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Full Length Research Paper

Is trading in used computers creating a digital dump? Reflections from tertiary institutions in Ghana

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The proliferation of computers has made them more accessible, yet there are many more who cannot afford them, and this seems to have created a digital divide which touches economies and threatens to slow progress towards an all-inclusive information society. The divide in the developed world appears much less severe due partly to higher income levels. However, in developing countries the situation is more complex and calls for a range of policies in order to expand access. Of these tools, regulatory reforms have been very prominent. In Ghana, the government zero-rated the importation of used computers as a way of making them easily accessible and affordable. Using a stratified sampling technique and exploratory factor analysis, the study examines the effect of the policy base on data collected from four tertiary institutions. The result shows uneven access to computers along familiar lines of social inequality such as economic status and gender. This paper establishes the need to re-examine the independent use of regulatory policies, as a cost-effective way to ensure optimum computer usage especially among the "poor". The Author considers such reforms as necessary but not sufficient condition to overcome the digital divide and argues for a targeted intervention such as the Ministry of Education's Basic School Computerization Project.

Key words: Digital divide, used computers, tertiary institutions, Ghana.

INTRODUCTION

There are questions that beg for answers at Agbogbloshie; these questions cry out from the bone yards where fallen icons of our proud information age lie as rotting fruits; the progeny of centuries of technology advancement (Puckett, 2011).

In recent years, the world has witnessed a surge in a new technologically-driven 'revolution', severally termed "the Information Age"; "the Digital Age"; and the "Computer Age" (Keniston, 2003). This revolution which already appears to be a reality to many has been propelled by the phenomenal proliferation of computers and information devices. The genesis of the revolution dates back to the historical development of electronic technologies which include 'the telegraph and telephone in the 19th century; broadcast media (radio, television, etc) in the mid-twentieth and recently, networks like Ernet in India or Ethernet in the U.S' (Keniston and Kumar, 2003). The emerging dynamics have been rapid and far reaching in the last two decades with an unprecedented growth in information and communication technologies (ICTs) (BAN, 2005; Brigden et al., 2008; Oteng-Ababio, 2010).

What is remarkable about the current ICT revolution is the extraordinary rapidity of change it encapsulates. For example, it took only four years for the internet to reach the first 50 million people while the printing press travelled at least a century to attain that mark. This has been fuelled by two major factors. The first is the sudden belief in the mantra "bridging the digital divide" which is seen as enabling poor developing countries to leapfrog the traditional problems of development such as poverty, illiteracy, diseases, hunger, unemployment, corruption and social inequalities. The second is the fact that the electronic business thrives on obsolesces, and users periodically discard or upgrade their gadgets. Thus, the sale of electronic devices keeps growing at the same pace as their life span keeps shortening and so does electronic waste. In 2006, Americans for example

removed over 300 million electronic devices from their homes and with a switch to digital television in 2009, they are expected to dispose of even more e-waste.

The burning desire to join the ICT revolution has prompted governments to pursue policies jeered towards making computers affordable and accessible especially to the financially disadvantaged. The desire to join the ICT family in the midst of limited resources has made some developing countries, including Ghana, the latest destination for obsolete electronic equipment, which invariably comes with a price - the eventual managing of the end-of-life of these devices. The situation appears worse in cases where some unscrupulous brokers and their collaborators who arrange these exports often pad shipping containers with useless junk, thus saddling the recipient countries with electronic garbage. Several aid groups and organizations also give these pieces of equipment as donations, usually in good faith to schools, churches and communities and indeed that appears to be the only realistic way the majority of populates can effectively participate in the ICT revolution (Shinkuma and Huong, 2009; Lepawsky and McNabb, 2010; Oteng-Ababio, 2011).

The government in 2004 tax exempted the importation of used computers to make the product easily accessible and affordable, a policy which has since resulted in a phenomenal increase in the importation of used computers, from a total of 1.3 million kilograms in 2004, to 3.6 million kilograms in 2008 (Oteng-Ababio, 2010). Currently, the monthly estimates of used computer shipments through the Tema port range from three-four hundred (Frontline, 2009) to six hundred forty-foot containers. From the government's perspective, "If the programmes and projects outlined in the national ICT roadmap are adequately pursued, there is every assurance for Ghana to break out of the poverty cycle into the middle-income bracket in the not-too-distant future.''

Admittedly, bridging the digital divide has in recent years become a continuing buzzword in public discourse and indeed, international agendas. These avowed commitments, proposed interventions and displayed optimism are built almost entirely on an empirical vacuum. Remarkably, existing studies have largely been confined to the boundaries of national states, with very little attention on intra-state contradictions. In Ghana, few studies have furthered our understanding of how government interventions impact on the intended beneficiaries. This paper attempts a contribution to the eradication of this information deficiency by examining the usage of computers among tertiary students of both public and private tertiary institutions in Ghana. The study is guided by the following key questions: what is the justification for allowing free importation of used computers into a country where illiteracy is very high, poverty is endemic and many basic needs remain unmet? Who are the real beneficiaries of such government policies?

The study is organized as follows. First is a review of the nature of the digital divide by analyzing those included in and excluded from the ICT revolution, after which it outlines the data and methods employed in the research. Furthermore, the study examines the level of computer usage among tertiary students and the factors that influence their choice. Finally, a debate was initiated which aims to dispel the emerging notion that the apparent increasing volume of computer imports into the country can be equated to increasing computer usage and by extension the bridging of the digital divide.

IS THE DIGITAL DIVIDE A REALITY?

Generally, most researchers have identified a clearly discernable divide within every nation, between those who are rich, educated, and powerful, and those who are not; between the digitally empowered and the digitally deprived; between information rich and information poor; between developing nations and developed (Wresch, 1996; Norris, 2001; Keniston and Kumar, 2003). According to a former UN secretary-General, the "digital divide" is the source of growing inequality in the world. Studies by Keniston and Kumar (2003) reveal that in the United States, income and education distinguish dramatically between those who own computers and those who do not. They noted that with household telephone penetration of 95% in 1999, rich households in the US were nine times more likely to own a computer than those in the low-income brackets. Comparing Americans with four years or more of university education with those who have six years or less formal education, they concluded that computer ownership figures were 69 versus 8% and the internet access percentages were 49 versus 3, respectively.

The situation in most African countries, where telephone connectivity is extremely low (less than 3%) and the installed base of computers and internet connections even lower, might be 'calamitous' although no comparative studies have been conducted. In 1999, excluding South Africa, only one in 9,000 Africans had access to the internet, with the world average being one person in forty (Fleury, 1999). Africa had the least telecommunications infrastructure worldwide, with only two percent of the world's telephones and twelve percent of the population, compared with Latin America which had six percent of the lines and eight percent of the population and Asia, thirteen percent of the lines and fifty-seven percent of the population (Jensen, 1997). Even within the African continent, there is a high variability. Figure 1 shows the level of internet penetration in Africa in 2007.

The figure depicts Ghana as one of the African countries among the lowest internet penetration, coming behind South Africa, Nigeria, Zimbabwe etc, with only

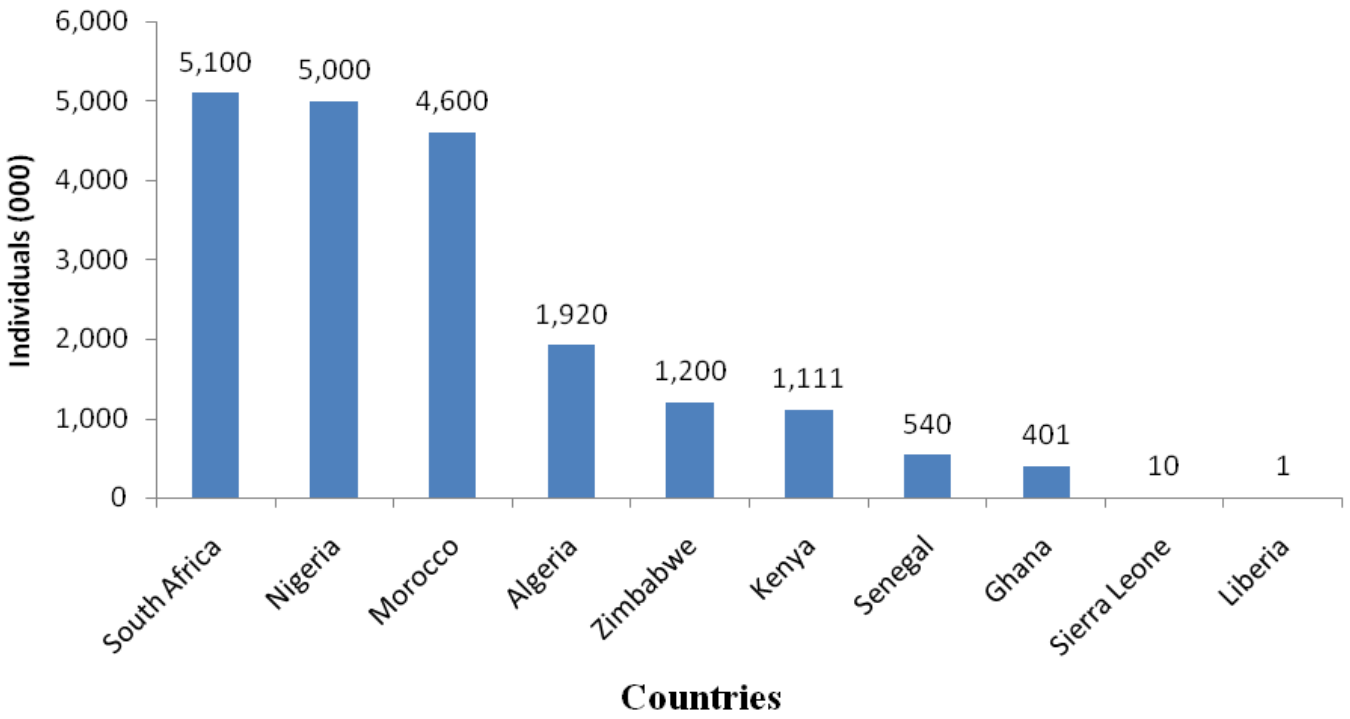

Figure 1. Level of internet penetration in Africa (2007). Source: World Bank Report on Internet use in the World (2007).

401,000 people, (that is, 1.8%) hooked on to the internet services in 2007. The obvious question then is who are the 'connected' in Ghana? What is the geographical distribution of the beneficiaries? Are there any discernable gender disparities? Clearly, the beneficiaries are most likely to be the elite, rich, successful and urban minority who has the opportunity and capacity though not always the requisite competence.

This development is a result of the endemic poverty that has saddled the majority of the populace, many of whom are rural dwellers struggling to obtain the basic necessities of life - food security, potable water and basic hygiene. Table 1 depicts the dimensions of poverty in Ghana where about 30 and 20% of the population are within the upper poverty and extreme poverty lines respectively; more than 40% of the population are illiterate; tens of millions of children are not in school; as many as 55% of the population are employed in the informal sector; more than 50% of the population are neither supplied with electricity nor pipe borne water.

Additionally, telephone connectivity in Ghana is less than three percent and has been reducing drastically with the introduction of mobile telephony. Currently, there is no indication that the trend will change unless the cost (in terms of procedure and cash) of connections can be drastically reviewed and lowered. The obstacles are genuinely economic. Only the few, affluent educated elites, concentrated in the major cities where connections are most widely available, seem privileged. Based on the current economic realities and the available infrastructure capabilities, many Ghanaians remain potentially outside the rim of the information age. Admittedly, mobile telephony has offered some optimism with the proliferation of many companies though their current networks and prices for example offer limited opportunity. In short, there can be no doubt of a massive digital divide in Ghana based on income, related to education and urban residence, and correlated with gender and economic power. Subsequently in this study, there will be an analysis of how these factors have influenced the use of computers in tertiary institutions and the factors that have informed the observed pattern.

MATERIALS AND METHODS

The primary objective of this study was to analyze the level and type of computer usage among tertiary students in selected public and private universities in Ghana and more importantly, what informs their choice. The data were collected through the use of questionnaires, administered on targeted students in level 100 and 400, offering courses for which the submission of an honours dissertation is a prerequisite for graduation. It was based on the assumption that all things being equal, a personal computer is a necessity for final year students engaged in project work. The study also targeted students from both private and public universities. It was assumed that private universities are fee paying establishments and therefore, students in those establishments should be relatively less challenged financially and hence, have better access to computers.

Table 1. Dimensions of poverty in Ghana.

Indicators (welfare measures)	Year		
	1991/1992 (%)	1998/1999 (%)	2005/2006 (%)
Upper poverty line	51.7	39.5	28.5
Extreme poverty	36	27	18
Males(female) literacy rate		62 (36)	62.7(40.3)
Urban(rural) literacy rate		63 (40)	70 (40)
Source of drinking water: urban (rural) (inside and public standpipe)	51.8 (11.1)	48.4 (14.4)	49.9 (9.6)
Prevalence of HIV/AIDS		3.6	
Population employed in Agriculture		55	55.8
Households using electricity	29.8	41.4	49.2

Source: Computed from the Ghana Living Standards Survey, round 4 and 5, 2005/06.

The institutions were geographically chosen to represent a North-South divide. Although there are new public and private universities emerging in the Northern part of Ghana, for example the Catholic University at Faipre (Sunyani) and the Agricultural University (Mampong), most of them are in the second year and do not meet the data requirements, hence, the choice of University of Development Studies (UDS), with four campuses spread across the four regions in the North: Brong Ahafo (Techiman campus), Northern (Tamale campus), Upper East (Navrongo campus) and Upper West (Wa campus) (Figure 2).

University of Ghana

The University of Ghana was founded in 1948 as the University College of the Gold Coast on the recommendation of the Asquith Commission on Higher Education in the then British colonies for the purpose of providing for and promoting university education, learning and research. With a student population of 29,754 (2009/2010) with a male/female ratio of about 2:1, the University of Ghana is the oldest and largest of the six public Universities in the country. The University has a communication network which is an Intranet, constructed through a DANIDA funding.

University of Development Studies (UDS)

The University for Development Studies (UDS) is a public university, established in May 1992 as a multi-campus institution to serve the four northern regions of Ghana (Brong-Ahafo, Northern, Upper East and Upper West Regions (Figure 2) in which rural poverty and environmental degradation are generally prevalent. UDS began with 39 students in Agriculture in 1993. The present student population (2009/2010 session) is 15,019 (made up of 11,350 males, 3,669 females; with 55% of the entire population being at the Wa campus). Through the assistance of TALIF, the University has invested heavily in ICT with the intention of using it for teaching, learning, research and communication.

Methodist University College (MUC)

Methodist University College (MUC) is a private tertiary institution granted accreditation in August 2000 and affiliation to the University of Ghana in October, 2002. From a humble beginning with 213 students in November, 2000, MUC recorded a total number of 3,743 students at the end of the 2009/2010 academic year, made up of 1,872 males and 1,871 females. Space and internet access have been provided on the campus to facilitate teaching-learning and generally in recent years, computer use by both staff and students in the university has increased.

The Pentecost University College

The Pentecost University College was inducted on May 6, 2004 and the first batch of students was enrolled in February, 2005. The students' number grew from 171 in 2005 to 1,717 in 2008 and 2,800 in 2010. To aid teaching and learning the university has invested in modern ICT technology and currently runs advanced courses in both computer software and hardware.

The data captured for the study included background information on the respondents such as their current level at the university, computer usage experiences and perceived usefulness. The questions also sought information on factors influencing the choice of a personal computer. In answering these questions, respondents were asked to indicate the extent to which they agree or disagree with statements on a five-point likert-scale ranging from strongly agree to strongly disagree. The research instrument was pretested using some final year geography students of the University of Ghana. The process culminated in the re-wording and re-arrangement of the questions, thus improving on the instrument before the final survey which took place during the second semester of the 2010/2011 academic year, between February and April, 2011.

As indicated, the students were purposefully selected and the questionnaires were randomly administered to a combined sample size of 500 students: 200 from Legon (including 40 foreign students), and 100 each from UDS, Methodist, and Pentecost. The sampled population in each university was a function of the total population of students. Students had the option to decide whether or not to participate in the project. A total of 483 managed to fully complete the interviews, giving a response rate of about 97%. Using the Statistical Package for the Social Sciences (SPSS), an exploratory factor analysis was employed to analyse the data to meet the objectives of the study.

RESULTS

The statistical summary of some of the variables used in the study is presented in Table 2. The findings reveal, 64% of the sampled population own personal computers, even though 96% of them see owning a personal

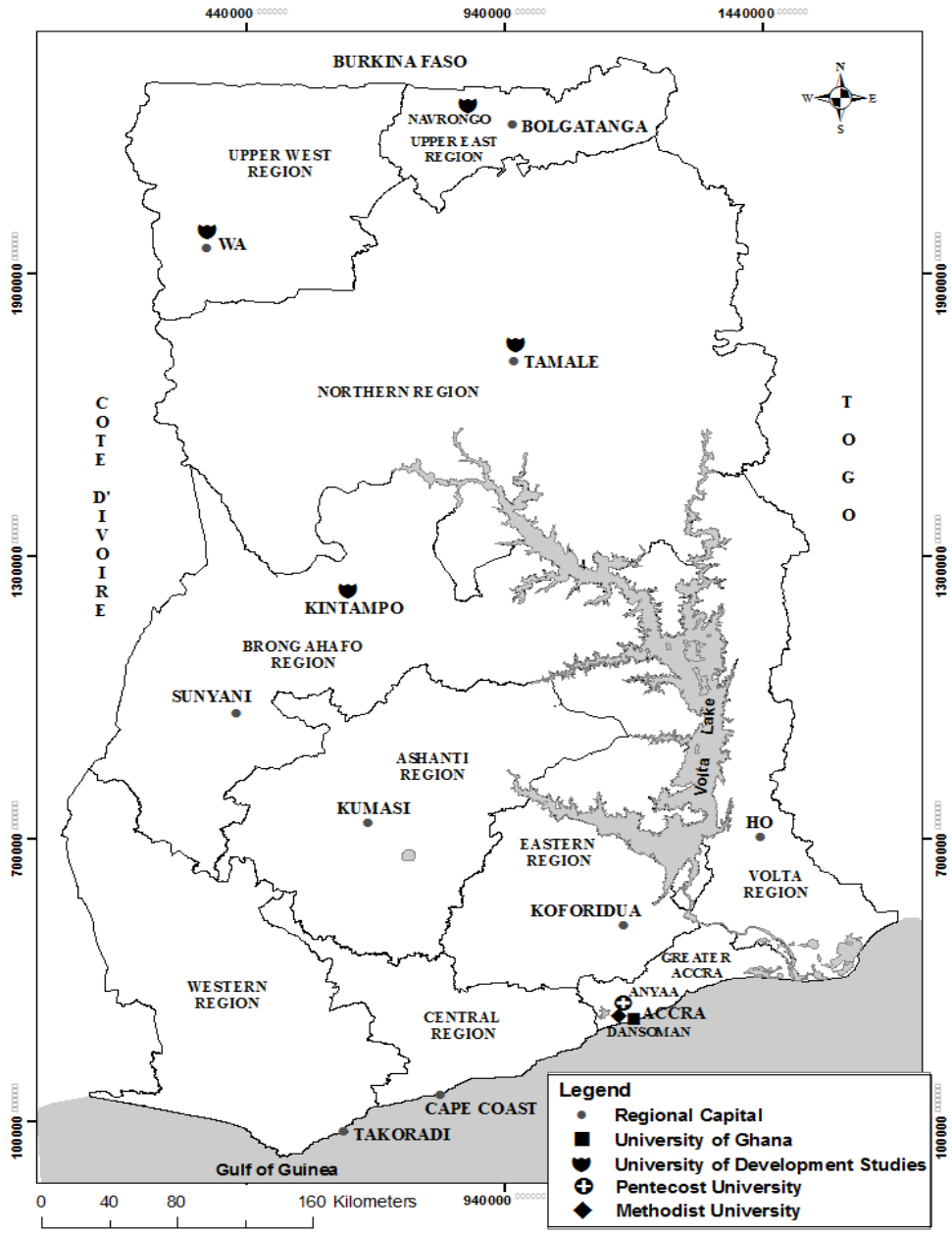

Figure 2. Map of Ghana showing the research locations.

Table 2. Percent distribution of the type of computers own by respondents.

Variable	Category	Public Universities			Private Universities			Total sample
		Legon	UDS	Average	Pentecost	Methodist	Average	
Own computer	Yes	67	47	61	64	73	69	64
	No	33	53	39	36	27	31	36
		***	*ns*	**	**	***	**	**
Nature of computer	Brand new	59	50	56	74	72	73	63
	Used	41	50	44	26	28	27	37
		**	*ns*	**	***	***	***	**

Source: Field work (2011).

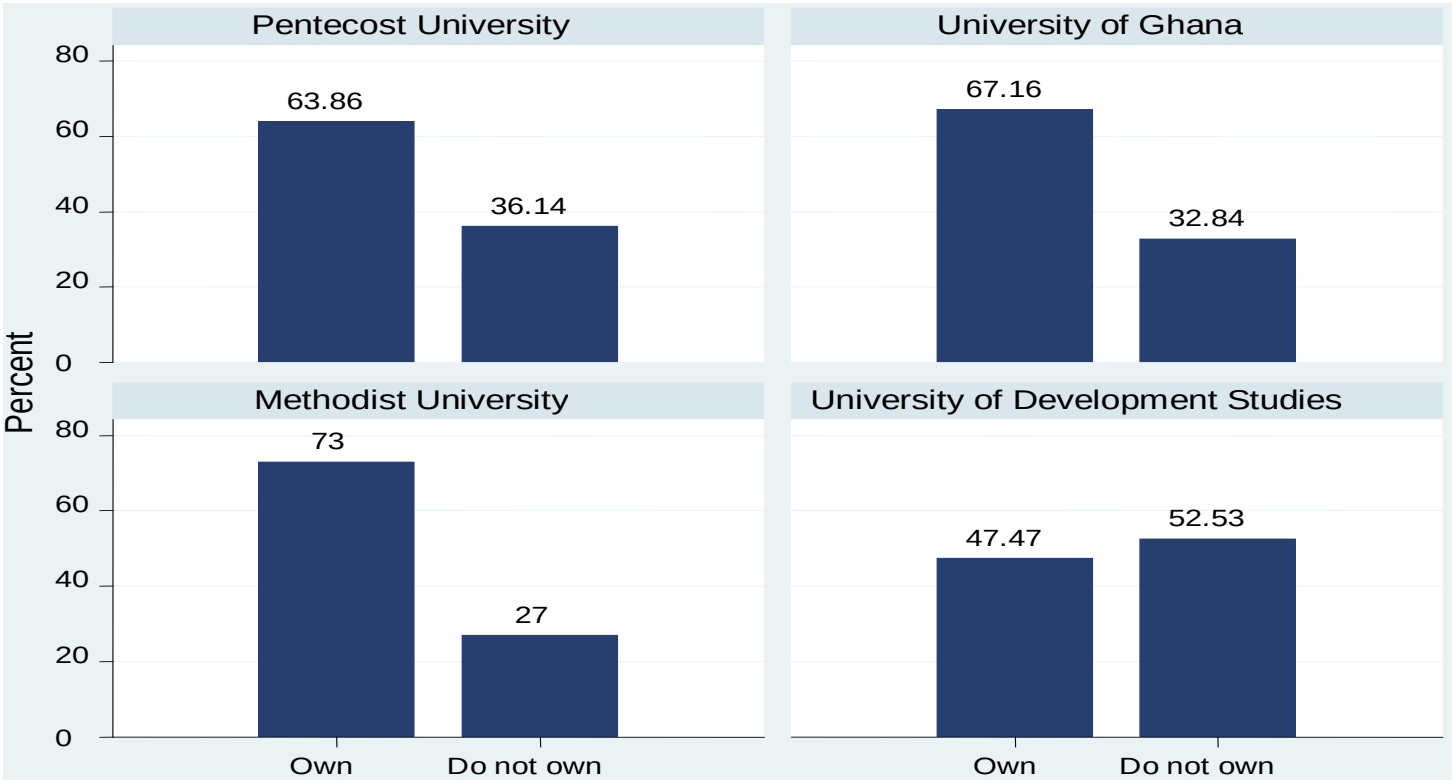

Figure 3. Ownership of computer among students in various institutions. Source: Field work (2011).

computer as a necessity for the course they are pursuing. By implication, all things being equal, only four percent of respondents would not have wished for a personal computer. In other words, but for certain challenges, 30% of the sampled population currently without computers would have wished for them. The study sampled 40 foreign students studying in Legon who were nationals of the USA and Norway where there is a relatively longer history of the use of computers. Quite expectedly, all (100%) of them had personal computers.

The findings also show a significant variation in the ownership of personal computers within the various institutions as well as across the public-private divide. Figure 1 shows the distribution of students' ownership of personal computers between the public and private universities. Generally, students in the private institutions show a higher propensity to own a personal computer than their counterparts in the public institutions. For example, about 64 and 73% of students in the Pentecost and Methodist universities respectively own personal computers while at Legon and UDS, the percentages stood at about 67 and 47, respectively (Figure 3). Another striking observation is the result from UDS, where 53% of the respondents do not own personal computers. Perhaps this is not unexpected as UDS campuses spread across the three northern regions, which incidentally are the most economically deprived in the country (GLSS, 2008).

On the average, 69% of the students in the private institutions had personal computers as against 61% in the public institutions (Figure 4). A test conducted gives a chi-square value of 10.18 at a 99% level of significance. By inference, there is a high systematic relationship between owing a personal computer and enrolling in a private university. Many reasons could account for this pattern. First, as already alluded to, private universities operate mainly on economic principles (cost recovery with profit) and therefore students who patronize their services must be financially 'sound' and therefore are more likely to own a personal computer. Additionally, most private students stay off-campus (in private hostels) and therefore have very limited access to the few institutional computer facilities after normal school hours.

The findings further show two micro institutional variations based on students' level attained and gender. Within each institution, level 400 students are more likely to own personal computers than their counterparts in level 100. From the data, only 52% of level 100 respondents had a personal computer while 80% of their counterparts in level 400 owned a computer (Figure 5). The observation is not unexpected as it confirms and validates an earlier position that a student in level 400, preparing for an honours dissertation is more likely to own a personal computer than a level 100 student in the same faculty.

The study further examined the gender perspective in

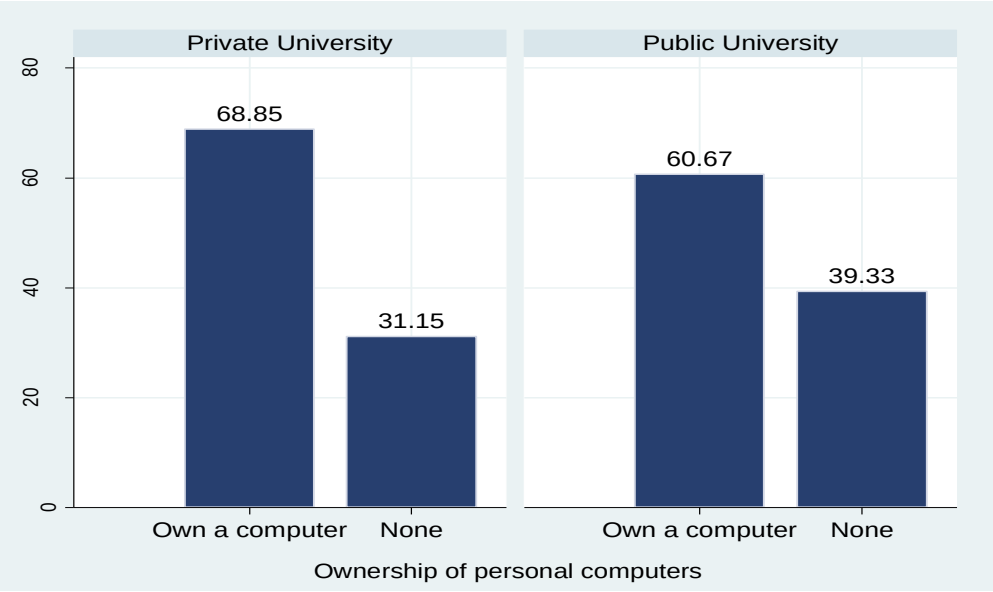

Figure 4. Public-private divide in the ownership of personal computer. Source: Field work, 2011.

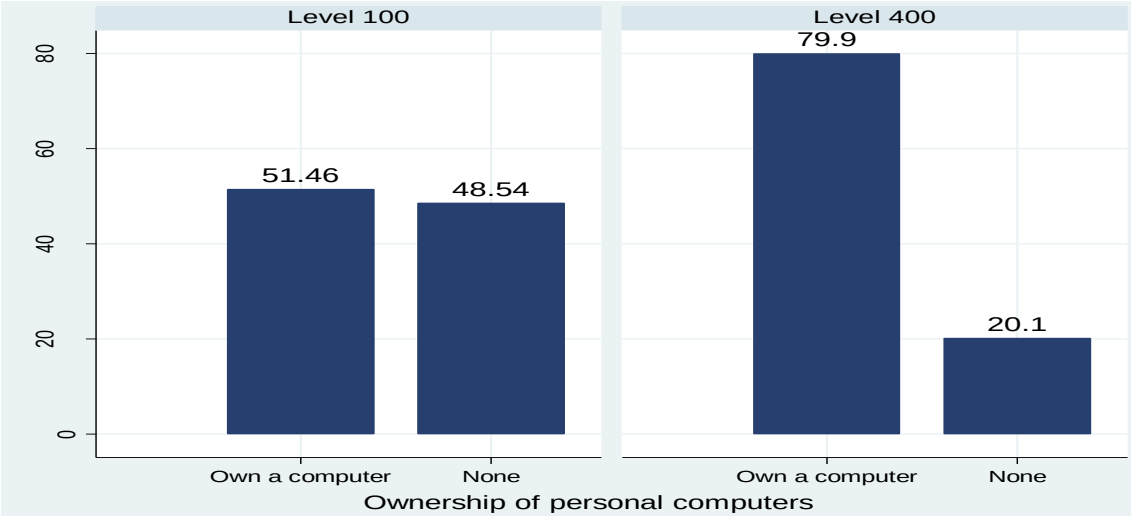

Figure 5. Level of education and ownership of personal computer. Source: Field work, 2011.

the ownership of personal computers. Overall, female students showed a higher propensity to own a personal computer than their male counterparts though the skewness was very prominent in the private institutions. The male-female ratio in the ownership of computers recorded 42 and 58%, respectively while in private universities, the percentage ratios were 32 to 68. A test conducted gives a chi-square value of 16.79 at a 99% level of significance. This is not surprising in situations where owing a personal computer on most campuses is now seen as more of a symbol of affluence (status enhancement gadget) than a learning tool. During personal interactions (discussions) with some students and faculty members during the research, it was alleged that most female students are able to acquire personal computers mainly through the magnanimity of their "friends."

The study further examined the type of computers owned by the students. This was intended to ascertain how the influx of used computers has facilitated the use of computers particularly among students in the tertiary institutions. The results shows that overall, 62% of the students who have personal computers in these institutions procured brand new ones while only 38% had used ones. Among the international students sampled, as many as 16% had second-hand computers. At the

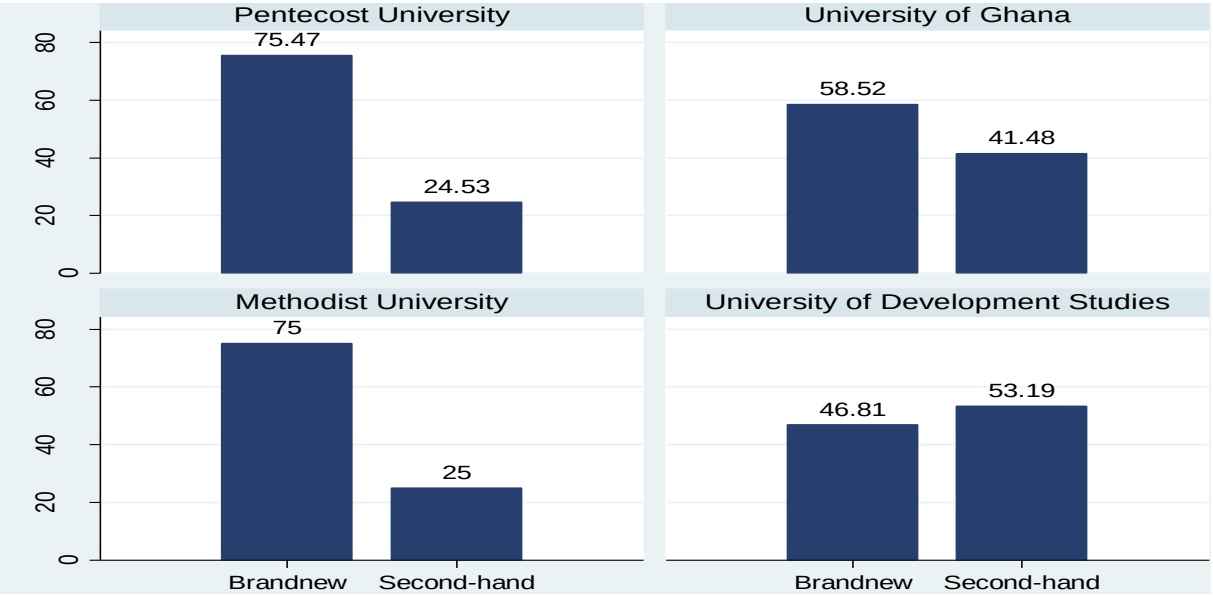

Figure 6. Institutional distribution of the type of computers. Source: Field work, 2011.

institutional level, UDS had the highest number of students (53%) using used computers. Figure 6 presents the institutional distribution of the type of computers used among the sampled population.

The reasons for the observation on UDS may not be farfetched. As already indicated, the three northern regions, where the majority of the students hails from are coincidentally the three most deprived regions in the country. It therefore, appears that with their current economic circumstances, the use of second-hand computers provides the most immediate and likely option for those determined to join the ICT revolution. During the study period, some used computers could be obtained for as low as 30% of the price of a brand new product of similar brand. According to Oteng-Ababio (2010), while a new Toshiba A110 series laptop computer was being retailed around $1,200, a refurbished one of the same make was available for $150.

These findings present multiple policy implications. On the one hand, they point to the relevance of used electronics to most economically challenged students in the deprived regions in dire need to join the ITC revolution. Even in the relatively 'economically rich south', the percentage of students using used computers (38%) is substantial and therefore one cannot easily discount the importance of used computers in the discourse on the technological revolution. It also shows that the use of used electronics is not the preserve of students from developing countries. The 16% of foreign students from the developed world (USA and Norway) attest to this.

However, the high percentage of students (62%) acquiring brand new computers raises and indeed, complicates a lot of government policy issues. It, for example, questions the justification why government should continue to tax-exempt the importation of used computers and lose presumably huge revenue while the majority will ordinarily prefer brand new ones. Hopefully, the use of exploratory factor analysis to understand what informs students' choice of a personal computer might help unravel this dilemma and this is what the subsequent part of the study seeks to achieve.

Description of variables

The description of the variables used in the factor analysis is captured under five sub-headings and presented in Table 3. The variable, 'academic performance' generally captures students' evaluation of the importance of computers so far as their academic work is concerned while 'computer specification' examines the in-built characteristics that inform students' choice of a computer. 'Financial capacity' looks at the extent to which the economic capacity of students facilitates or hinders their acquisition of personal computers and finally, 'availability of computers' interrogates how the ease of locating the computers and their accessories influences their acquisition among students. The likert scale of measurement, which ranges from strongly agree to strongly disagree, was employed. The means of the various scores were subsequently calculated and to ensure consistencies in the interpretation of the individual mean scores, a categorization schema was adopted. These are: strongly agree (1.00 to 1.490), agree (1.50 to 2.50), indifferent (2.51 to 3.50), disagree (3.51 to 4.50) and finally strongly disagree (4.51 to 5.00). The results are presented in Table 3.

Table 3. Descriptive statistics of variables used in factor analysis.

Variable	Min	Max	Mean	Std. dev.
Academic performance				
Using a computer ……..				
gave me greater control over my studies	1	5	1.90	0.962
improved my academic performance	1	5	2.05	0.920
improved my learning productivity	1	5	1.88	0.897
enhanced the effectiveness of my study activities	1	5	1.94	0.867
improved quality of assignment	1	5	1.62	0.847
enabled me to accomplish assignments quickly	1	5	1.77	0.892
made it easier to study/learn	1	5	1.99	0.931
Computer specification				
…….. is my foremost consideration in computer purchase				
processor speed	1	5	1.82	1.011
memory size	1	5	1.69	0.880
brand	1	5	2.05	0.996
functional characteristics	1	5	1.80	0.820
portability	1	5	2.00	0.982
country of origin	1	5	2.73	1.222
newness of the inbuilt technology	1	5	2.25	1.081
Financial capacity				
I cannot buy …….				
a new computer because I am not financially capable	1	5	3.08	1.383
a table top computer which is priced above US$200	1	5	3.03	1.254
a table top computer which is priced above US $400	1	5	2.92	1.267
a new computers instead I use a second hand computer	1	5	2.73	1.270
Availability of computers				
All brands of computers are readily available in the market	1	5	2.32	1.172
There are lots of avenues in buying a desired computer	1	5	2.02	0.939
The amount spent on acquiring a computer is satisfactory	1	5	2.46	0.989
New computers are easily available on the market to buy	1	5	2.24	1.069
Accessories for new computers are more available than old ones	1	5	2.62	1.083
Knowledge in computer				
Expensive computers are durable than moderately priced ones	1	5	2.86	1.143
I am proficient in computer hardware	1	5	3.10	1.209
I have a long history in computer knowledge	1	5	2.85	1.116
I have formal education in computer	1	5	2.29	1.067
I am more comfortable using computers for assignment/projects	1	5	1.95	0.903
High cost computers have high technological inventories	1	5	2.48	1.132

1 = Strongly agree, 2 = Agree, 3 = Neither agree or disagree, 4 = Disagree 5 = Strongly disagree.

The results show that an overwhelming number of students agree that having a personal computer impacts positively on one's academic performance. From the mean scores, many students believe a personal computer helps students to take greater control of their studies (*M* = 1.90, SD = 0.962); improves their academic performance (*M* = 2.05, SD = 0.920); assists in learning (*M* = 1.88 SD = 0.897) and enhances the quality of assignments (*M* = 1.62, SD = 0.847). The students also appear mindful about the in-built characteristics of the computers they use. Most students agree that a computer's processor speed (*M* = 1.82, SD = 1.011);

Table 4. Total variance explained.

Component	Initial Eigen values			Rotation sums of squared loadings		
	Total	Percentage of variance	Cumulative (%)	Total	Percentage of variance	Cumulative (%)
1	5.418	18.684	18.684	3.910	13.482	13.482
2	2.615	9.017	27.701	3.060	10.550	24.033
3	2.467	8.507	36.209	2.414	8.325	32.357
4	2.001	6.898	43.107	2.398	8.267	40.624
5	1.666	5.744	48.851	2.386	8.227	48.851

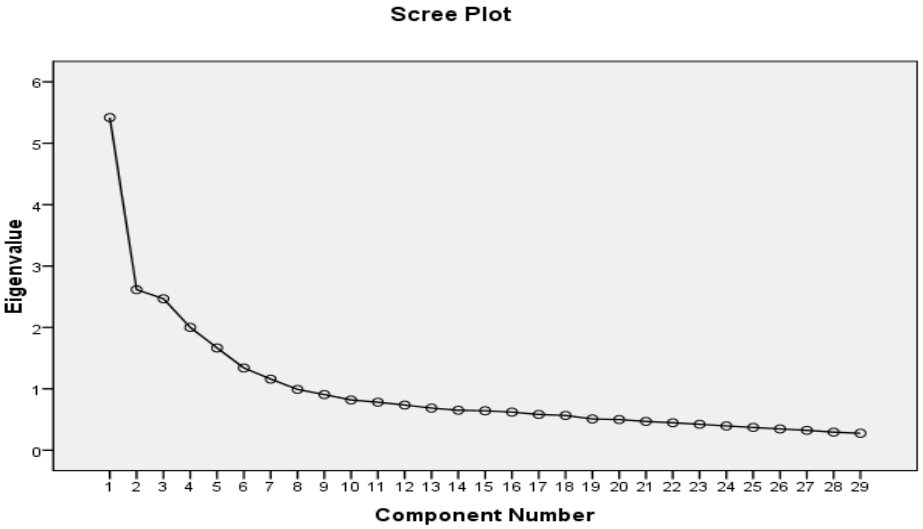

Figure 7. The Scree plot.

memory size (*M* = 1.69, SD = 0.880) and newness (M = 2.25, SD = 1.081) are some of the considerations that influence their choice of a personal computer. Ironically, the majority of the sampled population appears indifferent to the other variables used in the study: Financial capacity, availability of computers and knowledge of computers.

The foregoing observation reinforces the earlier observation which shows that over all, most students (62%) procure brand new computers. The results however show a high standard deviation which implies that the data are spread over a large range of values. By inference, it can be deduced that although the majority of students appear indifferent regarding the price, availability and the knowhow of computers, there is also quite a significant number who do take those variables into consideration in procuring personal computers. A possible reason for this development could be the fact that most students depend on their parents, friends and in some instances, their siblings both within and outside the country to acquire these electronic gadgets. Hence, they do not directly bear the financial burden of acquiring such a facility and therefore they are indifferent when it comes to price, availability and know-how.

Factors influencing students' choice of a personal computer

Here one of the main objectives of the study is addressed: factors that motivate students' choice of a personal computer. The variables captured through the Likert scale were varied and therefore defied easy manipulation and interpretation. This dilemma was circumvented through the use of exploratory factor analysis with principal component analysis which helped group the individual variables into categories that measure the same construct. The Kaiser Eigen value criterion and the scree test were employed to determine the number of factors to be retained for analysis. The Eigen value criterion helped retain variables with values greater than one as significant and in this study five factors were retained. Table 4 presents the results of the factor extraction with their Eigen values.

The Scree plot (Figure 7) is a graphical representation of the number of factors retained. The number of factors

Table 5. KMO and Bartlett's Test.

Kaiser-Meyer-Olkin measure of sampling adequacy		**0.808**
Bartlett's test of sphericity	Approx. Chi-square	3578
	Degrees of freedom	406
	Significance level	0.000

corresponding to the fairly horizontal point indicates the appropriate number to be retained and from the graph, this falls at about factor 5, confirming that five factors should be retained.

The Kaiser–Mayer–Olkin's (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess the suitability of the data set for analysis (Hair et al., 1998). The results show the data can potentially factor well. In applying the KMO statistic (which ranges between 0 to 1), a value of zero indicates that the sum of partial correlation is large relative to the sum of correlations, indicating diffusion in the pattern of correlations and therefore factor analysis is likely to be inappropriate. A value close to one, on other hand, indicates relative compactness and therefore factor analysis will yield distinct and reliable factors. Kaiser (1974) recommends accepting values greater than 0.5 and since the reported value is 0.808; factor analysis is seen as appropriate. Bartlett's test of sphericity was employed to test the null hypothesis that the original correlation matrix is an identity matrix. At 5% level of significance, the results show that the data is highly significant ($p<0.000$), and therefore factor analysis is appropriate (Table 5).

The Varimax rotation method was used to rotate the five retained factors (Kaiser, 1958) and the resultant factor matrix with its factor loadings is presented in Table 6. In this study, factor loadings greater than 0.4 were considered adequate to interpret a particular factor. Thus, only variables with loadings >0.4 were extracted.

Each factor is assigned a common nomenclature based on the variables that fall in that category. The results show that seven variables were loaded onto Factor 1 which relates to the usefulness of computers to academic work. These variables, all of which loaded more than 0.600, include the assertion that using a computer increases a student's control over his studies, academic performance, productivity and effectiveness. The factor also connotes using computers improves the quality of assignments and makes learning easier. This group of variables is jointly labeled "academic performance" with a scale reliability coefficient (Cronbach's alpha) of 0.862. By implication, students yearn for the personal computer as it is seen as impacting positively on their academic performance.

The findings also show that, seven items load onto the second factor which is related to the in-built qualities or characteristics of computers. The specific variables that load onto this factor include the processor speed, the memory size, the brand, the functional characteristics and the newness of the in-built technology. This factor was labeled, "computer specification" and had a scale reliability coefficient of 0.763, indicating that the in-built qualities of a computer influence the choices students make. It can be inferred that all things being equal, most tertiary students will go in for "quality" computers and most probably, brand new ones.

Four variables loaded highly on Factor 3 (financial capacity), namely inability to buy a personal computer due to its price, among other cost related variables. The Cronbach's alpha coefficient for this factor variable is 0.731 implying that overall; the issue of affordability is a major consideration and indeed a hindrance to the choice of personal computers among the majority of students. By implication, it can be deduced that even though most tertiary students appreciate the usefulness of good quality (and probably brand new) computers in their academic pursuits, their ability to obtain them is contingent on their financial capacities.

From all indications, Factors 4 and 5, availability of computers and knowledge of computers, respectively are emphasizing the obvious. Indeed, the government's open door policies (including trade liberalisation) coupled with the removal of the import duties on used computers have made electronic products in general readily available in every nook and cranny of the country. It is also a matter of course for a university student today to be computer literate as computer education has been factored into the current university curriculum as a mandatory course for all first year students. The influence of these two factors as captured in this study therefore emphasizes the positive aspects of the outcomes of government interventions such as tax-exemptions and the inclusion of mandatory computer education in the university curriculum.

COMING OUT OF THE SHADE

As already alluded to in this study, many governments in the developing world have looked to the ICT revolution and the accompanying influx of computers as a solution to the chronic poverty embedded in their economies. In pursuance to this ambition, they have pursued policy interventions geared towards making computers easily accessible and affordable to all. However, many of these hopes are not only misplaced but tend to be exaggerated. The findings of the study show that the decision making

Table 6. Rotated component matrix.

Variable	Component				
	1	2	3	4	5
Academic performance					
Using a computer **……..**					
gave me greater control over my studies	0.601				
improved my academic performance	0.784				
improved my learning productivity	0.795				
enhanced the effectiveness of my study activities	0.776				
improved quality of assignment	0.672				
enabled me to accomplish study task more quickly	0.669				
made it easier to study/learn	0.752				
Computer specification					
…….. is my foremost consideration in computer purchase					
processor speed		0.670			
memory size		0.726			
brand		0.656			
functional characteristics		0.666			
portability		0.595			
country of origin		0.539			
newness of the inbuilt technology		0.529			
Financial capacity					
I cannot buy **……**					
a new computer because I am not financially capable			0.647		
a table top computer which is priced above US$200			0.734		
a table top computer which is priced above US $400			0.812		
a new computers instead I use a second hand computer			0.653		
Availability of computers					
All brands of computers are readily available in the market				0.740	
There are lots of avenues in buying a desired computer				0.674	
The amount spent on acquiring a computer is satisfactory				0.592	
New computers are easily available on the market to buy				0.700	
Accessories for new computers are more available than old ones				0.584	
Knowledge in computer					
Expensive computers are more durable than moderately priced ones					0.535
I am proficient in computer hardware					0.727
I have a long history in computer knowledge					0.749
I have formal education in computer					0.501
I am more comfortable using computers for assignment/projects					0.485
High cost computers have high technological inventories					0.501
Cronbach's alpha	0.862	0.763	0.731	0.718	0.599

Extraction Method: Principal Component Analysis: Rotation Method: Varimax with Kaiser Normalization: Rotation converged in 6 iterations.

process leading to the acquisition of personal computers by tertiary students is influenced by complex factors, with economic factors conspicuously leading the tally. There is therefore the need for a more nuanced understanding of these dynamics in order to bridge the ICT revolution gap. Undoubtedly, the revolution generally appears important

and ongoing, yet in the economy of Ghana, which displays extremes of wealth and poverty, understanding how policies impact directly on different segments of the population is paramount.

The study shows that most students in tertiary institutions who own computers generally procure brand new ones, mainly because of quality considerations. This observation raises questions about the justification for the government's continuous zero-rating of used computers as a way making them more accessible to the most venerable. Such a policy tends to favour the importers and their foreign cohorts who are making "abnormal profits" out of a well-intended government policy (Prakash and Manhart, 2010).

However, the study also reveals that most students in the UDS, where poverty is quite endemic, procured second-hand computers. This reveals how financial considerations play an overarching role in the decision-making process. The understanding of such a conflicting (complex) situation can provide practical information for policy decision making, particularly for targeting different segments of the society with different social and economic backgrounds in different parts of the country. It will also assist in fashioning out appropriate public-private partnership policies that will facilitate the drive towards bridging the digital divide. Without doubt, governments, the private sector, and non-Governmental organization (NGOs) have initiated and sponsored numerous programs in this direction, but in most cases, a commitment to close the 'digital divide' is not enough. It is seductively easy to equate the increasing volumes in computer import with increasing access.

The study has confirmed that for many tertiary students in Ghana, without more targeted policies, joining the ICT revolution will remain elusive. The finding does not contradict nor challenge the current government policies. It reveals that many students, due to financial reasons, still rely on used computers. However, the situation becomes complicated given the fact that many students, given the opportunity, would wish for brand new computers because of perceived qualities. Thus, given the plethora of challenges, the problem appears to go beyond merely enacting policies (for example, tax exemptions) and even providing internet connections. It calls for taking cognizance of the spatial variations in income and other infrastructure. It also demands effective cooperation among all stakeholders: the government, the private sector, and non-governmental organizations. It is evident from the results that without purposeful intervention, the intra-spatial variation will persist.

The increase in the influx of computers into the country may be a welcome development, but what happens if some internal contradictions tend to concentrate all the potential and prestige in an increasingly small number of privileged students? What happens if it leaves a huge segment of the population out of the loop? Probably, the government can replicate the Basic School Computerisation Project under which more than 60,000 locally assembled computers are being sent to basic schools by 2012 (Mould-Iddrissu, 2011). Launched in Accra in September 2011, the project has as its theme "ICT as a Tool for Development at the Basic Level of Education" and is intended to create a platform to enhance skills of pupils in ICT, and forms part of the Ministry's e-school policy, which involves the use of ICT in teaching and learning at the basic education level. For many tertiary students in Ghana, without such policies and leverage, they may perpetually be out of the loop.

It must however, be emphasized that procuring computers alone does not guarantee a successful integration into the ICT world, as for example, there cannot be access without connectivity. Bridging the digital divide requires infrastructure, social capital, and human capital: phone lines, electric lines, affordable and publicly-available Internet sites, appropriate software and hardware and the narrowing of fundamental social gaps (gender, socio-economic status etc). These facilities work complimentarily in ensuring an all inclusive policy. The study thus proposes a direct government supply of computers as critical for the transition to the knowledge society. This is due to economic wealth disparity and the variations in telecommunication infrastructure within the geographical space. For the moment, the use of computers has spread across higher education like a fast-growing ivy. There is a huge appetite for learning and a great desire to join the revolution but there is also a huge heartbreaking uphill struggle for students, especially in the low-income areas where about 43% of persons live below the poverty line, and where there have been "multiple dysfunctions", the least of which have been poverty and marginalization.

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