly universal, quality education is a daunting and difficult task faced with specific challenges. For example, fifty percent of the population is between ages zero and fourteen and the pupil to textbook ratio is four to one.

Educational ICT in Uganda is similar in many ways to other countries in East Africa. Efforts are being made to integrate ICT into schools and curricula, but with mixed effort and success. One such effort is the New Partnership for Africa's Development (NEPAD) e-schools initiative (Evoh 2007). Bugulumbya Secondary School in Uganda was one of the first to take part in this project on the continent (APC 2005). This and similar local, national, and international initiatives show a recognition of the importance of ICT in education. However, ICT in the schools is still not the norm due to a number of logistical and developmental challenges. Even when computers are available in some schools, evaluation of the actual impact of ICT is rare, and similar to a recent study in Kenya, computers are often only used for specific courses or by specific personnel, and many teachers, students, and subject-areas still lack access to ICT (Wims & Lawler 2007).

Computers for Africa (CFA) was conceived and established by Tim and Ruth Leacock of Omaha, Nebraska in the year 2000 (http://computers4africa.org). They began with the realization that in the United States thousands of older but still serviceable computers were being warehoused and/or melted down. With the initial help of a former missionary in Uganda, they began to acquire and refurbish computers, eventually installing complete computer labs in clusters of schools around the country. They traveled to Uganda to learn more about the beneficiaries of their work. Their time in Uganda made them interested in not only delivering the much needed technology to agencies that served Ugandan youth, but also developing relationships and partnerships with the stakeholders.

The Leacocks moved to Kampala, Uganda in 2004 with one simple goal: to "share the wealth of U.S. technology with people in least developed nations" (Computers for Africa 2006). Though not specific to schools, this mission manifested itself in Ugandan secondary schools. They laid out the following mission:

- To refurbish and transport used computers to East Africa
- To provide ready-to-set-up technology centers for African non-profits
- To promote volunteer involvement in international issues
- To provide an alternative to wasteful and harmful dumping

- To build US-African relationships.

We traveled to Uganda in July, 2006 to observe and participate in CFA operations. The results presented here are the result of that trip and are intended to form a better understanding of how new development organizations can find their niche and succeed in efforts to bridge the digital divide.

METHODOLOGY

The research methodology for this study consisted solely of qualitative techniques. Since this research attempts to determine "why" technology-related projects succeed or fail, rather than simply documenting success or failure more broadly, qualitative methods and a single-project case study are the most appropriate. As qualitative researcher Robert Yin (1984) emphasizes, a case study can "explain the causal links in real-life interventions that are too complex for survey or experimental strategies" (p. 25). Within this qualitative framework, interviews were utilized to investigate the mechanisms at work. Methodology experts Rubin & Rubin (1995) claim that interviews allow one to "unravel complicated relationships" (p.51) in a way that other means do not.

Interviews were guided by questions such as:

- What institutional, societal, and personal factors affect the success of technology-related projects?
- How do these factors affect the beliefs, attitudes, and practices of various stakeholders?
- What are various stakeholders' initial perceptions and expectations of technology related projects?
- When are technology-based projects the appropriate intervention? When are they not?
- What types of planned policies and programs are most effective for promoting success before, during, and after implementation?

We used these questions via semi-structured and informal interviews with CFA personnel, with Ugandan education and/or development professionals, and with local stakeholders – i.e., computer teachers, subject-area teachers, administrators, and students. We also relied on observation by taking part in a CFA workshop with local secondary computer teachers working to form an online virtual community. This participation and observation gave us a better understanding of how the project operates and involves local stakeholders.

RESULTS

Based on interviews and observation, we identified nine key transitions in CFA's development of ICT delivery in Uganda. We present these transitions below. Each is characterized by a challenge that was faced and a solution that was implemented or attempted by CFA.

Challenge 1: long distance operations
Solution: establish a local presence and a network of local stakeholders

As described above, CFA was born in Nebraska, USA. Once a need was identified and CFA determined a way to fill this need, the organization began to send computers to Uganda. Though this was a large task for a small organization, they soon came face to face with another reality.

Namely, how could they effectively run these operations from the United States, when the need – and more importantly the ability to gauge local stakeholder desires – was in Uganda? Seeing that local participation and local ownership were crucial, CFA established local connections in the country, hired a Ugandan secondary school teacher to be Director of CFA operations in Uganda, Herbert Busiku, and the directors themselves moved to Uganda for two years.

Challenge 2: communication
Solution: streamline, direct connections, clear messages

Once established within the country, the day to day needs of running local operations became the main concern for CFA. An integral part of running any organization that deals with a diverse group of stakeholders is communication. Communication problems were exemplified by a convoluted and complex chain of phone calls, emails, and word of mouth from CFA staff to a secondary school head mistress, the result of which was more confusion than understanding. In response to this, CFA made conscious efforts to streamline communications with their stakeholders, to have direct communication and not rely on a chain of communication when possible, and to construct communication in the most understandable manner possible.

Challenge 3: cultural competence
Solution: constant awareness and diligence, proactive solutions

The previous challenge leads directly to a challenge that exists at every stage of the international development process: the challenge of cultural competence. This may take the form of language, etiquette, issues of authority or hierarchy, or an understanding of cultural subtleties such as time and relationships. Beyond these culturally constructed differences however, organizations from the global North, must also deal head on with issues of cultural bias, colonialism, imperialism, and hegemony. Though organizations may have the best of intentions, if they do not recognize and acknowledge the historical legacies of power which still have an impact, and with which they might be complicit if they aren't diligent to work against, they are likely to be missing a key cultural ingredient at this stage. CFA recognized this challenge and was alert to the potential dangers if not addressed.

Challenge 4: appropriateness for the local context
Solution: actively receive local input and respond to it

An extension of cultural understanding and the avoidance of hegemonic behavior is the need to understand the local context as it relates the project itself. In other words, how does the organizationally perceived need compare to local desires and local perceptions of need? From step one, CFA had to check their assumptions about what was needed from their viewpoint, and trust in what was needed from the perspective of teachers, students, and administrators in Uganda. These issues may be of a very practical nature. For example, CFA envisioned Linux as the operating system of choice since it was open-source and freely available. They soon had to adapt, however, when they received feedback informing them that the local context was not favorable to this, and responded by switching to a Microsoft operating system for the computer labs. (See a related discussion in Wims & Lawler 2007).

Challenge 5: defining and documenting success and failure
Solution: evaluation and assessment at every stage

The solution above is, perhaps, over-simplistic since receiving feedback is a challenge in and of itself. This desire to get stakeholder feedback is part of a larger challenge: how do we know if what we're doing is working? To answer this question, CFA first needed to be able to define what success was, and specifically what success was to their stakeholders. From that point on, they

were able to include an evaluation component at every stage of their organizational development. This includes formative evaluation as specific projects are underway and summative evaluation when project components are completed. Especially useful in this regard may be practices of participatory evaluation (e.g., Broughton & Hampshire 1997; Cracknell 2000).

Challenge 6: technical sustainability
Solution: build local skills & build a cluster/community of stakeholders

Due in large part to effective evaluation utilized by CFA, their next challenge became apparent via stakeholder feedback. Once computer labs were operational in schools, how could they be sustained? In other words, when computers had problems and needed troubleshooting and/or maintenance, how would this occur – especially in the long term, without CFA assistance? CFA responded to this challenge with a maintenance and repair workshop which supplied the local community with the skills to repair most common computer problems. In addition, from the beginning CFA conducted operations in a strategic way such that individuals could rely on a community that was organically developing out of a geographical cluster of schools, from which stakeholders could tap collective expertise to solve problems as they arose. This was extended into a virtual community in addition to a geographical one (http://www.bbukka.org) and can serve as a model for other clusters of schools and/or ICT projects in the future.

Challenge 7: organizational logistics and operations
Solution: clarify mission, respond to evaluation, consider staffing and funding

As with any organization, the day-to-day, on-the-ground operations are only a part of being successful. Although CFA had established a substantial presence in parts of Uganda, there were continual issues to deal with both in Uganda and in the United States simply due to running an international organization. As the organization came to understand that operations could be successfully expanded, personnel and funding issues arose. How many staff do we need? Can we utilize volunteers? Can we pay more local workers? How is the financial viability of the organization as a whole? Based largely on quality evaluation, CFA has responded to such issues effectively, in large part because they have a very good understanding both of their organization's mission and capacity, and the stakeholders' needs and desires. They remain small and focused, which allows them to use their resources effectively and efficiently.

Challenge 8: unintended consequences
Solution: anticipation of, vigilant monitoring for, and immediate response to them

As with any development project, and with any evaluation of such projects, unintended consequences must be considered. They should be anticipated to the extent possible, but must also be addressed as they arise. CFA quickly came to the realization that shipping computers into Ugandan schools meant that someday those Ugandan schools would have to deal with getting rid of old computers that no longer work. Typically, this meant unsafe and/or environmentally unfriendly means of disposal in a context that is not equipped to recycle used computers. CFA researched possible solutions and has worked to begin a secondary operation and/or a partnership for recycling computers from Uganda. This issue remains under study and is yet unresolved.

Challenge 9: external obstacles
Solution: research and developing expertise and/or partnerships in other development efforts

As with all development work, there are challenges that arise externally over which the organization has very little control, but which affect operations nonetheless. In Uganda, the local power situation has been crippled due to one of the major hydroelectric dams being taken offline,

and also due to crime targeting the recently privatized power company. The result for schools with CFA computers is that they very often do not have power. Six of the seven schools we visited for our observations did not have power at the time we arrived. For schools without generators, this means that the use of computers is inconsistent at the very best. For those with generators, the schools are faced with difficult decisions concerning expensive fuel versus the use of the computers. CFA has responded to this external barrier by working with local stakeholders to research various energy options. In addition to generators, CFA is actively looking into the viability of solar power solutions for the partner schools. They are examining partnerships with solar power providers and NGOs, and are becoming experts this area of development as it suits the needs of their stakeholders.

One additional item of interest can not be effectively captured in the challenge/solution format. Rather than a challenge addressed, CFA was able to recognize an opportunity for CFA volunteers and stakeholders and to capitalize on it. As an international organization that spanned borders and effectively linked communities from the U.S. and Uganda, CFA used this position to establish relations between two international communities. The most obvious manifestation of these global relationships is travel. The Director of Ugandan Operations was able to visit the organizations' operations in Nebraska as well as attending additional training in the U.S. In addition, student volunteers from Nebraska have been able to travel to Uganda to take part in operations with local stakeholders. Beyond technical assistance, therefore, CFA is helping to build positive global understanding which will benefit efforts such as theirs in the future.

IMPLICATIONS

Each of the nine transitions described above – a challenge faced and a solution implemented – may have broader implications for similar organizations in the educational ICT development field. This section attempts to draw broader "lessons learned" from the results of the interviews and observations described above.

Lesson 1: Develop a local presence, build local networks, and develop local leadership.
CFA was able to become viable and successful by basing part of their operations in Uganda, by developing relationships with local stakeholders, and by ultimately having local leaders in charge of the implementation of the projects.

Lesson 2: Communication, communication, communication.
Communication, in any organization, can make great ideas into great successes, or can turn great ideas into failures. Operating across international and cultural boundaries amplifies this. Conscious and deliberate attempts to streamline and clarify communication are key.

Lesson 3: Cultural competence is obligatory.
The very notion of "streamlining" and "clarifying" communication may be an American cultural interpretation of events. Every phase of operations, from business communications to informal meetings, is governed by the cultural context. Building competence in the local culture is likely the only way to improve this. Of course, there will be missteps and misunderstandings, which should be addressed and corrected as they arise rather than ignored.

Lesson 4: Local stakeholders, and the context they are in, are the ultimate judges of success and/or failure.
CFA experienced a context in which selected solutions (e.g., Linux operating system) were ultimately not viable, and they proactively changed their strategies. Other organizations will face similar barriers to ideas which do not match a changing local context, and must realize that

cutting short-term losses in pursuit of ultimate success and longevity of the organization may be necessary.

Lesson 5: Evaluation, evaluation, evaluation.
Even organizations which are well-intentioned and understand their stakeholders well can not be sure that projects are having the impact which they assume. This is true of any organization, but is especially true of small organizations in challenging development environments. CFA is able to respond to barriers such as those described, in large part, due to formative and summative evaluation measures at all steps of the process.

Lesson 6: Build local skills and local ownership.
For long-term sustainability, these components are vital. For CFA this means not only developing the skills of computer usage, but of troubleshooting problems, and doing so as a community cluster of concerned stakeholders. Other organizations will have different challenges, but the sustainability of efforts, with the eventual goal of limited or no organizational support, must be a component of a successful effort.

Lesson 7: Sustain the organization as well as the projects.
Although the stakeholder-driven projects are how an organization demonstrates success and are most often the place where real passion and attention are aimed, the well-being of the organization as a whole must not be neglected. Funding, staffing, and logistical needs of the organization are not sufficient for success, but are certainly necessary.

Lesson 8: Do no harm.
The development version of the Hippocratic Oath would be to remain diligent in looking for unintended consequences. Though these may be positive effects in some cases, they are often negative. In the case of CFA, one consequence is the eventual disposal of hundreds or thousands of computers in a context not equipped to handle the safety and environmental implications. They have responded with attempts to find ways to limit this impact. All projects will have unintended consequences and organizations must take precautions to minimize negative impacts.

Lesson 9: Engage other development efforts.
CFA and their stakeholders face an energy crisis in Uganda. Therefore, they have found themselves tangentially in the field of energy development, researching solar and other solutions, as well as forming partnerships in these areas. The broader lesson is that development efforts do not exist in a vacuum. Education and ICT projects are vital components of a broader holistic development agenda that must include not only power but public health, environment, infrastructure, etc. A synergistic effort among these development sectors is likely to have an amplifying effect, above and beyond the sum of the parts.

In all, the lesson's learned by Computers for Africa's operations in Uganda can serve as a model for small development organizations in any context. Beginning with little more than a recognition of the global imbalance in information technology and computer resources, an idea of how this gap might be diminished for some stakeholders in sub-Saharan Africa, and the will and the means to attempt it, Computers for Africa has succeeded in partially achieving their goals. They continue to address new challenges as they arise and this adaptability will assist them in continuing to assist local stakeholders in bridging the digital divide.

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Engagement Theory, WebCT, and academic writing in Australia

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ABSTRACT

The development of Engagement Theory for technology-based teaching and learning provides guidelines specifically for Information and Communication Technology (ICT). This article is drawn from a case study in which a popular learning management system, WebCT, is used in an academic writing course at the University of Sydney, Australia. The study highlights both the benefits and difficulties of using technology when teaching academic writing and shows how effective Engagement Theory has been in the design, implementation, and outcomes of the website associated with the course. The website enhances the teaching and learning experiences of the students and the lecturer, students participate actively in the unit, interact and collaborate with each other and with the lecturer, and do so within a safe environment. The students also work together on projects that are meaningful and which are directly relevant to their own disciplines. Significantly, the time associated with the development and maintenance of the site was a problem, an issue not addressed by Engagement Theory.

Keywords:

INTRODUCTION

Kearsley's and Shneiderman's development of a theoretical framework for technology-based teaching and learning has benefited curriculum developers by providing clear guidelines that specifically relate to Information and Communication Technology (ICT), and has helped to increase credibility of the general benefits of ICT in educational settings. As in other countries around the world, use of ICT is an ever-increasing feature of education in Australia, and Kearsley's and Shneiderman's Engagement Theory does and will continue to enhance the quality of ICT in education. The following article is a case study of the use of a popular learning management system, WebCT, in an academic writing course at the University of Sydney, Australia. The study highlights a significant number of the benefits and difficulties faced with teaching academic writing, an area of study not common at tertiary level in Australia, and shows how effective the use of Engagement Theory has been in the design, implementation, and outcomes of the WebCT site associated with the course of study.

ENGAGEMENT THEORY

Kearsley and Shneiderman indicate that Engagement Theory shares many of the features of other theoretical frameworks for learning, particularly constructivist and problem-based learning approaches, however, they believe that "technology can facilitate engagement in ways which are difficult to achieve otherwise" (Kearsley & Shneiderman 1999). Engagement Theory specifically promotes student activities that "involve cognitive processes such as creating, problem-solving, reasoning, decision-making, and evaluation" in which students are "motivated to learn due to the meaningful nature of the learning environment and activities" (Kearsley & Shneiderman 1999). An ICT environment, they claim, is best suited to providing a meaningful and authentic experience for

students, one that can be configured to simulate the kinds of experiences students will face outside of the classroom. Specifically, Engagement Theory comprises three components:

Relating: learning activities that occur in a group context
Creating: learning activities that are project-based
Donating: learning activities that have an outside (authentic) focus

Relating, that is, collaborative work, forces students to "clarify and verbalize their problems, thereby facilitating solutions" (Kearsley & Shneiderman 1999). Creating involves student participation in the development of their assessment tasks: "students have to define the project and focus their efforts on application of ideas to a specific context" (Kearsley & Shneiderman 1999). Donating "stresses the value of making a useful contribution while learning" (Kearsley & Shneiderman 1999), a feature that motivates learners because they are engaged with an activity they value.

Engagement Theory has underpinned some important features in the development and implementation of the WebCT site used for teaching academic writing at the University of Sydney. Essentially, Engagement Theory's emphasis on providing a meaningful and authentic experience for students, in this context, involved creating assessment tasks and providing information to encourage the students to engage with writing as a process to be considered in its own right. To this end, the website developed for the course, by the mere fact of its written medium, provided the appropriate authentic experience to facilitate student learning. Taught using a combination of face-to-face lectures, workshops, and online material, the website contributes to a significant feature of the course, which is its ability to insist that the students engage with the writing process by writing for themselves.

USE OF WebCT SOFTWARE

The use of an online component to complement the face-to-face nature of the academic writing course was a trial, and used only for a small class of 27 students. Despite the limited class size, the results of the trial indicate many of the benefits and problems associated with an Engagement Theory-based website. The WebCT site associated with the academic writing course provided support for the face-to-face mode of presentation in three significant areas: (1) by offering an additional means by which students were able to communicate and discuss class issues amongst themselves, and also with the course instructor, (2) by the inclusion of optional online material to assist both those students who were more advanced, and those who were struggling with the course, and (3) by the use of online assessment in the form of a series of quizzes. These three features of the WebCT site were created and developed with reference to Engagement Theory, where this theory clearly assisted the goals of the course.

An important feature of the WebCT site is its ability to save and collate statistics on the way the students made use of the site. The website collected data on the time of access, the length of access, the pages viewed, the length of time students took to complete each quiz question, as well as maintaining a log of all bulletin board exchanges. The data for this paper has drawn on these statistics, as well as on individual interviews with the students at the completion of the course of study.

ENCOURAGING STUDENT DISCUSSION AND COMMUNICATION:

Traditional methods of tertiary instruction, particularly lecture-based tuition, are understood to be of value for imparting information to students, yet this does not develop skills of collaborative group work. By shifting away from the paradigm of lecturers being the fount of all wisdom, to

encouraging students to learn from one another, Kearsley and Shneiderman assert that students gain a deeper understanding of the course material and are more likely to develop concepts beyond the immediate scope of the course (Kearsley & Shneiderman 1999). Yet the practicality of collaborative work at a tertiary level is not always easily facilitated in the face-to-face environment. Time restrictions often do not allow students to develop working relationships with their peers, and can reduce the scope of their projects. In addition, self-conscious or shy students are often unwilling to speak in front of their peers, and some students find they have difficulty interpreting topics into verbal comments quickly under the pressure of a classroom.

WebCT software provides a bulletin board, which was used in Sydney University's academic writing course to encourage students to present questions or comments in a less-intimidating manner than in the classroom. It may be argued that this can result in students not contributing to classes, preferring only to communicate online, yet in reality the reverse occurs. A question or comment suggested on the WebCT site then finds its way into the classroom discussion, which can encourage a more reserved student to speak out. This counters Burdett, who states: "Student reluctance to participate in chat or group discussions stemmed from ideas of being exposed and a lack of anonymity" (Burdett 2003). Bunker and Vardi, however, would agree with my finding, in which: "use of asynchronous discussion may increase the reflection and thoughtfulness in student discussion" (Bunker & Vardi 2001).

Concurring with Kearsley's and Shneiderman's theory, the WebCT bulletin board encouraged student collaboration. Since some of the assessment tasks required the students to collaborate on projects, this tool was extremely valuable for them, and clearly encouraged the students to interact and communicate with each other. Anecdotally students reported on the convenience of this feature of WebCT, which allowed them to work collaboratively on a project from different locations and for as long as they wished, an attribute also commented on by Littlejohn (Littlejohn 2003).

The bulletin board is also a less intimidating way for students to speak to their lecturer. On previous occasions I have always offered students the option of emailing any questions to me directly, an offer that approximately 8% of students accept. The bulletin board on WebCT, however, resulted in more questions and enquiries from students than through standard email; a total of 37% of the students in this trial made use of the bulletin board to ask me questions directly. Perhaps this increased figure occurs because, once logged on to WebCT, the ease and availability of using the bulletin board encouraged students to use the option. The result is that I have been able to respond more effectively to the needs of students, and have been able to address specific concerns of individual students.

From the lecturer's point of view, the bulletin board has also been a valuable tool for contacting all of the students at once with news or information, and in a manner that respects the students' right to privacy. It has been a concern of mine in the past when contacting students through a group email that some students may not want their email address to be known to their fellow students. The bulletin board circumvents this problem because the lecturer can disallow contact details between students, if this is deemed necessary.

This does, unfortunately, raise a potential problem with the use of the bulletin board. Although the students on which I trailed this function adhered to the rules of communication that I outlined to them, this does not ensure that students in the future will do so. There is the potential for students using the bulletin board to bully or intimidate fellow students, and the only way to avoid this is for the lecturer to monitor the messages that are posted on the bulletin board. In my own experience, this meant checking the postings once a week, but with large numbers of students, this may require the delegation of the task among lecturers and tutors. This, according to Felix, is a time commitment we must face: "If we are serious about achieving the best results for out students, we

must be prepared to invest serious time in monitoring group dynamics" (Felix 2003). Kearsley's and Shneiderman's Engagement Theory does not address the issues of time-management for staff maintaining an online learning site, yet clearly for a site to effectively offer the students the opportunity for collaboration, a great deal of monitoring time is required by staff.

OPTIONAL WEBSITE CONTENT:

A large component of the WebCT site for the academic writing course was the inclusion of additional material for the optional use of students. It is true that the optional nature of the material resulted in a low number of students accessing the information, approximately 25% of students, but its availability seems to outweigh this factor. The optional material consisted of three types: additional material for students wanting to advance their knowledge beyond the scope taught in the unit, additional material to assist students struggling with concepts covered in the unit, and administrative material concerning lecture and seminar schedules and information and feedback about assessment tasks.

For the more advanced students, material was available on WebCT that offered them the opportunity to learn more about specific concepts that had been introduced at a preliminary level in the class, and they were encouraged to use this material in the completion of their assessment tasks. Although optional, the students were able to download this material on to their own computers for future use, and this has been the most significant achievement of the inclusion of the optional material. 100% of the students who accessed the optional material then downloaded the information for their future use. Similarly, students who struggled to understand the concepts taught in the class were, in addition to one-on-one assistance, able to access material on WebCT that helped with their understanding and learning. Again, the access rate of this material was low, but it was clear that those who did benefited greatly and improved their subsequent work. This material was also available for the students to download on to their own computers, and 100% of the students who accessed the information did so.

This section of the website was designed for individual rather than collaborative use, there was no deliberate intention to create this section of the website along the guidelines of Engagement Theory, as I decided that a combination of collaborative and individual options would be of value to the students, particularly in my overriding hope to offer a flexible method of learning that would be of value to all students. The reality, however, suggests that the students who did access the optional material soon used it in their collaborative class projects; the material became an additional resource.

The administrative material posted on the website ensured that all students had access to the course schedule at all times, and this avoided the common situation of students mislaying material handed to them in class (Bunker and Vardi 2001). More significant, however, was the inclusion of information concerning the assessment tasks. Information outlining the tasks was available from the start of the course, allowing students to prepare for the tasks well in advance, and, once completed, I posted general comments and feedback on the tasks. This function performed better than expected. All students received individual written feedback on their assessment tasks as they were marked, and so the usefulness of giving general feedback on the website was a surprise. Students commented on the usefulness of the general comments for suggesting further avenues for their work to develop, areas that may not have related to their individual comments on their marked assessment tasks. I discovered, too, that the online feedback acted as a checklist for the students' later assessment tasks. Although I presented the general feedback verbally in class at the return of their tasks, the students reported that having the general feedback online allowed them to use the information when preparing their subsequent assessment tasks. This was an unexpected benefit.

COMPULSORY WEBSITE CONTENT

One part of the website formed a compulsory component of the students' assessment. The course made use of the quiz function on WebCT. Understandably not all courses of study would benefit from this form of assessment, but the academic writing course had previously included quizzes that had been implemented during the classes. Because the existing quiz structure was compatible with the online version, it made sense to trial the WebCT format. It must be acknowledged that the preparation time of the online quizzes was considerable. Burdett indicates that: "time consumption is a negative consequence of using ICT and a deterrent to further innovation" (Burdett, 2003). Once created, however, the benefits were significant for both the students and the lecturer, and the time taken in preparation results in an improved outcome (Felix 179).

Previously, administering the quizzes in class required approximately 30 minutes. The quizzes then took approximately 2-3 hours to mark each week, and there was no scope for presenting any feedback to the students on their results. The WebCT quizzes considerably altered these elements of the quizzes, a feature that Bunker and Vardi note in their research into the reasons for developing online learning sites (Bunker and Vardi 2001).

Each quiz was based strictly on the content of each lecture. The WebCT quizzes were configured to become available one at a time, after the corresponding lecture had taken place. This ensured that the students could not see the quiz prior to the lecture and that the students attended the lecture. Each quiz consisted of ten questions, and for each question the students had to choose the correct answer from a selection of four possible answers. Approximately five concepts were introduced in each lecture, and each quiz consisted of two questions on each concept, one relatively simple, and one significantly more complex. Once each quiz became available to the students, it remained available for the remainder of the semester. This allowed for potential difficulties with students enrolling late, and it allowed students to spend as much time as they needed to answer the questions. On completion of each quiz, the students received immediate feedback and mark for their work. For each question, they received a response to indicate if their answer was correct or incorrect, and in every case, the students received information to explain why their answer was either correct or incorrect. To reduce the opportunity for cheating, every student received a slightly different quiz. The students received the same questions, but the selection of possible answers was randomised to avoid students passing answers between each other, and to avoid students collaborating on the quizzes.

The results of the WebCT quizzes have been significantly positive. From the students' point of view, the online quizzes are a much more effective teaching and learning tool than the earlier in-class format, because the students receive feedback about their results. Students commented that this has been the most valuable feature of the quizzes, because they have learned from their errors, which is reiterated by Felix: "Computers can provide individualised feedback when it is difficult in the classroom to attend to all students equally and fairly at all times" (Felix 2003). The quizzes also encourage the students to apply the information learned in lectures, rather than to repeat the information without understanding it. Because the quiz questions alternate between simple and complex, the students must first answer a simple question, similar to as it had been taught in the lecture, but then must apply that knowledge to a more complex question on the same concept. McLoughlin and Reid have commented on the shift away from memory-based assessment to "fostering learning and transfer of knowledge", which the complex quiz questions help to stimulate (McLoughlin & Reid 2002). From the lecturer's point of view, the online quizzes removed the amount of time previously spent marking, and increased the time available in class for teaching, a factor particularly important for this course, which requires students to perform a number of time-consuming writing tasks in class.

Although the quizzes were designed for individual rather than collaborative assessment, they were specifically designed with Kearsley's and Shneiderman's 'authentic focus' in mind. For an academic writing course that is used by students across disciplines, the course material must have an authentic focus; it must be immediately transferable to the students' other areas of study. For this reason the quizzes were designed with the simple and complex examples, and the possible solutions were taken from a range of academic writing samples from several different disciplines. From this the students were able to directly apply what they had learned from the quizzes to their own academic writing in other courses of study.

CONCLUSIONS

From the trial, the WebCT site for the academic writing course has proven to enhance the teaching and learning experiences of the students and the lecturer. The site has shown to encourage students to participate actively in the unit, to interact and collaborate with each other and with the lecturer, and to do so within a safe, monitored environment. The assessment methods encouraged the students to work together on projects that were meaningful and which they could see were directly relevant to their own disciplines. In the creation of the website, the intention had been to draw on Engagement Theory where it was deemed relevant and useful to the aim of providing an authentic experience of the writing process. While Engagement Theory does not consider the needs of the lecturer, particularly in terms of time-management of the website, the result of this trial was an overwhelming endorsement of Engagement Theory for online learning systems, beyond what was expected or hoped for.

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A sustainable model for use of ICTs in rural Pakistan

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ABSTRACT

The major part of Pakistan is comprised of rural areas, which are underdeveloped and lack of facilities as compared to their urban counterparts. The main reasons for this underdevelopment are; low priority assigned by the government in developing the infrastructure, lack of interest of private sector to exploit the potential of rural areas and inability of private sector to invest in the development of rural sector. Only a marginal percentage of budget is being spent in the development of rural people specially on the education. This has in turn become a main hurdle to gain, accept and to implement the new technologies in the agriculture sector as well as other rural sectors (as agriculture is not the only source of development in the rural areas of Pakistan). We must think about that 70% community to produce good manpower by providing them the latest facilities and up-to-date information in less time and in a short way. To accomplish this purpose we are proposing an ICT-Training Centre consisting of an area wise wireless networked Rural Kiosk Machines placed at every village, which will be updated through a central place of information (ICT-Rural Development Department (ICT-R2D). Initially the people of rural areas need some help from ICT-R2D to understand the system, but then they can develop themselves and interact with other world through Rural Kiosk Machines directly for their daily life matters and up-to-date information. By using this model this major proportion of our population can play an important role not only to develop their life but also to develop the country.

Keywords: *ICTs; rural development; poverty alleviation; Sustainable Model; ICT-R2D; ICT-TC; RKM, area wise wireless network.*

INTRODUCTION

Pakistan has a total population of 165.8 million [1] and is divided into four provinces viz., North West Frontier Province (NWFP), Punjab, Sindh and Balochistan. Provinces of Pakistan are further divided into Divisions and Districts and every district has a major proportion of rural area.

Table 1: *Divisions, Districts and Rural Population*

	Divisions	**Districts**	**Rural Population**
NWFP	7	24	79%
Punjab	8	34	72%
Sindh	5	21	57%
Balochistan	6	22	84%

Also in other areas of Pakistan e.g., FATA, Azad Kashmir and Northern Areas most of the population is living in rural areas. The rural population of Pakistan is approximately 70 % (Sandhu, 2003) of the total as mentioned individually for all the four provinces in the Table 1. [2]

Pakistan has a dismal literacy rate of 36.8 percent; gender wise males have a 50 percent literacy rate while females have 23.6 percent literacy. The 36.8 percent literacy rate also takes into account all those individuals who can even write their name. In addition, the total expenditure on education is only 2.9% of the National Budget. The government has tried to eradicate illiteracy, but government projects for mass literacy have become administrative and bureaucratic nightmares. This is one of the reasons why Pakistan hasn't been able to improve its literacy level.

Among the two population groups living in the cities and in the villages, it is the rural population that suffers the most. Unemployment in rural areas has risen to 7.55 percent [3] in 2004 from 6.94 percent in 2000, but the unemployment rate in urban areas has decreased to 9.80 percent in 2004 from 9.92 percent in 2000. There are currently around 2.28 million jobless people in the rural areas and 1.44 million in the urban areas. Pakistan's rural population has been largely ignored by efforts at improving mass literacy. The educational facilities provided by the Pakistani government have been of a substandard quality with no thought to the people's needs or advancement.

Pakistan's economy has undergone considerable diversification over the years, yet the agricultural sector is still the largest sector of the economy. Over the last one decade i.e. 1990s (Table 2) [4] agriculture grew at an annual average rate of 4.54 percent per annum but the overall performance of agriculture during (2000-01 to 2003-04) was below than the average of 1990's. This situation can be improved if we provide proper information and have strong and fast communication with farmers.

Table 2: *Agriculture Growth (Percent)*

Year	Agriculture	Major Crops	Minor Crops
1990-91	4.96	5.69	3.51
1991-92	9.50	15.48	2.37
1992-93	-5.29	-15.60	3.95
1993-94	5.23	1.24	12.62
1994-95	6.57	8.69	6.91
1995-96	11.72	5.96	4.89
1996-97	0.12	-4.33	0.94
1997-98	4.52	8.27	8.13
1998-99	1.95	-0.02	4.23
1999-00	6.09	15.42	-9.10
Average of 1990s	**4.54**	**4.08**	**3.84**
2000-01	-2.2	-9.9	-3.2
2001-02	-0.1	-2.5	-3.7
2002-03	4.1	6.9	0.4
2003-04	2.2	1.8	2.6
2004-05 (P*)	7.5	17.3	3.1

P* -Provisional.

While agriculture is a central activity in rural life, rural does not necessary mean farming of crops as there are significant numbers of the rural population who are engaged in many other activities, some of them are listed below:

- Poultry Farming
- Fish Farming
- Dairy Farming
- Live stock
- Fruit Gardens
- Bee Farming
- Wood cutting
- Handy crafts etc.

In addition to basic agriculture all these things are also very important and of our daily use. Increase in the production rate and well in time consumption is not only helpful for the rural population but also helpful for the urban people and ultimately for the country. No doubt rural areas have very hardworking people, but they have lack of skills, information and direct contact with the consumer or buyer. Lack of skills reduces production rate and lack of information and contacts decreases profit.

With all these statistics we came to know that even though the rural population is more in proportion they are living with substandard and poor life. Most of them are uneducated and jobless. Unfortunately, if some of them get education, they try to move towards urban areas for better job and the situation remains same. If government thinks only about the education of rural people, that is insufficient. So, there is a need to improve their lives at their own place in such a way that they love to live there with their own resources. So, there is a need for horizontal coordination among Government Departments and vertical co-ordination between local initiatives and national policy-making to ensure an integrated response to address rural community and to promote rural development.

EXISTING PROBLEMS

The rural community is suffering from multi-dimensional problems mainly due to unavailability of information and lack of communication, this includes the lack of:

- Education
- Income, because they are not getting good production due to lack of information and also they don't know where to sell their products
- Agriculture information including soil, water, crops, seeds, fertilizers and modern farming techniques.
- Healthcare including childcare
- General Knowledge and latest information about markets, market rates, weather and flood forecasts and other related information according to the geographical position.
- Community Development

PROJECT SCOPE

Equality of opportunities in social life and development of the rural areas of Pakistan, through accessible information and telecommunication technologies and empowering people to across the digital divide.

PROJECT OBJECTIVE

- To provide a forum for the exchange of knowledge and national experiences in promotion of ICT for development in the rural area through Training Centre.
- To produce a tested set of resource and training materials on concepts, issues and approaches to promote and realize the access of ICTs for all through Rural Kiosk Machine.
- Equality of opportunities for persons who are in rural areas and are uneducated, financially marginalize or disable.
- Fast and easy access of updated and latest information.
- Bridging of communication gap between rural and urban communities.
- New market opportunities for agricultural inputs, products with the development of electronic auctions and market places and elimination of middle man in marketing transactions.
- Direct transaction of agricultural inputs, products and services to target consumers.
- Dissemination of knowledge and research to rural community.

PROPOSED MODEL

The United Nations Millennium Declaration adopted by over 180 heads of governments in September 2000 stated that, given an increasing digital divide, we need "to ensure that the benefits of new technologies, especially ICT, are available to all". ESCAP as the regional United Nations organization covering the entire Asia and Pacific region is dedicated to make the commitments pledged at the highest level work to the benefit of the rural poor.

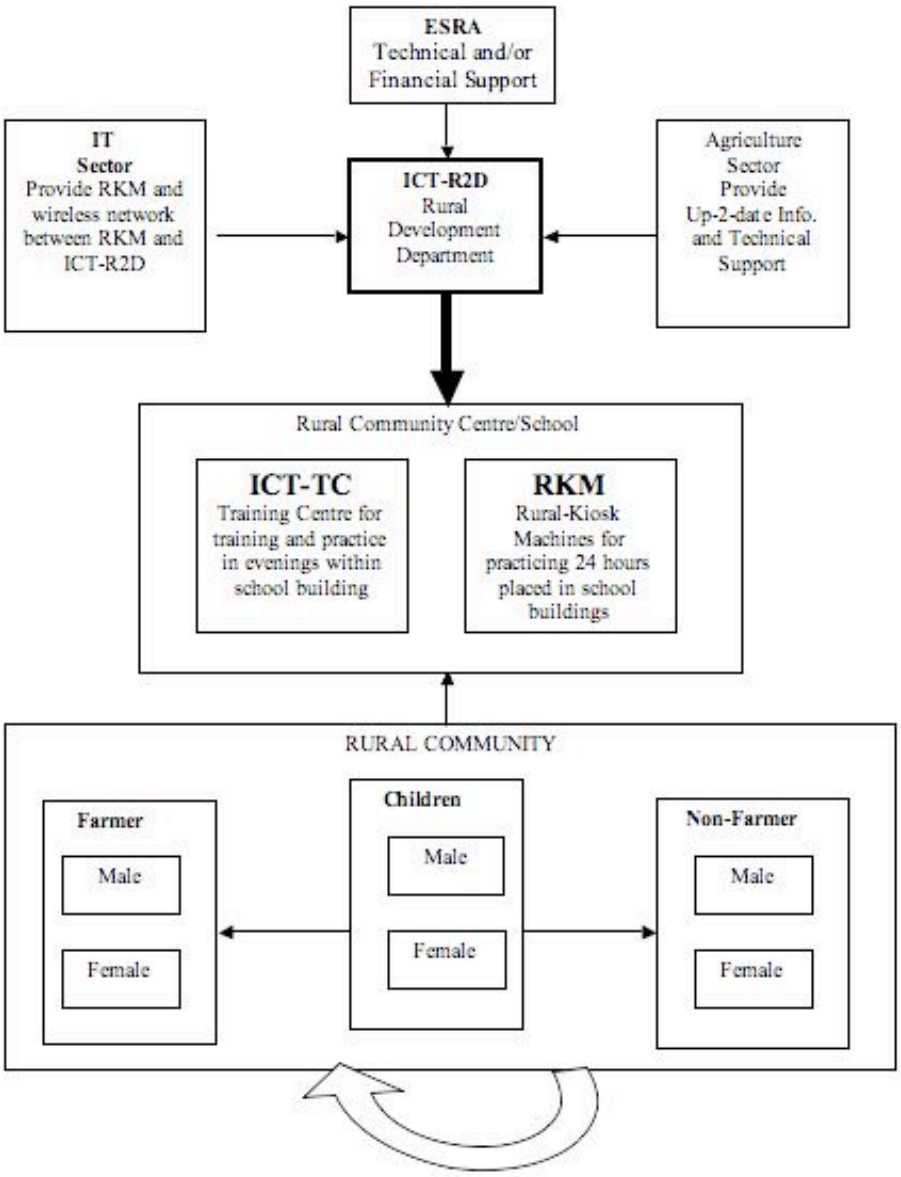
What does this mean for rural development in the region? Economic and Social Commission for Asia and the Pacific (ESCAP) has reviewed over 30 projects of varying success that have brought ICT services to rural areas in Asia [5]. Leaving details aside, in short, the following is what we have found to be of essence if people in rural areas were to benefit from the ICT revolution as ICT can be regarded both as a driver and enabler (Herselman, 2003):

- First, they need to be technically connected
- Second, they need to have physical access to connection
- Third, content and services must be developed according to local needs
- Fourth, there needs to be sustained capacity building.

In the proposed model we have considered all these points and for technical connection we are using RKM which will provide physical connection between the ICT-R2D department and rural community. Then these RKM's will be updated through different departments, by using area wise wireless connection according to local needs. Initially people will be trained by ICT-R2D in the community training centres i.e. ICT-TC and then people itself will be able to use the RKM for getting the information.

Rural Community Centre is the central component which consists of Rural Kiosk Machine (RKM) and ICT-Training Centre (ICT-TC). Rural school building will act as a rural community centre which will hold RKM and facilitate the people for 24 hours. The same building will also work as ICT-TC for discussion and trainings in the evening timings for the rural community. ICT teacher/instructor of that ICT-R2D department will help the people that how to use the RKM and how to get information from that machine directly. After some time the rural people itself help

other people and this process of self learning will accelerate in a very rapid way like use of mobile phones in Pakistan.



Educated community will then train the rest of the community

Figure 1: *Proposed MODEL for sustainable ICT Project for Rural Pakistan*

Rural Kiosk Machine (RKM)

In a move to take the benefits of Information Technology to the doorsteps of farmers, Indian Farmers Fertilizer Cooperative Limited (IFFCO) launched "Agri kiosks" in 2003 with specific focus on providing information on agriculture, fertilizer industry, agro-chemicals and the co-operative sector at the touch of a button. It guide farmers through a text and audio mode through the various agricultural practices, land preparation, seed and seeding, fertilizer application, irrigation, plant protection among others. Indian Farmers Fertilizer Cooperative Limited has tied up with Department of Marketing and Inspection, National Informatics Centre and various local agencies to provide latest information from market centres.

In Pakistan, a similar kind of machine is being developed and its working prototype is placed at Centre for Information Technology, University of Arid Agriculture Rawalpindi. It is complete with respect to information in English and its multilingual interface, to support rural communities speaking Urdu, Pashto, Sindhi, Balochi and Brahvi is being developed.

Pakistan National Language is Urdu but it is spoken only 9% as a first language. Punjabi is spoken 65%, Sindhi 11%, Others (Pushto, Saraiki, Baloch, Brahui etc.) 24% and English is very rare in rural areas. That's why there is a need for such a kiosk which can present information in all languages. And I have already stated that agriculture is not the only source of development in the rural areas of Pakistan therefore we need to develop a kiosk machine also for other source of rural development that's why I give the name for this machine Rural Kiosk Machine in the model. This machine will consist of user friendly interface in local language having all the required information which is mentioned in the introduction part. E.g. weather information in one corner and will update on hourly basis by using wireless connection by ICT-R2D department which will take information from concerned department.

Figure 2: *Rural Kiosk Machine*

The Rural Kiosk Machine will contain the following information in local language:

- Maps and landmarks
- Text, audio and video Information for all crops

- Fertilizers information
- Land preparation
- Seed and seeding
- Irrigation practices
- Plant protection
- Poultry Farming
- Fish Farming
- Dairy Farming
- Live stock
- Fruit Gardens
- Bee Farming
- Wood cutting
- Handy crafts
- Flood and Weather forecast
- Market prices

The Rural Kiosk Machine and its installation will be sponsored by ministry of IT. These machines will be connected through wireless connection to the ICT-R2D department. All the RKM machines will be updated centrally through ICT-R2D department.

ICT-Training Centre (ICT-TC)

ICT-R2D department will responsible for providing basic education for use of RKM for each faction of rural area by establishing ICT-Training Centre at each school in every village even though it is very small. If school is not available in the village then RKM should be placed at well known secured central place of the village. These centres will provide education on how to get information from the RKMs on almost every rural aspect.

Education Sector Reform Assistance (ESRA)

The Education Sector Reform Assistance (ESRA) Program should support R2D to achieve strategic, significant, and sustainable improvements in education. The educational process should foster self-development, provide people with the ability to realize their full potential and provide them with the appropriate skills which will earn them job and income opportunities. The ability of young people to avail themselves of education and training without leaving their areas has important consequences for the population profile of rural areas. So the policies should be that they don't leave their areas.

ICT cannot be promoted without education. Education and training have a vital role in generating and sustaining economic activity. The availability of a well educated and flexible workforce facilitates economic diversification and the attraction of income and job creating opportunities to rural areas. The development of new technologies, for example, requires a flexible labor force with a high level of general education and possessing good basic skills in handling information technology. The education and training systems must ensure that the needs of all factions of rural dwellers are addresses and it can develop to their full potential.

Agriculture Sector

Agriculture sector is the single most important contributor to the economic and social viability of rural areas. Agriculture employs 79.4% [6] of rural women and 60.8% of rural men of the rural population and, while employment is declining in relative terms, the sector continues to play a defining role in the rural landscape and is a conduit for major public support for rural communities. Agriculture is, and will remain in future, critical to the well being of the rural economy and, in many

areas, represents the main option for economic activity. Maintenance of a healthy agriculture sector is, therefore, an essential component of a comprehensive rural development strategy.

In this model agriculture sector will play a vital role by providing up-to-date localized information to ICT-R2D department about each and every aspect of agriculture including soil, weather, crops, fertilizers, water, machinery, seeds, new technologies, cropping patterns, new cash crops etc. ICT-R2D department will then update the RKM's at every place.

ICT-Rural Development Department (ICT-R2D)

This department will get latest information from agriculture, IT and other related departments and will update the RKM's and will provide training to ICT instructors for the latest updates at rural community centre. The purpose and theme of the ICT Rural Development Department is the same with an amendment that it will work only for the development of the 70% population which need more attention and care and can be more productive for the development of country, but its cyclic process and hope it will accelerate rapidly with the passage of time. Even in some European countries like Italy after the first world war in 1950's the situation was same as now in Pakistan but they have developed a lot and now they are equipped with the latest technology and people love to work in the villages and in the farms.

Sustainability of the project

We can make this project sustainable by using one or more options given below:

- We can earn some money by providing printouts for the required information.
- We can earn some money by providing printouts of reports for land ownership etc.
- We can earn some money by the registration charges from people who want to do online sale and purchase.
- We can earn money by getting some percentage on every online transaction.
- We can add some money in the dues which each person submit to the government according to his/her land size, like TV charges in electricity bills.

CONCLUSION

With the implementation of this proposed model either by fully sponsored by the government of Pakistan or with the financial support of ESRA and all other technical supports provided by different sectors as clearly mentioned in proposed model *fig. 2* the rural community can get maximum benefits to improve their education, knowledge, health, skills, earnings and living standard. This model can help to reduce the "electronic gap" between rural and urban communities. Especially the rural kiosk machine can change the lifestyles of the rural community in a short period of time. No other rural development project can grow faster than this proposed model.

Endnotes

1 https://www.cia.gov/cia/publications/factbook/print/pk.html
2 http://www.infopak.gov.pk/public/country_profile_index.htm
3 http://www.dailytimes.com.pk/default.asp?page=story_14-6-2004_pg7_20
4 http://www.finance.org.pk/survey/chapters/02-Agriculture.PDF
5 http://www.infopak.gov.pk/public/country_profile_index.htm
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E-Governance in India: Dream or reality?

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ABSTRACT

India is moving towards achieving e-governance. E-governance can be attained in four steps: Information or Cataloguing, Transaction, Vertical Integration & horizontal integration. India has already achieved the first and the second stage of e-governance. And presently the country is on the verge of attaining the third stage, and moving towards the fourth or the final stage, that is, horizontal integration, which is most challenging. Still there are number of issues untouched. Geographical, social, & economical disparities are the biggest barriers for full-fledged e-governance. Illiteracy, lack of infrastructure, security and privacy of personal and financial data are other constraints. This article discusses the position of India in e-governance environment and issues and challenges ahead.

Keywords: *E-Governance, four stages, India, information to transformation*

1. INTRODUCTION

One day Mr. Indian decides to move from a small village of Nainital, a hill station at the foothill of the Himalayas, to business capital Mumbai in the western region of India. Being away from home for a long time, he felt the need to *connect through Internet chatting or e-mail*, but his family is not net savvy. In fact, the family members are not even comfortable with computer, leave alone the internet. His sister is working at a far remote place; where and how to get internet connection itself is a big issue. Phone lines are available, but speed and connectivity through dial up network is another big issue. Some times even the phone lines are not available or in working condition because of difficult geographical location.

So in order to get connected all the time, Mr. Indian decided to get a mobile connection. He visited the official web site of all the service providers and was able to download the form. While filling the form he realizes he has his PAN card, Passport, Voter's ID card, driving license but the address mentioned in the documents, was of his native place. He do not have a residential proof for local Mumbai address, so he can't get the connection. He tried very hard to get the post-paid cellular connection, but the government officials are reluctant to listen and the private service providers had no choice but to abide by the rules imposed by Telecom Regulatory Authority of India [TRAI]. They want his present local Mumbai residential id proof, which is not readily available since he is in a paying guest accommodation. He was wondering, how difficult it is for an honest and law abiding citizen to get a post paid mobile connection through proper channel. He wished, if the government would have maintained a database for its entire citizenry, perhaps they could have checked his identity from there so that he could have been a mobile user. Simultaneously the security issues could also be dealt with.

He can debit or credit the money through online transactions. He can submit his insurance premium at Nainital, sitting at his office at Mumbai through online payments. He can file his income tax return on line. He can request for a reservation (both train and airline) sitting at home on his computer, pay with a credit card and can print an e-ticket. In case one does not have a printer, railways and airlines service providers deliver it in 24 hours. He wonders if "some day will

we be able to track down our train from our home or on screen at railway station through satellite?" He can even shop few items through Internet.

The answer to all his questions and queries is "E-GOVERNANCE" in India.

E-governance is no more and no less than governance in an electronic environment. It is both governance of that environment and governance within that environment, using electronic tools (Zussman, 2002). This is a very broad definition given by David Zussman, President of Public Policy Forum in his Keynote Address, reflecting the far-reaching implications of information and communication technologies.

Definition of e-Governance

> *E-governance is the application of information & communication technologies to transform the efficiency, effectiveness, transparency and accountability of informational & transactional exchanges with in government, between govt. & govt. agencies of National, State, Municipal & Local levels, citizen & businesses, and to empower citizens through access & use of information*.

2. THE BASIC STRUCTURE OF E-GOVERNANCE

Layne in 2001 described a four-stage growth model to develop a fully functional e-government. Based on technical, organizational and managerial feasibilities, the four stages of a growth model for e-governance are:

- Cataloguing (Information)
- Transaction
- Vertical integration (Interactive)
- Horizontal integration (Strategic, interactive) or transformation

These four stages are arranged in terms of complexity and different levels of integration. This section explains these four stages, mainly based on the original paper of Layne 2001.

The first stage is *"cataloguing" or "Information"* because efforts are focused on cataloguing government information and presenting it on the web. The first stage is focused on establishing an on-line presence for the government.

The second stage "*Transaction"*, where e-government initiatives are focused on connecting the internal government system to on-line interfaces and allows citizens to transact with government systems to on-line interfaces and electronically, is referred as "transaction-based" e-government. This stage is a link between the live database and the on-line transaction.

However, the critical benefits of implementing e-governance are actually derived from the integration of underlying processes across different level of government. Any citizen can contact one point of government to complete any level of governmental transaction, which can be referred as "one stops shopping" concept. This integration may happen in two ways: vertical and horizontal. *Vertical integration* refers to local and central administration connected for any functions or services of government, while *horizontal integration* refers integration across different functions and services.

Vertical or intra- departmental integration is must before implementing the horizontal or inter-departmental integration because of different level of complexities associated. It is expected that vertical integration across different levels of government should happen first, because the gap between the levels of government is much less comparatively than the difference between different functions. Mostly administrators interact more closely with their central or local counterparts than with other departments in the same level of government. The *vertically* and *horizontally* integrated e-government represents an ideal situation, in which citizens have on-line access to ubiquitous government services, with a transparent system.

3. OBJECTIVE

In the fast moving world of automation and digitization, is the fully flagged E-governance for India a dream or a reality? The objective of the paper is to find at which state India lies in terms of e-governance growth model. Being the largest democracy, second in terms of population and diversified geography it self creates the big challenges. The study will try to analyze the issues and challenges for the country.

4. E- GOVERNANCE AND INDIA: WHERE ARE WE?

Table 1 reflects the different e-governance schemes launched by Indian government in different states. All these schemes are presently in different stages of e-governance, but most of these schemes have reached in second stages.

4.1. Stage I: Cataloguing of Information:

The first stage is the creation and the *administration of the website*. Parts of the government's non-transactional information are put on the site. The main reasons of the "electronic cataloguing" stage is to have an on-line presence and access information on government services just like the website from the private sector.

In terms of G2C, this stage offers the least amount of functionality for the user. The typical government department home pages at this stage have description of the department, and some links to other pages. It establishes a departmental "presence". The next step is to re-organize information by services, by different actions or by different events. India has crossed the first stage of "cataloguing". All the government departments and the states have their official web sites with full information.

Technological requirements are the simplest at this stage. Nevertheless, there are some challenges on managing theses sites. The administrator has to balance different amounts of on-line presence and allocated resources required by different departments. Another important issue is maintenance of the information. The web page needs to be continuously upgraded along with the procedural and policy changes. Privacy is another critical issue at this stage, as it is possible to track on-line activities. While this tracking information is collected toward improving the website and its offerings, at the same time this information may also be sold to external parties. Thus several policy issues must be decided by the administration in establishing the site.

Table 1: *State wise list of e-government schemes in India.*

State/Union Territory	*Initiatives covering departmental automation, user charge collection, delivery of policy/programme information and delivery of entitlements*
Andhra Pradesh	e-Seva, CARD, VOICE, MPHS, FAST, e- Cops, AP online – one –stop-shop on the internet, Saukaryam, Online transaction processing, e-immunization Rural Health Call Center and Site Suitability for Water Harvesting, Professional e-Pension
Bihar	Sales Tax Administration Management Information, E-Khajana
Chhattisgarh	Chhattisgarh InfoTech Promotion Society, Treasury Office, e-linking project
Delhi	Automatic Vehicle Tracking System, Computerization of website of RCS office, Electronic clearance system, Management Information System of Education, Delhi Slum Computer Kiosks etc.
Goa	Dharani Project
Gujarat	Mahiti Shakti, Dairy Information System Kiosk (DISK), Request for government documents online, Form Book Online, G R book Online, Census Online, Tender Notice.
Haryana	Nai Disha, Result through Binocular
Himanchal Pradesh	Lok Mitra, HIMRIS ,e-pension, Unreserved Ticketing System by Indian Railways
Jharkhand	Vahan, Tender Notice
Karnataka	Bhoomi, Kaveri, Khazane
Kerala	e-Srinkhla, RDNet, Fast, Reliable, Instant, Efficient Network for the Disbursement of Services (FRIENDS)
Madhya Pradesh	Gyandoot,Gram Sampark, Smart Card in Transportation Department, Computerization MP State Agricultural Marketing Board (Mandi Board), Headstart etc.
Maharashtra	SETU, Koshvani, Warana Wired Villages, Telemedicine Project (Pune), Online Complaint Management System Mumbai
Orissa	E-Shishu, Common service centres (CSCs) in panchayats
Punjab	SUWIDHA(Single User WIndow Disposal Help Line for Applicants), SUBS(SUwidha Backend Services), AGMARKNET(Agriculture Marketing Network), ALIS(Arms License Information System), TISP(Treasuries Information System of Punjab), SSIS(Social Security Information System), WEBPASS(District Passport Application Collection Centre)
Rajasthan	Jan Mitra, RajSWIFT, Lokmitra, RajNIDHI, Aarakshi - Online FIR, Professional E-Delivery of Tax Payers by Income Tax
Tamil Nadu	Rasi Maiyama-Kanchipuram, Application Forms Related to Public Utility, Tender Notice & Display
Uttar Pradesh	Lokvani,e Suvidha,Bhulekh,(Land Records), Koshvaani, Treasury Computerization, PRERNA: PRoperty Evaluation and Registration Application, Bouquets of services offered by Transport Department
Uttarakhand	Kisan Soochna Kutirs (KSKs) , Village Information Centres (VICs), Computerization of Land Record Department, Automation of Transport Department:
West Bengal	Vehicle registration, land records, birth and death registrations, employment exchanges, payment of excise duty, sales tax and local tax, electronic bill payment of water and electricity, computerization of health records,
North Eastern State	
Assam	ASHA
Arunachal Pradesh, Manipur , Meghalaya, Mizoram & Nagaland	Community Information Centre. Forms available on the Meghalaya website under schemes related to social welfare, food civil supplies and consumer affairs, housing transport etc.

Organizational challenges are limited at this stage since its scope is also limited. The first challenge is assigning responsibility for the overall coordination and planning of services on the administration web site as well as its maintenance. The second issue is assigning responsibility for the answering of e-mails. Web sites often include an email address for questions from site users. In most of the cases the government web sites are unable to give on time replies to queries but web sites managed by private sectors handle the customer queries very quickly and effectively. Some procedure must be established by the department to address to handle these emails and that to very quickly.

4.2. Stage II: Transaction

Stage II is a two-way communication, where citizens move from a passive to active role. Citizens transact with government, on-line by filling out forms and government responds by providing confirmations, receipts, etc. In stage two, citizens can perform on-line transaction, for example, renew their licenses and pay fines or taxes, Birth or death registration. In this stage transaction is done through on-line interfaces directly connected to the internally functioning government systems with minimal interaction with government staff. Electronic transactions offer a better hope for improved efficiency for both the customer and the government agency than simply "cataloguing information". This stage presents Government on the internet as an active respondent. In India now it has been possible to get the reservation (rail or airlines) on line, transact the money or fill the forms for most of the departments. The entire government department be it election commission or bank, income tax or insurance, colleges or railway, has helped the Indian government to attain second stage.

4.3 Stage III: Vertical integration (Intra-departmental assimilation)

> *"Petrol pumps to go Hi-Tech in country" (Mumbai Mirror, 3 September, 06)*
>
> *"Use the mouse to visit under trials: Arthur road jail will install online system to enable relatives to get appointments" (Sunday times of India, Mumbai, September 23, 2006)*
>
> *"State police get net savvy, interrogate accused on webcam" (Times of India, 23 Sept, 2006)*
>
> *"E-filing cases in apex court of India from 2 Oct 2006"*

All these headlines of the newspaper indicate the state of the country in the e-governance era. E-governance is not about automating and digitizing existing processes but transformation of government services; it requires a re-conceptualization of the government service itself. The full benefit of e-governance can be experienced only when Organizational changes accompany technological changes.

After successfully completing the second stage, India is now on the verge of attaining the third stage for most of the departments like financial institutions, railways, income tax department etc. After on-line transaction services become prevalent and mature, citizens' expectations increase. Most transaction stage systems are localized and fragmented. A natural progression is the integration of scattered systems at different levels (intra-departmental) and different functions (inter departmental) of government services. Fragmented local and central systems are expected to connect and communicate with each other for smooth functioning. Vertical integration goes beyond this simple interconnection. The objective of vertical integration is to seamlessly integrate the central and local systems for cross-referencing and checking. With each transaction with an administration, the transaction information moves upward or downward to the appropriate counterparts.

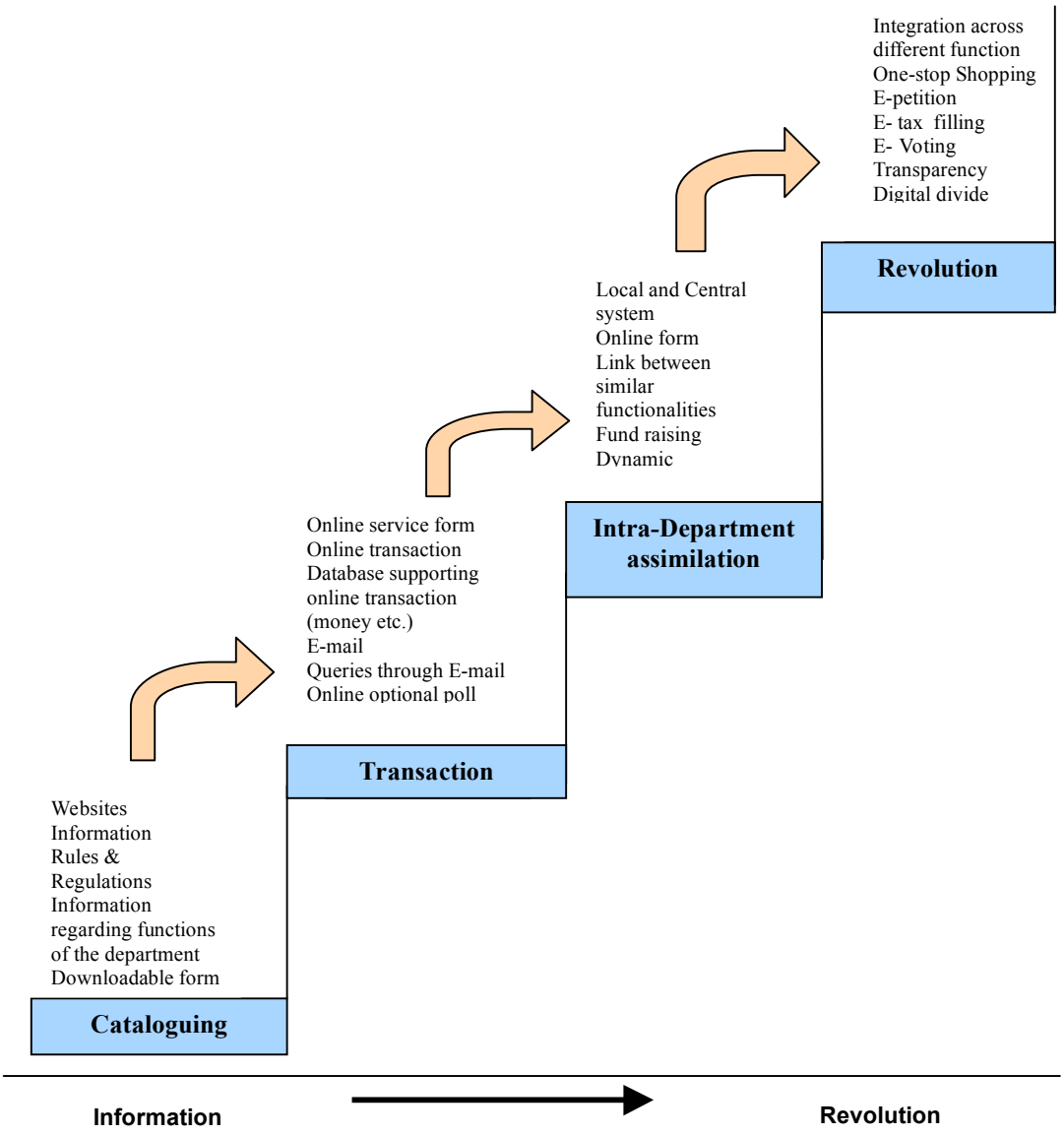

Figure 1: *Stages of e-governance*

The various levels of systems are inter-connected so that results of transactions from one system can be interchanged with another system. Physically, this may be integrated as a central database or a connected web of databases communicating with each other. At this stage G2G transactions are more important than G2C ones.

Communication and integration-oriented technologies become more important for the initial third stage. In order to integrate central and local administrations, a web of remote connections is a technical prerequisite. In this remote connection and virtual transactions, several technological issues are emerging: authentication, format compatibility of electronic data interchange, exposure level of internal legacy system to outside, etc. With the automation of the systems and the process, the role of government employees also changes, extends beyond the functional local departmental boundaries.

Even though stage three has improved efficiency, in whatever department be, privacy and confidentiality issues must be carefully considered. Simultaneously government officers have to be less proprietary about their information. A conceptually centralized database is still viewed with alarm as opposed to increasing efficiencies. An appropriate balance is must between the privacy of personal information and the right of individuals to access public records. In India all the banks and finance department are far ahead in this stage. But the public administration, health care, electricity, water supply etc needs a cautious watch. E-voting is still a dream since confidentiality and authentication issue is still a distant dream in India and political will is very weak.

Stage IV: Horizontal Integration (Revolution):

State Bank of India and Bharti Airtel has partnered to enable money remittance over mobile phones in 2007. The intent is to enable individuals' access to the benefits of a full range of financial services regardless of socio economic level or geographical location using the ubiquity and ease of mobile communications. The project is piloted in a small Himalayan village of District Pithoragarh in state of Uttarakhand have seen the tremendous results in that unbanked village. The project has the potential of transforming the lives and economies across the globe.

The benefits of e-governance from the citizen's as well as government's perspective can only be achieved by inter-departmental integration of government services across different functional units. The limitations of the functional nature of both the public and private sector will become clearer as more public administrators begin to see the vision opened by the ICT. "One Stop Shopping" concept helps the citizens to get assistance in more then one service area.

The horizontal integration within different departments and functions increases the efficiency of the government exponentially. Through communication and sharing the information through all the level and function, the shared information will propagate immediately and thus will help the citizen to access the services and do the work across the wide variety. As an example, when a citizen moves from one city to another, the basic residence record could be propagated to different functional service branches of government such as the medical assistance and the local election department so that the citizen does not have to run from one department to another or administration. Sharing of such database and information is a major stumbling block for India being a fully functional e-government.

The concept of governance and, management of government staff is subject to re-evaluation from the perspective of e-governance. The need is to change the mindset of the government officers, especially to those who think their department is superior to others, so they need not to share the information. This is another fumbling block for inter-departmental integration and e-governance. Instead of department centric approach, a new citizen centric approach has to be adopted.

5. E-GOVERNANCE FOR DEVELOPMENT OF INDIA

The concept of e-governance is now moving towards reality for Indian citizens. The country is graduating from pilot e-governance projects to bigger Mission Mode projects. Table 1represents all the current e-governance projects in the country. The core strategy for India is to move ahead in a systematic manner, and the approach is to achieve success step by step. The financial sector is revolutionized through ICT, but the democracy and e-voting concept is still a dream.

The National e-Governance Plan (2003-2007) [1] of Indian Government seeks to lay the foundation and provide the impetus for long-term growth of e-Governance within the country. The plan seeks to create the right governance and institutional mechanisms, set up the core infrastructure and policies and implements a number of Mission Mode projects at the center, state and integrated service levels to create a citizen-centric and business-centric environment for governance. In 2005, the World Bank signaled its willingness to increase funding further (if required) for a range of e-governance initiatives in India as part of the first phase of the country's National e-Governance Plan (NeGP) [2]. Mission 2007: every village to be a knowledge centre aims to provide knowledge connectivity to every village of India by August 15, 2007, according to the policy of Indian government. The government has set this target according to national e-governance plan (2003-2007) and a National Alliance for Mission 2007 was formed in 2003. An apex committee under the Cabinet Secretary is already in place for providing the strategic direction and management oversight. Knowledge village seems to a distant dream.

Case of Gujarat interstate border check posts: e-Governance causes reduction in corruption and increase in tax revenues. In Gujarat, a team of techno-savvy bureaucrats have finally succeeded in bringing corruption under check and consequently increasing state's tax revenues through the effective usage of computers and other electronic devices at some 10 remote interstate border check posts. [3]

6. CRITICAL ISSUES FOR INDIA

E-governance is a big challenge and a far big opportunity to bring services to all citizens. The most significant characteristic of any successful e-government application is its *quality* (Signore, et al 2005) and accessibility. The issue (Cost, Time) of integration of legacy systems comes onto the scene. As the information collected by governments may be politically sensitive, installation of appropriate security mechanisms may be an important technical consideration. At the same time, many other policy issues need to be resolved, such as authentication and confidentiality.

6.1 Technical issues

IT infrastructure is the backbone of E-governance. Interoperability with existing software and hardware platforms is a key success factor. It is unlikely that available resources can support a full replacement of existing application. Hardware should be fully compatible with future technologies as well.

Finally, some legal aspect, like security and privacy, must be considered, as personal data are processed and stored, and financial transitions must be executed. To cope with such requirements appropriate technical changes must be done. Multi-model application can make it more successful.

6.2 Privacy

Citizens' concern on privacy of their life and confidentiality of the personal data need to be technically supported**.** Privacy and confidentiality has to be highly valued in establishing and maintaining websites. An ideal Cyber policy and strict appliance of it is the backbone for citizen's support.

6.3 Securities

The financial transaction demands for transactional security. Few recent cases have raised the issue once again. All support for full security is necessarily needed to maintain. An ideal Cyber Security Policy will ensure the existence of a sound and secure e-governance and critical infrastructure base in India. The security and safety of various ICT platforms and critical infrastructures in India must be considered on a priority basis before any e-governance base is made fully functional.

6.4 Social issues

Acceptance and usability by a large variety of people make e-governance successful. Since the social disparity is very high in India, so this issue needs a careful observation. This implies that interface must be usable by rich or poor, disabled or elderly people, understandable by low literacy or non-native language people, etc.

6.5 Infrastructure

Social, geographical and economical disparity issues have to be removed and proper infrastructure is required to establish e-governance. The ICT facilities need to be developed and should be available to one and all citizenry. Internet connection through satellite, phone lines or through cable or Television should be accessible for all specially to the people in rural areas.

Table 2: *Comparison of ICT usage between India and developed countries*

Country	PCs/100	Telelines/100	% of population on line
India	0.45	3.20	1.2
USA	58.52	69.97	62.1
Canada	39.02	67.65	46.5
UK	33.78	67.65	55.3
Australia	46.46	52.41	52.5
New Zealand	36.02	49.57	46.1
Singapore	48.31	48.57	49.3

Source: Mahapatra R. and Perumal S. 2006

6.6 Accessibility

Any service should be accessible by anybody from anywhere at anytime. Even if Internet population is exponentially growing in India, still there is a significant portion of the people who may not be able to access services for various reasons like limited access to ICT technologies and devices, low literacy, or phobia for Computer etc. Therefore, universal access is still a mirage.

Table 3: *Concern for E-Governance in India*

	RURAL	URBAN
ISSUES	Lack of infrastructure	Concern for security
	Less literacy	Concern for privacy
	Less Computer literacy	Lack of time
	Lack of Awareness of the function	
	Fear from Bureaucracy	
	Social and economic disparity	
SOLUTIONS	Education	Technical supported security & privacy through Bio-metrics etc
	Computer & Internet Education	Well placed IT & security rules
	Transaction through other media like phone or mobile or cable TV	Inter-operability
	Proper Training	One stop shopping
	Cheap & Simple procedure	Transparent system
	Availability of ICT facilities	
	Easy to operate	
	Accessibility to all	

6.7 Usability

People especially in rural areas are often non-expert users and need guidance and support for their transaction. Governmental websites must be user friendly, to be effective. In India English speaking percentage is very low, so the web sites should also have the facility to access in native or local language.

6.8 Acceptance

A reconceptulization of government services is mandatory for successful implementation and to get social acceptance. This will happen only if government processes will be organized for citizens' convenience instead of the convenience of the government. A relevant issue will be to have all the citizens well aware and acquainted of the facilities offered by the e-government infrastructure, and have them to trust in it. The demand is appropriate marketing actions and education for less skilled people.

6.9 Political will power

E-governance means less interaction with government servants, it will be helpful in reducing bribery issues. The strong objections of the government officers also need a careful and wise approach. This task may require an honest and strong will power of the politicians and leaders. E-voting concept is not acceptable to politicians.

6.10 Economical issues

Economical issues are mainly concerned with return of investment and safeguard of the previous ones. Cost of implementation, operational and evolutionary maintenance must be low enough to guarantee a good cost/benefit ratio.

6.11 Maintainability

Maintenance of ICT is a key success factor for long living systems in rapidly changing technical regularity environment. A well skilled labour force and strong will is need of the hour for timely and regular maintenance.

6.12 Reusability

Full fledged e-governance is for the whole nation. Some modules at least should be re-usable.

6.13 Portability

Independence from hardware/software platforms is primary requisite for portable application, to help in possible reuse by other administrations.

6.14 Legal Issues

Strong and effective rules related with IT has to be formulated and strongly implemented. This presupposes the adoption and use of security measures more particularly empowering and training judiciary and law enforcement manpower with the knowledge and use of cyber forensics and digital evidencing.

6.15 Literacy

In India where literacy rate is low, e-governance is a real challenge. Lack of IT Literacy and awareness regarding benefits of e-governance has to emphasize.

6.16 Other issues

- Underutilization of existing ICT infrastructure.
- Attitude of Government Departments and government officers need a proper counseling. Many officers perceive their department as most important and disregard other department's needs.
- Lack of coordination between Govt. Department and Solution developers.
- Resistance to re-engineering of departmental processes is also a challenge, but this approach is changing now.

7. NEED OF THE HOUR

7.1 Database of citizens

A proper and well placed database of all the citizens is one of the major requirements for a successful e-governance, which will prove to be most challenging for India. It should contain all the personal i.e. name, address, citizen Id, etc. and financial information. Every citizen should have a unique Id number and password. The citizens can access their information and transactions through this but at the same time the other people won't be able to access their record. Just by going through his/her file the individual will come to know about their electricity bill, bank statements, next due LIC premium, phone bill etc. and can transact with all or any of the department at the same time. This one database will be common and accessible for all the departments. The strongly secured and systematic database will also be helpful in identifying the intruders and thus will be able to tackle the security issue for the country too.

7.2 Biometrics:

The strong database needed for a successful e-governance is vulnerable to fraud. There are attempts being made to come up with "Biometric" techniques, which are more secure. The password can be replaced as an individual's mark of identity. Similarly, password can be replaced by fingerprints or facial characteristics to verify the identity. Instead of having card readers, there should be devices like fingerprint readers or eye scanners. Common Biometrics implemented or studied includes fingerprint, face, iris, voice, and signature and hand geometry. It is one of the important evolving technologies, which will ensure the security and privacy issues as well. The market is full of such type of computers and laptops. But underutilization of these techniques is one of the barriers.

7.3 Smart Cards

One smart card with complete detail of the citizens is the smartest solution. A smart card with citizens name, address, financial information, personal information etc. fully supported and secured by Biometrics may be the key solution. A fully secured card with easy operability can be used for all transactions, and information. One such project was pilot run at IIT Bombay campus few years back. But a lot of issues need to answered, before actually going for it.

8. CONCLUSION

E-governance is an evolutionary phenomenon, and requires a change in the mindset of one and all – citizen, executives or the government. With the support of the Internet, the government processes defined by specializations can be made efficient, effective, and citizen friendly. There are many challenging issues lying ahead. Security is the main concern for the citizen, and redefining rules and procedures, information transparency, legal issues, infrastructure, skill and awareness, access to right information, inter-departmental collaboration, tendency to resist the change in work culture, are the main concerns for the government to address.

Other then all these factors, the government needs to make significant investments in areas such as government process re-engineering, capacity building, training, assessment and awareness. The beneficial impact of ICT and of e-governance on the rural economy and quality of life is now widely recognized. An apex committee under the Cabinet Secretary is already in place for providing the strategic direction and management oversight. The need is to maintain a proper database of all the citizens and well developed infrastructure. Security issues need to be tackled very carefully supported by technical security. Most important is the strong political will power and the social acceptability of e-governance not only in urban areas but rural areas as well.

Endnotes

[1] http://www.egov.mit.gov.in

[2] www.e-governance-imp.html

[3] http://www.it.iitb.ac.in/~prathabk/egovernance/egov_success_stories_gujrat.html

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