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A formative assessment of information communication technology in Lebanese schools

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ABSTRACT

Information Communication Technology (ICT) devices as servers, personal computers (PCs), hubs and other artifacts that make-up these technologies have important role in the educational development in public and private schools. This paper measures the level of ICTs in Lebanese public and private schools for the academic year 2005/2006 and evaluates the effectiveness of ICT on student school performance. The number of PCs, servers, printers, hubs, UPSs, scanners, LCDs, modem/fax, and email access, were measured and ICT indicator values were calculated. No significant differences were found between private and public schools on the aggregate level of ICT or computers per school or per student. The study also evaluated the effectiveness of ICT using the aggregate measure of ICT artifacts and PCs and its effects on student secondary school performance. A two-by-two factorial design using type of school (private/public), level of ICT (high/low) and PCs (high/low) was run on the baccalaureate-passing rate. Mainly, a significant difference between public and private schools was found, but no differences between the two ICT levels (high/low) or PC levels (high/low) per student. ICT levels in private schools did not impact student performance specifically, passing the baccalaureate exams. Although ICT levels were higher in private schools, the differences were not significant at the 0.05 level.

INTRODUCTION

At a general level, computers are essentially the artifacts for Information Communication Technology (ICT), which allow other components to integrate and network in a technologically driven setting. ICT also functions in the organization, storage and processing of information in schools and in knowledge-based organizations. ICT has had an important role in the educational and social development in Western nations and in most nations of developing economies (Macleod, 2005). A society committed to the infusion of ICT has a higher probability for a world of global communication, leisure, enjoyment, learning and the integration in world polity (Drori & Jang, 2003). In educational terms, the existence of ICT hardware and software in schools allows students to transact and enjoy a new form of literacy than those that may not be able to afford the use in and outside schools

Proponents of ICT evoke alarm in the asymmetric ICT distribution in societies or nations of developing economies as that of Lebanon. Engaging among sociologists-- they argue, digital divide appears to be a larger social phenomenon and educational problem (Atwell, 2001). Indeed, many social scientists claim that more than half of the world children lack the basic ICT resources and considerable agreement on the relevancy of ICT in developing economies (Walsham & Sahay, 2006). The main proposition in "ICT inequality" is that many of the world peoples will never be able to catch up with the information technology advances and that new forms of illiteracy will be more prevalent; moreover, costly to remedy. On the other hand, a "counterpunch" and prevalent thinking among radicals, consider digital divide is a mere invention created by interest groups who invent and reproduce these differentials to allocate monies for specific interests at costs of improving curriculum or even teacher training needs. According to Stone (1997), policy makers construct implicit models of problem causation and its solution. They provide the scenario, that tends to be one-dimensional; and they narrowly and functionally

describe characteristics of the problem then offer a targeted and operationally defined solution (Hatch, 1998; Hoffman, 1995). Protagonists and players who have treated the digital divide as a crisis often call for government intervention; when these policies confirm this need, millions, if not billions of dollars pour in for infrastructure development leaving out other needed remedies in schools.

In Lebanon for instance, there is enough anecdotal evidence to say that schools do not have the basic infrastructural hardware for a networked computer, a trained teacher, and the necessary technical upgrades. However, new prospective and forecasts have kindled government officials' plans for a substantive growth in ICT structure. Only on November 15, 2007, the Minister of Higher Education announced the distribution of 400 computers for public schools, connected to the WEB through broadband. In addition, in a recent 2005 statistics provided by the Ministry of Telecommunication, the use of PCs and Internet accounts will almost double in 2009 considering the 2004 as a stratum.

The infusion of ICT in nations of developing economies is quite prevalent. Worldwide TV sets and satellite stations spur the slums of the poorest countries in the world, as the Internet Café, has become part of the culture of the bazaar and the "market place." Murdock (2002) points out in citing Norris (2001), even with poor neighborhoods in the US anyone may be able to "surf the WEB from public libraries, schools, community centers, or even cyber cafes, but this is not the same as having automatic access via high-speed connections at home and at the office" (p.87). No time in history however, as quite recently has low socioeconomic groups become consumers of affordable modern industrial products simply out of easy, and cheap use, and everyday demand in and outside school. Even with or without schools more people are learning to use these tools without the needed training (Cooper, Alcorta, Bastos, Kumar & Mitter, 1995).

Predominant progressive thinkers still consider that schools rather than society are the active constructors of dominant ideology, those who have control over information have control over the distribution of knowledge and the wealth generated by it (Persell & Cookson, 1987). The argument goes, that even with the poor or affluent schools equipped with ICT tools or the excess of neighborhood e-café in poverty stricken areas; still affluent children may have ample resources at home to contribute to a richer cultural context compared to poor students living in poverty-stricken neighborhoods (Atwell, 2001). In fact, schools and higher education institutions who influence students in the direction of future generations are actually putting symbolic and sometimes instrumental cultural capital in the hands of those who can afford these schools, thus a well integrated and functioning ICT program will train affluent students in the use of these technologies to advance with greater comprehension of global culture and pluralistic attitudes (Wagner, 2005). In the mid-eighties, McPhail (1985) reports on a large study carried out in the US (viz., a survey of 1082 schools) by the Center for Social Organization of Schools at the John Hopkins University, they found that drill and practice exercises was used through computers among minority and less affluent students, while wealthier students use computers for discovery and inquiry approaches in learning. Hasselbring (1986) extensive review on the effectiveness of microcomputers, found that computer-based instruction was effective when used with traditional teaching than used alone. Kulik, Bangert & Williamsn (1983) found that ICT and specifically computers, motivate students to learn than those with out them. Miller (2001) argued that ICT output is quite complex and variegated, even if equal distribution of ICT resources between public and private schools does not entail similar output levels as in student achievement. Miller (2001) adds, even though economically disadvantaged groups, amply provided with resources during training or in "one-shot programs", they are marginalized from ICT use, in or out of school because of a lack of structural and technological sustainability.

Still however, schools play a significant role in the delivery of information and their ability to access and exchange the information. For instance, according to a report on the US public

schools, Kleiner & Farris (2002) found that 35% of the schools in the US had access and in 2002, the levels reached 99%. In the US for instance, the ratio of students to computers has increased substantially for low-income schools. According to Pisapia (1984) surprisingly, instructional computers in poverty-stricken schools had the highest level compared to those schools that were the least poor. Access opportunities have leveled-out in US schools, but were not informative of student achievement

Recent international studies have shown a relationship between the availability and use of ICT and its impact on student academic achievement. These studies have been variegated and not all provide findings that are consistent. Some studies show a positive relationship between computer availability, use and achievement; while others show a negative relationship; and some show none. For example, two large studies in the US by the National Center for Educational Statistics (2001a; 2001b) found that with the availability of computers, a positive relation between science and math test scores, and cognitive performance i.e., achievement (Banks, Cresswell & Ainley 2003; NCES, 2001a; NCES, 2001b Ragosta, Holland & Jamison, 1982). Other studies have shown a negative impact of computers on student achievement (Fuchs & Woessmann, 2004; Welginsky, 1998). International studies as in India (Linden, Banerjee, & Duflo, 2003) and Kenya (Kulik, 2003) to some degree presented relevant and palpable results. A study involving 31 developed and emerging countries, and another US sample of schools, found a negative relationship between the availability of computers in the home and academic performance (Fuchs & Woessmann, 2004). However, not one study has emerged in the Arab world on the effects of ICT as resources to the extent that it indicates a level of success in secondary schools. It is clear that the issues of ICT immersion are more complex; thus, the immersion of ICT into the school without proper planning or even assessment and evaluation, says nothing of the performativity of these tools. This particular perception of ICT suggest that policy makers consider and use ICT from a functionalist-neutralist perspective, in that technology lays the tools without the inherent pedagogical powers needed to advance these tools for students' success in school subjects (Feenberg, 1991).

Challenges of integrating ICT into the life of economic, social and educational development has not been easy for nations of developing economies (Castells, 2000). There are many situational constraints that limit these nations from transcending policies and programs for ICT development. In some cases policies have not been formed and ICT integrated haphazardly or conversly, policies in place without the ICT tools or trained people. But even those who integrate ICT, they show disparaties in the use of the Internet and the World Wide Web (WWW), because English is not the first language, they find little use in the world's Internet English content. Ebbert (2002) cited in Albirini (2008) surveyed 2,024 million WEB pages, and found that over 50% of the content was in English and the rest distributed among German and French languages. With public schools being the harbingers of the national curriculum and programs, the use of native language to carry instruction, find little panacea in ICT to improve their curriculum along global educational changes as in fields of science and mathematics. Hence, ICT artifacts are not easily transferable and integrated into the national economy as a provision and support for the growing global economy.

There is a lack of well-developed body of evidence of empirical studies that evaluate whether digital technologies accomplish what their proponents which them to do, as it affects student learning (Denzel, Haney, Ore, Persell, Schulte, Steele & Winfield, 2002). Even if such inequities exist do they create the knowledge gap between those that "have and have-nots"? Whether those that do have the ICTs and know-how, can they manifest at some sort of macro-level, output results? The basic premise suggest that a technologically deterministic approach, appropriately considered to studying the impact of ICT, as a resource and physical construct. The opposing view belonging to pragmatists and specifically John Dewey's basic notion of ideas as instruments. In this regard John Dewey's instrumentalism considers ICT artifacts helpful in devising methods

and ideas in attaining educational ends. Thus, those people who at the margins of using and benefiting from these technologies are clearly not effective participants of society (Martin, 2005).

ICT as an Indicator

The different resource artifacts in schools produce a different set of indicators (Shavelson, McDonnell & Oakes, 1991a) and can characterize the nature of these artifacts through some of its components, at which benchmarks can be compared to some future time against some set benchmarks (Shavelson, McDonnell & Oakes, 1991b). Educational indicators tend to be statistics that reflect aspects of an educational system and provide substantive information for decision makers. For instance, the number of computers in schools does tell a great deal about the entire ICT system. However, the number of computers per student tells more of how an educational program is functioning and an indicator that provides information about conditions that interact to produce an effect (output). Kozma and Wagner (2005) suggested a number of indicators as a standard for ICT, citing the United Nations Educational, Scientific and Cultural Organization (UNESCO) and United Nation of Development Program (UNDP) a broad set of indicators palpable to the development of ICT infrastructure. Some of these indicators will be measured in this study in relation to output measure as in school performance:

- Presence of a national educational ICT policy
- Presence of a master plan with a timeline
- National expenditure on ICT in education
- Ratio of students to computers
- Availability of computer networks in schools
- ICT as a separate subject in the curriculum
- Integration of ICT into the curriculum
- Number of schools incorporating ICT

ICT is used as an indicator to study student performance in secondary school (Wagner, 2005). Questions as to what is the impact of ICT on secondary school achievement? And what it served in the traditional curriculum. Thus, it seems important to analyze the output measures of these schools and compare them using ICT as a school resource.

Empirical measurement of an index and indicator is difficult because there is little consensus for what is a key indicator for ICT. A standard indicator considered as means for ICT tools, these being computers— if a school has more than one computer then it has a higher probability for software data communication, telecommunication (wireless) and connection hardware. Probably the most precise method to assess the level of ICT is actually to count the number of "ICT artifacts." These would be essentially considered the main hardware utilities that make the software operate. Kozma and Wagner (2005) indicated that a basic ICT access utilities as electricity, computers, printers, projects, Internet access and pieces of educational software as indicators of school output. We use these indicators as resources in relation to achievement in schools (Hanushek & Tayor, 1990; Card & Krueger, 1996).

The recommendation made by the International Communication Union (ITU, 2005) and Mansell's (2005) suggest that a comparable empirical study of ICT being implemented and developed. Whether primary and secondary schools around the world meet the challenges of information technology, it is important to draw attention to the discrepancies if any, and whether the digital divide has any drastic effect or output as a measure of performance. The digital divide in the context of this paper is juxtaposed to the divide between public and private schools as a differential ICT resource in Lebanese schools.

Aim of the Study

This study will primarily survey schools on a predefined set of ICT artifacts, as to determine ICT effectiveness in public and private schools and understand the relation between input (ICT) and output in student achievement. Specifically, in this study, national exam scores will be examined as being a summative school performance, measured by a percentage of those who succeeded i.e., pass the baccalaureate national exams. All Lebanese students go through a set of national exams in four basic strands, humanities, sociology and economics, general sciences and life sciences for the baccalaureate. In all strands, students complete a set of exams and must receive a passing grade to receive the national baccalaurette degree or a Lebanese secondary school degree.

This study is a formative assessment in the evaluation of ICT in Lebanese schools. The study attempts to understand the extent to which ICT levels in schools and their effectiveness as measured through students' success in baccalaureate exams. The evidence in the research literature suggests that ICTs can contribute significantly to changes in teaching practices, and school innovation. The study will aid policy makers in understanding the differences between private and public schools. This study is exploratory, through the analyses of school data, it attempts to underline the relationship between ICT and student performance. ICTs is considered as a resource, which will determine whether differences in the resources in schools are associated with student achievement.

Schools in Lebanon are in fact of three kinds, private fee-paying, private subsidized by the government, and public. The administration of public schools is centralized, managed and controlled by the Ministry of Education. Private schools enroll a higher number of students than public schools as these private schools are run either by religious communities, private associations and individuals. Both private and public schools differ substantially in identity, character, and purpose (Abouchedid, 1997).

The basic assumption is that ICT use, tends to reproduce a resource deferential, which would seem logical to assess the difference between public and private schools in terms of student output.

METHODS

Data Description

The data for this project came from one source being the Center of Educational Development and Research (CEDR[1]). The CEDR maintains a detailed record, demographic characteristics, gender, age of students and teachers. It also maintains information about each school in terms of its facilities, students, teachers and other related information. This data used in this study can be considered secondary-data comprising information on students and resources. The data was collected by CEDR in 2006. All schools responded to an inventory questionnaire sent to all schools in Lebanon whether private or public, measuring 9-main ICT artifacts being PCs, servers, printers, hub, UPSs, scanners, LCDs, modem/fax, and email access used by students and staff in each school. Thus, two separate data-sets were obtained for students and staff for each of the 9 ICT artifacts. The administrator/principal reported the number of these artifacts and staff at CEDR entered the responses. A total of 1071 public schools and 1299 private school data was accrued for the inventory. This data was entered in a database according to school code (SC).

[1] A public research center, known to be the "right arm" of the Ministry of Education in Lebanon runs all statistical studies and the assessment of national exams for the Ministry of Education

The second set of data provided by CEDR to the researcher included the SC, number of students in each secondary school, percentage of passing on the baccalaureate exam (as a measure of success on the four baccalaureate strands, in the humanities, socio-economic, general sciences, and life sciences). This dataset included the grades (mean for each school) on each subject for each school on the baccalaureate secondary school exam attached with an identification number (ID) "tagged" to the SC. This data was related or matched based on SC to the ICT data (base-data file). The dataset was aggregated such that percentage of success was obtained as a cohort for each school, public and private. The data was obtained from CEDR in the end of 2006, All educational input measures used in this study were measured at the group-cohort level.

RESULTS

The evaluation began with the analysis of the ICT in public or private schools. The first set of results report a total number of artifacts in private and public schools; a ratio of the total number of artifacts to the total number of schools, and a measure of the average ratio of artifact to the number of students in public and private schools. Aggregated data is reported on Table 1.

A total of 6921 computers in public schools and 20400 in private schools at the end of the academic year 2006. The mean value indicates the average number of artifact across public or private schools. On average, the public schools had 9.85 computers per school whereas, private schools had 17.23 per school. A t-test was run to compare public and private schools; a significant difference was found between the two schools ($t(df=1886)=8.63$, $p<0.001$). In terms of modems/faxes, public schools had a higher average of 3.19 compared to 2.88 in private schools. However, no significant results appeared between private and public schools specifically on modems/faxes $t(df=449)=0.54$, $p>0.05$.

The proportion of schools having these artifacts was measured by n/N ("n=number of schools that have these artifacts"; "N=total number of school survey"). In public schools for instance, it was found that 66% (n/N) of the schools had PCs and only 9% have modems/faxes. In comparison, 91% of private schools had PCs and 28% had modems/faxes. The number of modems/faxes totaled 290 for all public schools and 1036 for all private schools. The number of modems/faxes per school ratio (i.e., n/N as shown in Table 1), 9% of public schools had these facilities and 28% of the private schools.

Using the artifact/student for the average of each artifact were compared using public and private schools. A non-significant difference was found between all the artifacts with exception to a higher number of UPSs ($t(df=1344)=9.50$, $p<0.001$) in private schools and LCDs ($t(df=344)=3.9$, $p<0.001$) per student. Also by inverting the artifact/student (i.e., 1/(artifact/student)) we can obtain the ratio of student to instructional computer in private and public schools. Our results showed that there were 19.2 students per computer for public schools and 16.67 students per computer in private schools

Table 1: Ratio of artifacts to number of schools, mean and artifacts/student for public and private schools

	Public Schools N=1071					Private Schools N=1299				
	No. of Schools	Total # of artifacts	Ratio (n/N)	Mean	Artifact/ Student	No. of Schools	Total # of artifacts	Ratio (n/N)	Mean	Artifact/ Student
PC	703	6921.00	0.66	9.85	.052	1185	20400.00	0.91	17.23	.06
Server	144	233.00	0.14	1.62	0.01	182	345.00	0.14	1.90	0.01
Printer	423	718.00	0.40	1.70	0.01	846	2143.00	0.65	2.53	0.02

Hub	198	325.00	0.19	1.64	0.01	399	937.00	0.31	2.35	0.01
UPS	467	4087.00	0.44	8.75	0.04	879	5640.00	0.68	6.42	0.02
Scanner	253	307.00	0.24	1.21	0.01	499	749.00	0.38	1.50	0.01
LCD	56	169.00	0.05	3.02	0.02	290	565.00	0.22	1.95	0.01
Modem/ Fax	91	290.00	0.09	3.19	0.01	360	1036.00	0.28	2.88	0.01

Table 2 reports the statistics for ICT artifacts for school administrator's in private and public schools. For all ICT artifacts, private schools had a higher ratio (n/N) than public schools. Noticeably, there was a significant difference ($t(df=2100)=10.03$, $p<0.001$) between the number of computers per school in private compared to public schools. This difference appeared with higher average among private schools for printers, UPSs, scanners, and modems/faxes.

Table 2: Indicator Statistics for Administrators in Private and Public Schools

	Public Schools				Private Schools			
	N=1071				N=1299			
	No. of Schools	Total # of artifacts	Ratio (n/N)	Mean	No. of Schools	Total # of artifacts	Ratio (n/N)	Mean
PC	899	1491	0.84	1.66	1203	5319.00	0.93	4.42
Server	63	94	0.06	1.49	195	257.00	0.15	1.32
Printer	689	948	0.64	1.37	1022	3400.00	0.79	3.33
Hub	51	68	0.05	1.33	320	656.00	0.25	2.05
UPS	564	1058	0.53	1.88	849	2906.00	0.65	3.42
Scanner	275	297	0.26	1.08	560	755.00	0.43	1.35
LCD	30	33	0.02	1.1	167	231.00	0.13	1.38
Modem/ Fax	112	141	0.11	1.26	425	814.00	0.33	1.92

Private and public schools were compared on Internet access. Table 3 reports the frequencies of those that have Internet and those that do not. Private schools by far had a higher number of Internet accesses compared to public schools. Only 5.7% of public schools had Internet access. Surprisingly however, 97.8% of these schools reported they had an email address; whereas, 71.1% among private schools had an email address.

Table 3: Internet Access and Email Address in private and public schools in Lebanon

	Internet Access		
	Private Schools	Public Schools	Chi-square
Available	554	78	
	52.7%	5.7%	
Not Available	498	1294	689.01**
	47.3%	93.9%	
	1053	1372	
	100%	100%	
	Email		
Available	748	1347	
	71.1%	97.8%	
Not Available	304	31	358.1**
	28.9%	2.2%	
	1052	1378	
	100.0	100%	

** Significant at the 0.001 level

The final analysis compared private and public schools and levels of ICT on student performance (percentage of those who passed the baccalaureate grades in private schools and public schools). The baccalaureate national exams were used to compare performance based on PCs and an aggregate sum of ICT. The second set of analysis including all ICT artifacts. The PC levels i.e., high and low levels were calculated using the median cut-off to classify those having less or equal to the 50 percentile score= "low PC levels" and above the 50 percentile score= "high PC levels". The first analysis crossed school type (private/public) by PC (high levels/Low levels) through a 2x2 factorial Analysis of Variance (ANOVA) design on percentage of passing on the baccalaureate exam measure of success on the four strands those in the humanities, socio-economic, general sciences, and life sciences. Each strand requires students to take the exams in different subject matter or the same subject but with increasing/decreasing difficulty depending on the track. For instance, in all strands, students take language and mathematics exams with increased/decreased difficulty in exams. The factorial design was run on each of the strands separately, to determine the affects of PC use on school output measures. The results are reported on Table 4. Significant difference appeared between public and private schools with higher means for the passing success in the humanities and general science strands. No significant differences appeared on all the baccalaureate strands (high/low PC-levels); humanities, sociology and economics, general sciences, and life sciences for PC levels per student. No interaction effects appeared for all strands.

Table 4: 2x2 means and ANOVA results for type of school by PC/student on passing percentages for four the baccalaureate tracks

	Humanities			Sociology and Economics			General Sciences			Life Sciences		
	Mean	SD	F (df)	Mean	SD	F (df)	Mean	SD	F (df)	Mean	SD	F (df)
Private	78.05	3.16	6.14**	79.39	3.20	3.4	77.17	3.51	4.9*	84.97	2.89	.037
Public	88.71	2.92	(1,94)	87.39	2.95	(1,94)	87.76	3.23	(1,94)	85.73	2.66	(1,94)
Low PC levels	83.42	3.05	0.0001 (1,94)	83.12	3.08	0.02 (1,94)	80.53	3.38	0.66 (1,94)	84.43	2.78	0.22 (1,94)
High PC levels	83.34	3.04		83.67	3.07		84.39	3.37		86.27	2.77	
Interactions			0.46 (1,94)			0.12 (1,94)			0.32 (1,94)			.04 (1,94)

* Significant at 0.05 level

** Significant at 0.001 level

Table 5: A 2x2 means and ANOVA results for Type of School by ICT/student on passing percentages for four the baccalaureate tracks

	Humanities			Sociology and Economics			General Sciences			Life Sciences		
	Mean	SD	F	Mean	SD	F (df)	Mean	SD	F	Mean	SD	F(df)
Private	77.45	3.26	5.9* (1,97)	79.12	3.21	3.1 (1,97)	76.42	3.51	5.9* (1,97)	84.9	2.90	.03 (1,97)
Public	88.15	2.95		86.76	2.91		87.97	3.17		85.7	2.62	

* Significant at 0.05 level
** Significant at 0.001 level

Table 5 reports the ICT levels per student crossed by the type of school (public/private). Differences between private and public schools were found with higher mean scores for public schools in the humanities and general science strands. No difference appeared on the aggregated measure of the ICT level per student on all the strands. In addition, no interaction effect was found between high/low ICT artifacts and type of school and between high/low PC-levels and type of school. Thus, this would confirm that ICT was not a main influencing factor in student success in schools.

DISCUSSION

The study explored the difference between private and public schools on ICT resources in Lebanon and the effect of ICT resources on student achievement in secondary school as measured in the success in the baccalaureate exams. Although few studies have emerged in surveying national programs, this study is unique in that it treated ICT as a resource to compare between public and private schools. The analysis remained at the macro-level and focused on issues related to resources and access. The results showed differences between private and public Lebanese schools in output measure of achievement, across academic tracks, this difference was not significant using ICT as a measure.

Historically it is shown that public schools out perform private schools in the national baccalaureate exams even though the Ministry of Education acknowledging that public schools are lagging behind private ones (Ghusayni, 2001). It is also well known globally that public schools are less likely to be funded than private schools (Mansell, 2002). Still however, probing questions remain: what are the formative differences between these schools that may have better ICT infrastructures than those that do not? The analyses in this study provided answers to some of these questions. It is well known in Lebanon that private schools are well funded, well equipped, have educational programs that meet international standards and have integrated ICT into the curriculum. On the other hand, public schools in Lebanon are less equipped, have no upgrades and their teachers and staff lack training in the use of ICT (Ghusayni, 2001). Even if these poor and under funded schools do not maintain ICT infrastructure, it questions those schools that “have” and whether ICT is effective in its use for preparing students to compete in knowledge based societies. One methodological strategy undertaken was to compare schools that “have,” to those that did not. If those that have; generally, at the aggregate level, produce better performance results (achievement) than those that do, it gives indication that at some permutable level schools may lack the resources that underscore the importance of these indicators on school performance. Thus, the analyses of private and public school output in relation to ICT as a resource, provide some sense to the measure of how equipped these schools are with computers and other ICT artifacts. In addition, school resources determine the type of quality in student output and performance. Whether schools have the resources for students or academics, questions the use of ICT in the service of schools and in the way it impacts student learning outcomes (Benson, Haney, Ore, Persell, Schulte, Steele & Winfield, 2002).

The study showed that private schools had more computers than public schools. Overall, ICT artifacts were found to be higher in private than public schools. Even when considering the ratio of ICT artifacts to the number of schools, as a measure of a general proportion of artifact to the number of existing schools, this number was higher for private schools than those in public schools and indication that these artifacts in private school weregenerally higher per student.

The average number of students in public and private schools came to 258.35 and 440.53 respectively. It was apparent from the data, private schools housed a higher number of students than those in public schools. As a result the artifact/student ratio gave us a measure and indicator of the proportion for the number of artifact to the number of students. This was a key factor in understanding differences between schools. No significant difference was found between the two types of schools. The data also says that there are more artifacts in private schools as these artifacts in private schools were distributed along a greater number of students than those in public schools.

It is important to note that only in terms of LCDs and UPSs a higher number of these utilities per student were found in public schools than in private schools. The findings were also illuminative in terms of the number of ICT utilities in the administrative bodies of schools. Although there was no perceptible measure of the number of employees in each school-- many employees are working on part time basis or have a co-academic status, teaching and doing administrative work. It was found however, that the number of computers in ratio to the number of schools for staff was much higher for private than public schools; noting that this did not provide a measure as to whether there was more than one computer per school staff.

Private schools had a higher number of artifacts for administrators and staff than public schools in that only 5.7% of public schools have Internet access and almost 50% of private schools had access. Comparably in the US, year 2002, all schools had Internet access and 86% of public schools had access to the Internet and had a WEB page (Kleiner & Farris, 2003). The public schools had a higher email address than those public schools. There was no mechanism to check whether these emails are individual subscriptions or institutional (i.e., school). These email addresses could be established by staff at the school, then used or measured as a school ICT resource and hence, not a reliable measure of an e-communication outlet.

The final analysis in the result section measured the effectiveness of ICT on student passing rate in the baccalaureate exam as an aggregate measure. There is substantial empirical support for a reasonable proposition that students learning are affected by the level of ICT in school. It was found that neither computers nor ICT as an aggregate sum of all the 8 artifacts produce a significant main effect on the percentage of passing in the baccalaureate exam in all four tracks based on whether the school is private or public. Even with the greater ratio between students and computers in private schools, and ICT artifacts. Interaction effects between computer levels (high/low) and type of school (private/public) would have been expected given that there were higher number of computers in private schools and students in public schools outperformed students in private schools in the baccalaureate exams. This however, was not evident in our results, comparatively, the study by Welginsky (1998) explored the effectiveness of the ICT in US schools, using the National Association of Educational Progress and data from 31 developed and emerging countries, then removing all key covariates, the starling results showed that the more students spend time using computers, the lower their performance on mathematics. A number of US studies found a positive relation between achievement and the presence of computers in schools (Liao, 1999; NCES, 2001a; 2001b; Watson, 1993). Fuchs & Woessmann (2004) found a relationship between ICT and student learning. In a number of these studies it was not known how the types and use of ICT impacted student achievement and whether it was applied to problem-solving, simulations, or simple exercises (Cox & Marshall, 2007). As this study reports that there is no ICT effect on student passing the baccalaureate in secondary schools, specifically in strands as the general and applied sciences where ICT is used for instructional purposes.

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It is well established that ICTs serve to complement the traditional curriculum. Specifically, PCs improve student procedural knowledge in reading, writing, and basic mathematics (Becker, 1984) However, it is often faculties who define the objectives; choose the pedagogical styles or even device the curriculum in school. In fact, the curriculum and faculty are probably the main

harbingers to student performance. Faculties may integrate aspects of ICT in their work so that students can use these artifacts in their school work or problem-solving activities. ICT tools can hinder or help in the learning process depending on faculty who make use of these technologies to advance their teaching and learning. Thus, examining how ICT may affect teaching styles and learning outcomes is crucial to understanding whether these learning artifacts are key to the success of student performance in a globally networked learning society.

In a recent World Bank subsidized survey of ICT use in Lebanese schools, the Ministry of Higher Education suggested that a step in creating a system of exploration and private investment in-line with the privatization of the telecommunication sector, as it may act as the catalyst in improving the Internet infrastructure in and out side schools (Press, 1996). A number of programs run by NGOs and other funding bodies have established shops in and outside schools in Lebanon. It is absent how these programs faired in their performativity. Even, if these tools have been implanted in schools and distributed homogeneously there is little control over function and use by teachers. As there is no substantive policy that compels schools to have students or teachers use these tools effectively. The "Manara" project for instance, early in the 1990s defined a set of ICT objectives (Yaghi, 2005), for a national integration of ICT in public schools. It is not clear what these programs have accomplished, specifically in developing a national educational ICT policy. Still however, the impetus in schools lag behind the market private initiative. The implementation would require greater direction, support policy and encouragement from government and coordination from the other agencies involved. One such case, in the Arab world has been Jordan's ICT thrust to compete at regional and global market, as to achieve a strategic, social and economical Arab hub in the Middle East (Al-Jaghoub & Westrup, 2003). This impetus materialized through a national policy in ICT, which may guide educational policy member, in substantiating ICT programs through a proper evaluation of ICT programs in public and private institutions.

CONCLUSION AND LIMITATIONS

Non-governmental organization in Lebanon have run programs such as distance and computer aided learning and engaged ICT in schools to connect them to the Internet, provided multimedia tutorials, simulations; these programs have neither met comprehensive evaluations or a sustainable approach to the development of ICT. Even though there is some form of ICT investment in Lebanese schools, this investment is not realized in public schools especially in terms of Internet access, where that need is clearly called for. In addition, administrators and teachers balk away from the use of ICT, and thus is not a determinant for improving educational outcomes of students. Still there is substantial research that needs to uncover how these resources do in fact lead to higher test scores and success in schools (Wagner, 2005).

It is also evident in this work that our survey was formative and non-summative. The relevance of this is that access and use of computers with the Internet has not been measured against a set of standards. Thus, it may be that some of these schools have these artifacts but they say nothing about their operative power and upgrades. It maybe that ICT artifacts are mere measures of dysfunctional resources rather than their effective use in schools.

It is also recognizable that ICT effectiveness cannot be considered without the varied and differential student population as it may well affect school outcomes. Naturally, cultural and socio-economic contexts have a major role in the impact of ICT for learning and teaching and thus may continue to occur as the technology develops in the future, and their varied and differential use by target populations may well affect the outcomes produced. Thus, by not controlling for socio-economic factors on the performance of students is one important issue to consider for any future research in the measure of ICT.

Another important issue in this study is to recognize obstacles and constraints facing teachers. As outlined by Oberg and Gibson (1999) there are time limitations, pressure to cover the curriculum, lack of funds to purchase or upgrade hardware and/or software, and limited numbers of Internet connections that all public and private schools suffer from, added to that is the needed continuous and sustainable teacher training for new upgrades and use of technology. In conclusion, this study presented a formative evaluation in Lebanese public and private schools. Future research would consider a summative evaluation of ICT in schools, in addition to studying the differences of public and private school development of ICT over time (i.e., longitudinally).

One generalization that can be concluded from this study is that increasing the opportunities for the use of ICT and access might only increase the competence in the use of these technologies and further the possibilities of interaction and communication with the "global community."

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REFERENCES

Abouchedid, K. 1997. *Confessional Pluralism and Education: Themes from the Lebanese Experience*, PhD Dissertation, University of Manchester, England

Albirini, A. 2008. The Internet in developing countries: A medium of economic, cultural and political domination. *International Journal of Education and Development using ICT*. 4(1), available at: http://ijedict.dec.uwi.edu//viewarticle.php?id=360&layout=html

Al-Jaghoub, S. and Westrup, C. 2003. Jordan and ICT-led development: towards a competition state*?* *Information Technology & People*, Vol. 16, No. 1, pp. 93-110.

Atwell, P. 2001. Comment: The first and second digital divide. *Sociology of Education*, vol. 74, no. 3, pp. 252-259.

Banks, D., Cresswell, J., & Ainley, J. 2003. *Higher order learning and the use of ICT amongst Australian 15 year olds*. Paper presented at the International Congress of School Effectiveness and Improvement, Sydney.

Becker, H. 1984. Computers in schools today: Some basic considerations. *American Journal of Education*, vol. 93, no. 1, pp. 22-39.

Benson, D., Haney, W., Ore, T., Persell, C., Schulte, A., Steele, J., Winfield, I. 2002. Thinking sociologically about digital technology, teaching and learning: What we know and what we need to know. *Teaching Sociology*, vol. 30, pp.140-157.

Castells, M. 2000. *The rise of the network society, the Information Age: Economy, Society and Culture*, 2nd ed., Blackwell, London.

Center for Educational Research and Development 2007. *Primary statistics*, Beirut Lebanon.

Cooper, C. Alcorta, L. Bastos, M., Kumar, N. & Mitter, S. 1995. *Social and economic exclusion, new technologies and learning process. Advanced Technology Assessment in Information Technology for Development*. United Nation Conference on Trade and Development. New York & Geneva.

Cox, M. & Marshall, G. 2007. Effects of ICT: Do we know what we should know? *Educ InfTechnol*, Vol. 12, pp. 79-70.

Denzel, B., Haney, W., Ore, T., Persell, C., Schulte, A., Steele, J., & Winfield, I. 2002. Digital Technologies and the scholarship of teaching and learning in sociology. *Teaching Sociology,* vol. 30, no. 2, pp. 140-157.

Drori, G. & Jang, Y. 2003. The global digital divide: A sociological assessment of trends and causes. *Social Science Computer Review,* vol. 21, no. 2, pp. 144-161.

Ebbert, M. 2002. Das Internet spricht Englisch ... *und neuerdings auch Deutsch Sprachen und ihre Verbreitung im* World-Wide-WEB. Available at: http://www.netz-tipp.de/sprachen.html

Feenberg, A. 1991. *Critical Theory of Technology*, Oxford University Press, New York.

Fuchs, T. & Woessmann, L. 2004. *Computers and student learning: Bivariate and multivariate evidence on the availability and use of computers at home and school*. Munich: Center for Economic Studies.

Ghusayni, R. 2001. *Values and Education.* Beirut: Lebanese Association for Educational Studies.

Hasselbring, T. 1986. Research on the effectiveness of computer-based instruction*: A review. International Review of Education*, vol. 32, no. 3, pp. 313-324.

Hatch, T. 1998. The differences in theory that matter in the practice of school improvement. *American Educational Research Journal*, vol. 35, no. 1, pp. 1-31.

Hoffman, J. 1995. Implicit theories in policy discourse. *Policy Sciences*, vol.28, pp.127-148.

International Telecommunications Union (ITU) 2003. *World telecommunications development report: Access indicators for the information society*. Geneva: ITU.

Kleiner, A., and Farris, E. 2002. Internet Access in U.S. Public Schools and Classrooms: 1994–2002. *Education Statistics Quarterly*, vol. 5, no. 4, Available at http://nces.ed.gov/programs/quarterly/vol_5/5_4/2_2.asp

Kozma, R. and Wagner, D. 2005. *Core Indicators for Monitoring and Evaluation Studies in ICTs for Education. Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries.* Washington, DC: The International Bank for Reconstruction and Development: The World Ban, InfoDev.

Kulik 2003. *The effects of using instructional technology in elementary and secondary schools: What controlled evaluation studies say*. Menlo Park, CA: SRI International.

Kulik, J., Bangert, R. and Williamsn G. 1983. Effects of computer-based college teaching on secondary school students. *Journal of Educational Psychology*, 75(1), 19-26.

Liao, Y. 1999. Effects of hypermedia on students' achievement. *Journal of Educational Multimedia and Hypermedia,* vol. 8, no. 3, pp. 255-277.

Linden, L., Banerjee, A., & Duflo, E. 2003. *Computer-assisted learning: Evidence from a randomized experiment.* Cambridge, MA: Poverty Action Lab.

Looker, E. and Thiessen, V. 2003. Beyond the digital divide in Canadian schools. From access to competency in the use of information technology. *Social Science Computer Review,* vol. 21, no. 4, pp. 475-490.

Macleod, H. 2005. What role can educational multimedia play in narrowing the digital divide? *International Journal of Education and Development using Information Communication Technology*, vol. 1, no. 4, pp. 42-53.

Mansell, R. (2002). From Digital Divides to Digital Entitlements in Knowledge Societies. *Current Sociology*, 50(3), 407–426

Mansell, R. 2005. Social informatics and the political economy of communications, *Information Technology & People*, vol. 18, no. 1, pp. 21-25

McPhail, I. 1985. Computer inequalities in school uses of microcomputers: policy implications. *The Journal of Negro Education*, vol. 54, no. 1, pp. 3-13.

Martin, B. 2005. The information society and the digital divide: Some North South comparisons. *International Journal of Education and Development using Information and Communication Technology*, vol. 1, no. 4, pp. 3041.

Miller, A. 2001. Reaching across the divide: the challenges of using the Internet to bridge disparities in access to information, *First Monday*, vol. 6, no. 10. Available from: http://firstmonday.org/issues/issue6_10/miller/index.html

Murdock, G. 2002. Review article: Debating digital divides. *European Journal of Communication* vol. 17, no. 3, pp.385–390.

National Center for Educational Statistics (NCES) 2001a. *The nation's report card: Mathematics 2000.* Washington, D.C.: National Center for Educational Statistics.

National Center for Educational Statistics (NCES) 2001b. *The nation's report card: Science 2000.* Washington, D.C.: National Center for Educational Statistics.

Norris, P. 2001. Digital divide: *Civic engagement, information poverty, and the Internet Worldwide.* Cambridge: Cambridge University Press.

Oberg, D. & Gibson, S. 1999. What's happening with Internet use in Albertaschools? *Alberta Journal of Educational Research,* vol. 45, no. 3, pp. 239-252

Persell, C. & Cookson, P. 1987. Microcomputers and elite boarding schools: Educational innovations and social reproduction. *Sociology of Education,* vol. 60, no. 2, pp. 123-124.

Pisapia, J. (1994). *Technology: The equity issue.* Research Brief #14. Metropolitan Educational Research Consortium, Richmond, VA.

Press, L. 1996. The role of computer networks in development, *Communication of the ACM*, vol. 39, no. 2, pp. 23-30.

Ragosta, M., Holland, P. & Jamison, D. (1982). *Computer assisted instruction and compensatory education: The ETS/LAUSD study. The executive summary and policy implications.* Princeton, N.J.: Educational Testing Service.

Stone, D. 1989. Causal stories and the formation of policy agendas. *Political Science Quarterly*, vol. 104, pp. 281-300.

Shavelson, R., McDonnell, L., & Oakes, J. 1991a. What are educational indicators and indicator systems? *Practical Assessment, Research & Evaluation,* vol. 2, no. 11, Available at http://PAREonline.net/getvn.asp?v=2&n=11.

Shavelson, R., McDonnell, L., & Oakes, J. 1991b. Steps in designing an indicator system. *Practical Assessment, Research & Evaluation,* vol. 2, no. 12, Available at http://PAREonline.net/getvn.asp?v=2&n=12

Yaghi, H. 2005. *Experience with Integrating Information and Communication Technologies into Lebanese Public Schools.* I. Osta (Ed.), Education and Information Technology in the Arab Countries, pp. 411-434 Lebanese Association for Educational Studies, Beirut Lebanon. [In Arabic]

Wagner, D. 2005. *Monitoring and evaluation of ICT for education: An introduction. Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries.* Washington, DC: The International Bank for Reconstruction and Development: The World Bank, InfoDev.

Walsham, G. and Sahay, S. 2006. Research on information systems in developing countries: current landscape and future prospects. *Information Technology for Development*, vol. 12, no. 1, pp. 7-24.

Watson, D. M. (Ed.) 1993. *Impact — An evaluation of the impact of the information technology on children's achievements in primary and secondary schools.* King's College London.

Welginsky, H. 1998. Does it compute? *The relationship between educational technology and student achievement in mathematics.* Princeton, NJ: Policy Information Center of the Educational Testing Service.