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In this issue:

Information and Communication Technology Literacy Issues in Higher Education

Li-Jen Shannon
Sam Houston State University
Huntsville, TX 77341 USA

Abstract: This paper presents a comparative quantitative study to analyze how prepared the Millennial Generation (MG) of university students is for their information and communication technology (ICT) literacy levels regarding specific skill areas at one of state supported universities in Texas. The MG is defined to be those people who were born after 1980. To measure technological preparedness, a self-report questionnaire was distributed before and after the MG completed the introductory computer courses. The questionnaire included the college students' demographic information, their prior experience with computers, and their ICT literacy levels. The significance of this study was a result of the recent legislation influencing Texas universities to cut introductory computer courses. This study revealed that there was a significant difference within ethnicity and gender's ICT literacy levels. Furthermore, by analyzing the MGs' perceptions of their ICT literacy levels, the results provided valuable information regarding how to address the needs of the MG students and how to best design the curriculum and instruction in higher education in order to prepare the MG for a technology-driven world.

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Information and Communication Technology Literacy Issues in Higher Education

Li-Jen Shannon
lys001@shsu.edu
Computer Science Department
Sam Houston State University
Huntsville, Texas 77341, USA

ABSTRACT

This paper presents a comparative quantitative study to analyze how prepared the Millennial Generation (MG) of university students is for their information and communication technology (ICT) literacy levels regarding specific skill areas at one of state supported universities in Texas. The MG is defined to be those people who were born after 1980. To measure technological preparedness, a self-report questionnaire was distributed before and after the MG completed the introductory computer courses. The questionnaire included the college students' demographic information, their prior experience with computers, and their ICT literacy levels. The significance of this study was a result of the recent legislation influencing Texas universities to cut introductory computer courses. This study revealed that there was a significant difference within ethnicity and gender's ICT literacy levels. Furthermore, by analyzing the MGs' perceptions of their ICT literacy levels, the results provided valuable information regarding how to address the needs of the MG students and how to best design the curriculum and instruction in higher education in order to prepare the MG for a technology-driven world.

Keywords: accreditation issues, Millennial Generation, Information and Computer Technology, higher education, Computer Literacy Education, technology changes

1. INTRODUCTION

A Texas public university recently held Town-Hall meetings to invite faculty input about the 120-Hours Rule from the Southern Association of College and Schools (SACS) (SACS, 2007). Attendees learned one Texas state university might remove the introductory computer course from its core curriculum. "This is a research-based university! We don't want to see it transforming to a vocational/technical college," said one of the attending professors. He used assertive body language to support his adamant position. One of the other attending professors responded, "It's not about vocational or technical, it's about the students' research and communication skills through technology!"

Federal Requirement 4.2 states that "The institution maintains a curriculum that is directly related and appropriate to its purpose and goals and to diplomas, certificates, or degrees awarded (SACS, 2007)". SACS requires that a baccalaureate degree should be the minimum of 120 hours. Many universities across several states reduced their required baccalaureate credit hours to meet this 120-Hours Rule since 2002. As a result, from a list of 34 public Texas universities which offer approved Educator Preparation Programs in Texas, 23 out of 34 universities do not require the introductory computer course as a core course from 2006 – 2008 academic years. Eleven out of 34 universities still require the introductory computer course as one of the core courses. Three out of 34 universities include the introductory computer course as one of the core elective courses (Shannon, 2007).

In Texas, the Texas Higher Education Coordinating Board (THECB) is dedicated to helping Texas meet the goals of the state's higher education plan (THECB, 2007). The project "Closing the Gaps by 2015" was designed to cultivate a bright future of eco-

nomic vitality, social independence, and civic engagement for the citizens of Texas. The project's first strategy made the recommended high school program (college-preparatory courses) become the standard curriculum in Texas public high schools and also made it a minimum requirement for admission to Texas public universities by 2008.

Toward the stated goal but approached with a different strategy, the 79th Texas legislature said the "Time-To-Degree" issue should consider "incentives to encourage institutions to structure offerings so that students can take the classes they need" (THECB, 2007). As the fall 2008 deadline approaches, several Texas public universities are evaluating this issue and resolving this curriculum conflict: what classes are vital for the students to take?

Many professors question the purpose of the 120-Hours Rule and debate whether to trim the existing academic programs. The focus meanders, touching also on the efficiency of introductory computer courses. Complicating resolution, the general population and many faculty members perceive the new generation as a computer wizard generation. In reality, the typical college student encounters difficulty in their academic work due to the assumption of high computer competency from the public and faculty (Sanchez, 2003). True, this new generation is familiar with surfing the web, chatting by instant messages, sharing web logs, and playing computer games, but they may not be developing the technological skills necessary for educational, vocational, and civic success in the 21st century (Kelly & Haber, 2006). Assumptions about skills that all students have may place some groups of students at risk. Consequently, students in baccalaureate programs often failed to maintain an acceptable mastery level on the identified computer technology competencies (Udobong, 2001).

In the past decade, there were only a few studies conducted with the students' technology assessment to determine whether the introductory computer courses met students' needs or not. In 1999, Georgetown College established the Information Technology Literacy Program which assessed technology skills of students in 16 states, such as Alabama, Florida, New York, and Pennsylvania. Results indicated that the initial information and technology proficiency (ICT) passing rate was less than 50% (Rafaill & Peach, 2001). Hardy (2005) conducted a study of Midwest students' technology skills (Hardy, 2005). The findings indicated that the majority of students did not demonstrate mastery or proficiency on the overall computer/literacy skills assessment. The results also indicated that there was no significant difference in students' knowledge of computer concepts when compared with the students' home state, number of high school courses taken, gender, or major field of study.

The purpose of this study was to study the Millennial Generation's ICT literacy levels before and after they take the introductory computer course from the selected university in Texas. Furthermore, the differences of ICT literacy levels regarding to ethnicity and gender were also studied. The following questions arose around the students' ICT literacy levels:

1. What is the competency (ICT literacy) of students who do not take an introductory computer course?
2. To what degree does the introductory computer course improve the college students' ICT literacy levels?
3. Is there a need to designate the introductory computer course as a developmental course as is done in English and Mathematics?

2. METHODOLOGY

To study the MG university students' computer use and skills, one state university in Texas was selected to analyze their ICT literacy levels. The selected university is situated in the southeastern rural area of its country. The university funding system is based on governmental budgets and research funds. The university's mission is for engaging the students in the work of life itself and instilling in the students professional expertise, humanistic concerns, and scientific competence. This university offers the academic programs of art and science, business administration, education, and humanities and social sciences. Master and doctoral programs are offered.

The total student enrollment in the spring semester, 2006 was 14,411 from the selected university. There were 815 students enrolled in the introductory computer courses from the selected university. A self-report questionnaire was distributed twice to the students who are members of the MG and who were enrolled in an introductory computer course from the selected university. The members of the MG are considered to be those born after 1980 (Carlson, 2005; Howe & Strauss, 2003; Lowery, 2001; Sanchez, 2003; Taylor, 2005).

657 questionnaires were collected at the beginning of the semester and 622 were valid surveys which were 76.3 percent of the purposeful sample. At the end of the semester, after having completed their introductory computer course, 441 self-report questionnaires were collected and 439 were valid surveys which were 53.9 percent of the purposeful sample.

Cohen (1988) stated that the larger the sample size, the smaller the error and the greater the reliability or precision of the results. Based on a statistical power of .7 (*N*) with *t*-tests at an alpha level of .05, and a small effect size, a sample consisting of a minimum of 620 individuals was needed (Gall, Gall, & Borg, 2003). Moreover, a Microsoft Office 2003 Excel worksheet was utilized for the stratifying process. By using the filter function of Excel, the odd numbers of over sampling were randomly deleted in both gender and ethnicity groups until the total sample were reduced to 400 for each instrument. Also, to maximize the precision of various comparisons, equal sample sizes were employed to obtain accurate results (Netter & Wasserman, 1974). The number of participants in this study was 800 which included two sets of 400 students who were members of the MG and were enrolled in an introductory computer course from the selected state university in Texas in the Spring of 2006.

To discover differences, relationships, and effects within the selected university sample, the statistical power analysis was utilized for studying the likelihood of the MG's ICT literacy levels between the sub-population groups. The Statistical Package for the Social Sciences (SPSS) version 15.0 was utilized to analyze the independent and dependent variances. Quantitative data were collected and analyzed by means of Independent-Sample *t* test, *F* ratio, ANOVA with Post Hoc, MANOVA, and Discriminant Analysis.

Instrumentation

This quantitative research method was designed to collect data from the MG computer users. The self-report questionnaire addressed the following areas; (a) the MG's demographic information and prior experiences with computers, and (b) the MG's ICT literacy levels of knowledge in specific skill areas.

To investigate the MG's background information, the questionnaire collected information regarding demographics and experiences with computers. The demographic information included:

(a) year of birth,

(b) student classification,

(c) college major,

(d) gender, and

(e) ethnicity

Questions regarding computer experience included:

(a) experiences with multimedia classroom environments,

(b) communication methods preference,

(c) hours working with computers for coursework,

(d) grade point average in coursework, and

(e) ownership of digital devices.

To evaluate the MG's ICT literacy levels of knowledge in specific skill areas, the questionnaire was constructed using a Likert scale of 1 to 5 which measures the skill areas from "No Knowledge", "Basic", "Average", "Advanced", to the "Expert" level. Overall, there were 55 survey items included for the 13 specific skill areas. The 13 skill areas included:

(a) computer hardware including hardware components, *CPU* process, input and output devices, and memory;

(b) computer software including network, *BIOS* boot process, and operating concept;

(c) file management including explorer, organization, desktop, and screen shots;

(d) *Microsoft Word* including alignment, font, format, page setup, insert, WordArt, and web page;

(e) *Microsoft Excel* including formula, chart, fill handle, function, merge cell, and organization;

(f) *Microsoft Access* including database design, calculation, sort, link, query, report, and import data;

(g) *Microsoft PowerPoint* including design, bullet, border, table, slide master, import data, slide view, and animation;

(h) web design including *Microsoft FrontPage*, html, and link;

(i) internet browsers including browsers, search engines, and save data;

(j) email including attachments, global e-mails, and save emails;

(k) *CD* burners including data, and music file;

(l) file transfer applications including *FTP*, and *WinZip* applications; and

(m) multimedia editing software including web design, audio, movie, and graphic software.

Reliability

Utilizing the self-report measure, this study provided an analysis of the MG's ICT literacy levels before the MGs complete their introductory computer literacy course, "A self-report measure is a paper-and-pencil instrument whose items yield numerical scores from which inferences can be made about how individuals differ on various aspects of self" (Gall, Gall, and Borg, 2003, p. 189). An analysis of variance was used to analyze the data in order to assess the effect of each measurement error source and their interactions. Also, to ensure the internal consistency, the Cronbach's alpha test was utilized to determine the degree of coefficient level for each individual item.

Validity

In designing the instrument for this study, I relied on both my own knowledge and experience in technology and computer science and those of experts in the field. To enhance the validity of this study, the self-report questionnaire was reviewed and edited by colleagues and chair-persons in the Department of Computer Science as well as the Director of Educational Leadership and Counseling. The computer science colleagues and the department chair of computer science worked closely to provide guidelines of teaching objectives for the introductory computer literacy courses. Merging the guidelines with the context of ICT from the literature reviews, the instrument content might be able to provide a deeper view from the individuals.

Data Collection

At the beginning and the end of spring semester, 2006, the students were informed of the human subject protection, following after; they voluntarily completed a hard copy form of instrument. The faculty of the Computer Science Department from the university in Texas distributed and collected the questionnaires.

Data Analysis

In the subsequent sections, the Statistical Package for the Social Sciences (SPSS) version 15.0 was utilized to analyze this study. Data were reviewed with the normality tests to determine whether this sample data were normal or not. Following after, the variance of each variable was investigated to review the stableness at all levels of the variances. For interval data and independence assumption, the categories and specific skill areas were measured with multivariate analysis of variance (MANOVA). Analysis of variance (ANOVA) and independent *t* test were applied to confirm the findings. The critical value of *F* ratio was also reviewed to determine the difference between the variances.

The correlations between the variances were tested at an alpha level of .05. To ensure internal consistency, the effect size (ES) was determined to the following standards. The ES can be measured as the standardized difference between two means (Cohen, 1988). Or the ES can be measured as the correlation between the independent variable classification and the individual scores on the dependent variable (Rosenthal & Rosnow, 2000). To prevent the future difficulties from occurring, the effect size measures for two independent groups and in

analysis of dependent variances were analyzed as well.

3. FINDINGS

Research Question 1

What is the competency (ICT literacy) of students who do not take an introductory computer course?

A *t* test was applied to compare 55 dependent variables of ICT literacy levels by subcategories with the scale of 2.7 which was determined to prevent Type I and Type II statistical errors based on a 1 to 5 scale (from "No Knowledge" to "Expert" level). The MG's ICT literacy mean level at the selected state university in Texas indicated a statistically significant difference from the expected average of 2.7 before taking an introductory computer course. The responses from the pre-self-reports indicated that most of the participants evaluated themselves at high levels on the following five items: (a) *File Management*, (b) *Word;* (c) *Internet Brower*; (d) *Email*; and (e) *CD Burners*. The participants rated themselves at high levels might because these five items were the most common types of programs the MGs used in their digital life environments. Based on the responses regarding computer experience, the findings indicated a positive correlation between the ownership of digital devices and the ICT literacy levels. In addition, most of the MGs were new graduates from high schools in which they had experiences working on these programs. Furthermore, the MGs were familiar with browsing the *Internet*, sending emails, and downloading multimedia (Carbonara, 2005; Carlson, 2005; Hardy, 2005; Howe & Strauss, 2003; Kelly & Haber, 2006; Lowery, 2001; Messineo & DeOllos, 2005; Oblinger, 2003; Sanchez, 2003; Taylor, 2005; Udobong, 2001).

The findings for the remaining eight ICT items, which were needed to support academic performance, revealed that the average MGs' ICT literacy levels were below the expected levels. The lowest four scores of ICT literacy levels, for example, *Microsoft Excel, Microsoft Access, Web Design,* and *File Transfer Applications* reflected that most of the participants had low technologically competent skills in math, database, and computer programming (Messineo & DeOllos, 2005). Knowing how to use these programs was important because many of our technical and scientific courses (and jobs) depended on the use of spreadsheets like *Excel.* In addition, the lack of proficiency in the applications of *Access,* a database program, might explain why many of our higher education students had difficulty accessing research from the databases in the library (Banwell, Ray, & Coulson, 2004; Crouse & Kasbohm, 2004; Kenney, 2006; Schroeder, 2007;). The general public believes that the MGs are skillful in creating their web sites, and downloading and uploading files through the *Internet*. In fact, most of the MGs still need assistance in creating web sites and loading files through file transfer applications. The skills they learned by using *Facebook, mySpace, iPods, instant messaging,* or *text messaging*, did not actually apply to their academic related subjects. Most of the MGs' web design skills were very low when compared to the other ICT competency levels.

Research Question 2

To what degree does the introductory computer course improve the college students' ICT literacy levels?

By using an Independent – Sample *t* test, the mean ICT scores between pre- and post-self-reports were shown in Table 1. All 13 ICT items had a statistically significant difference which indicated the post-self-report mean scores were greater than the pre-self-report scores ($df = 798$, $p < .01$).

The most improved group of ICT items included: (a) *Excel,* (b) *Access*, and (c) *PowerPoint* which indicated that the introductory computer courses could enhance the MGs' capability in working with mathematics, databases, and presentations (Bulion, 2007; Goldston & Bland, 2002; Kenney, 2006; Merrill & Comerford, 2004) The second most improved group of ICT items included: (a) *File Transfer Applications* and (b) *Multimedia Editing Software* which indicated the MGs had improved their skills in using file transfer protocol software, WinZip applications, and the editing software in web design, audio, movie, and graphic programs.

Research Question 3

Is there a need to designate the introductory computer course as a developmental course as is done in English and Mathematics?

The results indicated that introductory computer courses did improve the MG's ICT literacy levels. There was a significant gender difference in ICT literacy levels before the introductory computer course was taken. After taking the course, females still had lower ICT literacy levels than males but not at a significant level. The ICT literacy levels for the pre- and post-self-reports indicated that males had higher ICT literacy levels than females. Comparison of the pre- and post-self-reports for females indicated significant increases in all ICT items. The results also indicated the MGs had improved their skills in using file transfer protocol software, WinZip applications, and the editing software in web design, audio, movie, and graphic programs.

The results also indicated that the two most improved ethnic groups were African-Americans and Hispanics according to the rankings of the ICT literacy levels (see Appendices, Figure 1 & 2).

The White/Non-Hispanic group (72.3%) of the total samples, revealed statistically significant improvements in ICT literacy levels after they completed the introductory computer courses.

The introductory computer courses did provide a fair ground for disadvantaged sub-populations for accessing digital life environments.

4. SIGNIFICANCE OF STUDY

Since the Texas public higher education institutions are working toward *Closing the Gaps by 2015* in Texas in order to direct the future of higher education, the findings of my study have implications for the following areas:

(a) Reducing the gaps in technological areas within sub-populations;

(b) Helping the institutions in designing curricula;

(c) Supporting the needs of introductory computer courses in the vulnerable institutions;

(d) Preparing technologically competent students;

(e) and allocating the budget for technology.

By offering the opportunity for the MGs to upgrade their competency in technology, higher education institutions can meet the needs of students in such a way as to cultivate their skills and build their confidence in technology while preparing them for the fast-changing digital life environments they will face in the future.

The results show a consistent and positive correlation among the MGs' ICT literacy levels regarding to ethnicity and gender. To further study the impact of introductory computer courses, a future study may be considered evaluating the students with a research-based ICT test program to measure their ICT literacy levels for placement in courses and designing or modifying curriculum.

Further research might analyze the relationship of: (a) classification (undergraduate and graduate students); (b) college major; (c) grade point average; (d) American College Test (ACT) / Scholastic Aptitude Tests (SAT); (e) prior experience with technology; (f) years after graduated from high school; and (g) ownership of digital devices on ICT literacy levels and comfort levels with DLE. To widen the study, the population of future studies could also include the following categories: (a) traditional; (b) non-traditional; (c) part time; (d) full time; (e) national; and (f) international students. Moreover, the population of staff and faculty from the educational institutions may also need to be included into the future studies. With a fast-growing population of students participating in exchange programs and scholarships to travel abroad, and with the increase of faculty from other countries, further research could identify or determine challenges and benefits in technology programs, both nationally and internationally.

5. CONCLUSION

This study revealed that there was a significant difference within ethnicity and gender's ICT literacy levels before and after the MG completed the introductory computer courses. By analyzing the MGs' perceptions of their ICT literacy levels, the results provided valuable information with regard to

close the technological gaps in the selected Texas public university. The results indicated that the MG students' ICT literacy levels were not as competency as the public perceived. After the MG students completed the introductory computer courses, there was a significantly increased ICT literacy levels for all of the study items. This study leads to the direction of how to best design the curriculum and instruction in higher education in order to prepare the MG for a technology-driven world.

It was found that the MGs faced a challenge in transferring their technology skills to the workforce because it was assumed that MGs were all computer literate as found by Carbonara (2005): "The use of computers has become so prevalent that many managers assume they have a technologically literate workforce" (p. 107). Base on the results revealed in this study, universities need to examine the factors affecting knowledge acquisition, retention and application to sustain a competitive advantage. In fact, it becomes imperative to help higher education institutions to meet the national goals of closing the academic achievement gaps since there is little agreement on the following areas: (a) the need for improved technology skills in one gender over another; (b) the performance of sub-populations within the MG addressing the needs of these students; and (c) technology usage and competence improves students' academic achievement (Owens & Waxman, 1998; Udobong, 2001).

To reach the goals of *Closing the Gaps by 2015* in Texas, public higher education institutions currently have the resources to find the balance between the relationships of the students' ICT literacy levels, and their expectation for the curricula designs, if they act in a timely manner. Studies supporting the need for introductory computer courses in higher education should be a "wake up call" for universities.

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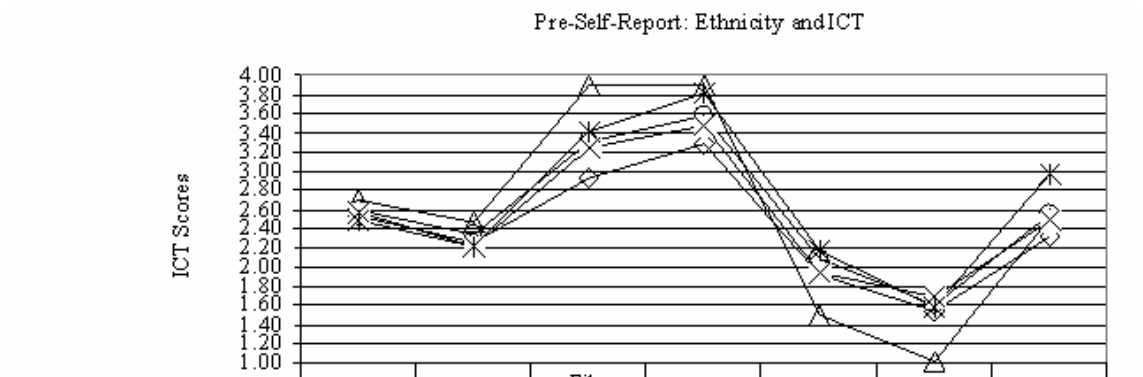
APPENDICES

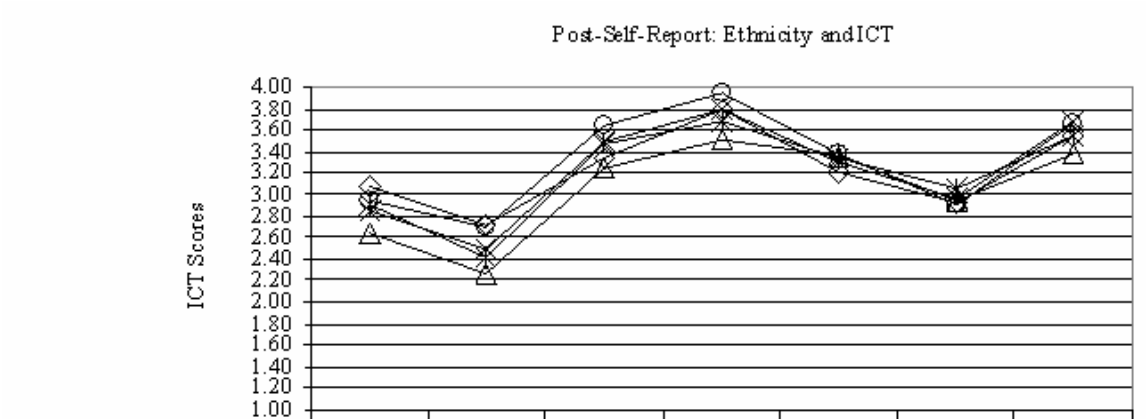
Table 1. *Independent-Sample t Tests: Pre- and post-self-reports in ICT Literacy Levels*

	Mean Score		Independent-Sample *t* Tests		
ICT Literacy Levels	Pre-	Post-	*df*	*t*	*Mean Diff.*
Hardware	2.586	2.953	798	-6.487 **	-.366
Software	2.315	2.669	798	-6.241 **	-.354
File Management	3.257	3.582	798	-5.292 **	-.325
Word	3.530	3.890	798	-5.987 **	-.360
Excel	2.052	3.350	798	-21.705 **	-1.298
Access	1.604	2.916	798	-21.212 **	-1.311
PowerPoint	2.524	3.645	798	-18.246 **	-1.121
Web Design	3.486	3.793	798	-4.644 **	-.307
Email	3.263	3.633	798	-5.224 **	-.371
CD Burners	3.278	3.556	798	-3.469 **	-.279
File Transfer Application	2.178	2.788	798	-8.470 **	-.610
Multimedia Editing Software	1.993	2.634	798	-8.899 **	-.641

Note. $*p < .05$, $**p < .01$.

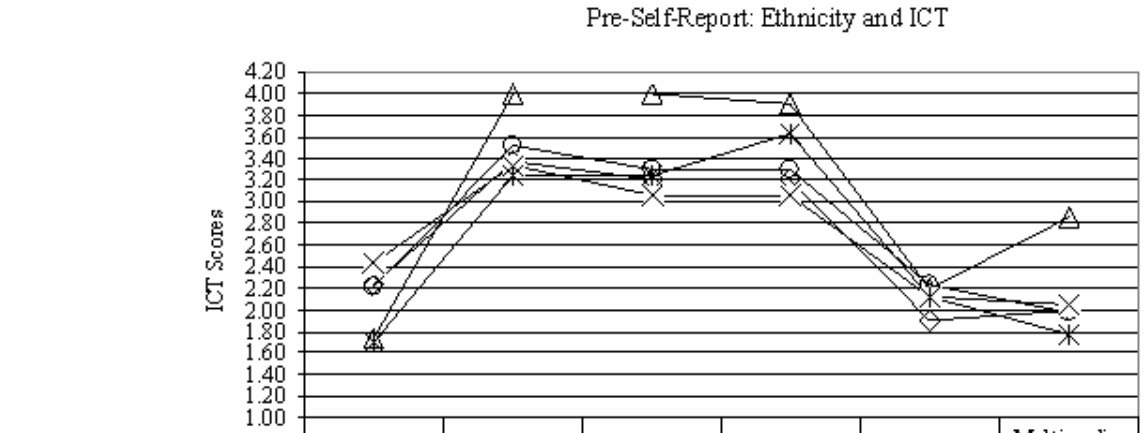


	Hardware	Software	File Manage-ment	Word	Excel	Access	Power-Point
African American	2.532	2.253	2.926	3.286	1.917	1.553	2.328
Asian	2.700	2.466	3.900	3.886	1.500	1.030	2.512
White/Non-Hispanic	2.599	2.342	3.305	3.570	2.101	1.613	2.552
Hispanic	2.574	2.220	3.250	3.471	1.936	1.682	2.500
Other	2.500	2.208	3.406	3.804	2.168	1.590	2.981

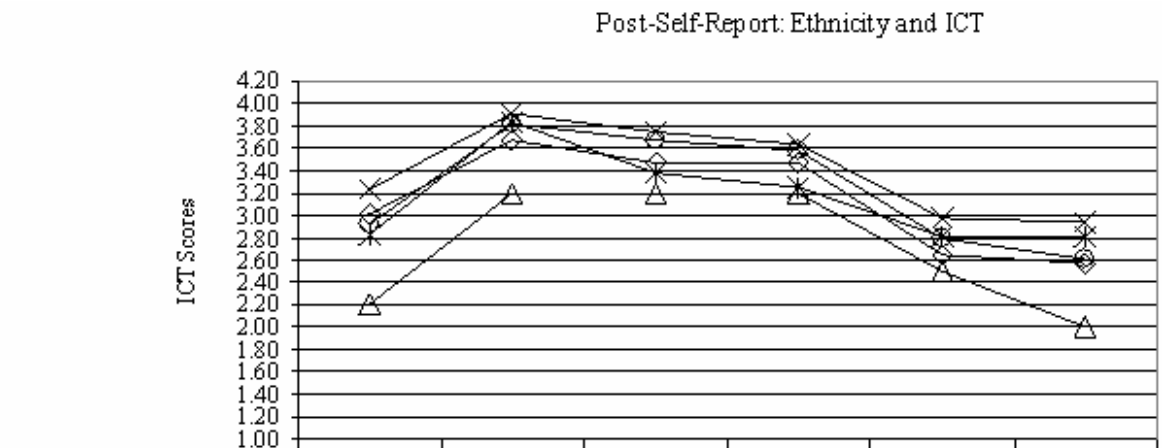


	Hardware	Software	File Manage-ment	Word	Excel	Access	Power-Point
African American	3.069	2.710	3.343	3.785	3.201	2.918	3.545
Asian	2.650	2.268	3.250	3.514	3.366	2.942	3.374
White/Non-Hispanic	2.952	2.701	3.649	3.936	3.385	2.904	3.667
Hispanic	2.852	2.499	3.494	3.799	3.307	2.961	3.672
Other	2.906	2.416	3.469	3.678	3.333	3.054	3.554

Figure 1. Comparative Results between Pre- and post-self-report in Ethnicity and ICT Literacy Levels (I)



	Web Design	Internet Browser	Email	CD Burners	File Transfer Application	Multimedia Editing Software
African American	2.234	3.377	3.204	3.204	1.898	2.000
Asian	1.734	4.000	4.000	3.900	2.200	2.850
White/Non-Hispanic	2.214	3.527	3.292	3.303	2.239	1.975
Hispanic	2.439	3.334	3.061	3.068	2.125	2.046
Other	1.708	3.250	3.250	3.625	2.125	1.781



	Web Design	Internet Browser	Email	CD Burners	File Transfer Application	Multimedia Editing Software
African American	3.019	3.661	3.469	3.472	2.639	2.579
Asian	2.200	3.200	3.200	3.200	2.500	2.000
White/Non-Hispanic	2.911	3.809	3.661	3.574	2.791	2.604
Hispanic	3.234	3.909	3.750	3.636	2.977	2.938
Other	2.834	3.835	3.375	3.250	2.813	2.813

Figure 2. Comparative Results between Pre- and post-self-report: Ethnicity and ICT Literacy Levels (II)