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ADDRESSING INFORMATION LITERACY AND THE DIGITAL DIVIDE IN HIGHER EDUCATION

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ABSTRACT

Aim/Purpose — The digital divide and educational inequalities remain a significant societal problem in the United States, and elsewhere, impacting low income, first-generation, and minority learners. Accordingly, institutions of higher education are challenged to meet the needs of students with varying levels of technological readiness with deficiencies in information and digital literacy shown to be a hindrance to student success. This paper documents the efforts of a mid-Atlantic minority-serving institution as it seeks to assess, and address, the digital and information literacy skills of underserved students

Background — A number of years ago, a historically Black university in Maryland developed an institutional commitment to the digital and information literacy of their students. These efforts have included adoption of an international certification exam used as a placement test for incoming freshmen; creation of a Center for Student Technology Certification and Training; course redesign, pre and post testing in computer applications courses; and a student perception survey.

Methodology — A multi-methodological approach was applied in this study which relied on survey results, pre and post testing of students enrolled in introductory and intermediate computer applications courses, and scores from five years of placement testing. Student pre and post test scores were compared in order to examine degree of change, and post test scores were also assessed against five years of scores from the same test used as a placement for incoming freshmen. Finally, a

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	student perception and satisfaction survey was administered to all students enrolled in the courses under consideration. The survey included a combination of dichotomous, Likert-scaled, and ranking questions and was administered electronically. The data was subsequently exported to Microsoft Excel and SPSS where descriptive statistical analyses were conducted.
Contribution	This study provides research on a population (first-generation minority college students) that is expanding in numbers in higher education and that the literature reports as being under-prepared for academic success. Unfortunately, there is a paucity of current studies examining the information and technological readiness of students specifically enrolled at minority serving institutions. As such, this paper is timely and relevant and helps to extend our discourse on the digital divide and technological readiness as it impacts higher education. The students included in this study are representative of those enrolled in Historically Black Colleges or Universities (HBCUs) in the United States, giving this paper broad implications across the country. Internationally, most countries have populations of first-generation college students from under-served populations for whom a lack of digital readiness is an also an issue therefore giving this study a global relevance.
Findings	The digital divide is a serious concern for higher education, especially as schools seek to increasingly reach out to underserved populations. In particular, the results of this study show that students attending a minority serving institution do not come to college with the technology skills needed for academic success. Pre and post testing of students, as well as responses to survey questions, have proven the efficacy of computer applications courses at building the technology skills of students. These courses are viewed overwhelmingly positive by students with respondents reporting that they are a necessary part of the college experience that benefits them academically and professionally. Use of an online simulated learning and assessment system with immediate automated feedback and remediation was also found to be particularly effective at building the computer and information literacy skills of students. The total sample size for this study was over 2,800 individuals as data from 2690 IC^3 tests administered over a five year period were considered, as well as 160 completed surveys, and pre and post testing of 103 students.
Recommendations for Practitioners	Institutions of higher education should invest in a thorough examination of the information and technology literacy skills, needs, and perceptions of students both coming into the institution as well as following course completion.
Recommendation for Researchers	This research should be expanded to more minority serving institutions across the United States as well as abroad. This particular research protocol is easily replicated and can be duplicated at both minority and majority serving institutions enabling greater comparisons across groups.
Impact on Society	The results of this research help to shed light on a problem that desperately needs to be addressed by institutions of higher education, which is the realities of the digital divide and the under preparedness of entering college students in particular those who are from low income, first generation, and minority groups
Future Research	A detailed quantitative survey study is being conducted that seeks to examine the technology uses, backgrounds, needs, interests, career goals, and professional expectations with respect to a range of currently relevant technologies.

Keywords digital divide, information literacy, first generation college students, technology readiness, HBCU, minority learners, technology assessment, digital literacy, under prepared students, IC3, computer skills, computer concepts course, computer education, generation z, computer skills assessment, UMES, University of Maryland Eastern Shore, SAM, Cengage, skills assessment management, Certiport, technological competency

INTRODUCTION

Institutions of higher education are challenged to meet the needs of students with varying levels of technological readiness with technology skill deficiencies shown to be a hindrance to student success. First generation college students, and minority learners, are even more likely to be on the negative end of the digital divide. More specifically, when the perceptions and experiences of freshmen attending Historically Black Universities has been examined, not only is technology access and ownership found to be less prevalent than what has been reported out of majority institutions, but HBCU freshmen are found to be less prepared to use the internet, core computer applications, and digital library/scholarly resources for academic pursuits (Buzzetto-Hollywood, 2017). This paper reports the results of a study that examined the technological readiness of students attending a Mid-Atlantic minority serving university, the efficacy of computer software applications courses, and the usefulness of a simulated learning and assessment system in building the computer and information literacy skills of students. A multi-methodological approach was applied which relied on survey results, pre and post testing, and scores from five years of placement testing.

Founded in 1886, the University of Maryland Eastern Shore (UMES) is a Historically Black, 1890 land grant institution. It is a member of the University system of the State of Maryland and primarily serves first generation, low income, and minority learners. The student population is approximately 3400, as of the fall of 2016, with a student body that is approximately 78% African-American, 9.6% white, 1.4% Hispanic, and 11% international, primarily coming from the continent of Africa and/or from the Caribbean region. The gender distribution of the University is 64% female and 36% male. The freshmen-to-sophomore retention rate is 71%, and the graduation rate is 41%. The student to faculty ratio is 15 to 1 and 85% of students receive financial aid. Situated in the historic town of Princess Anne, UMES has a 1100 acre rural campus and is located on the far south eastern corner the State. Uniquely situated, it is the only research and doctoral degree granting institution of the University System of Maryland on the Eastern Shore of Maryland and its programs in Construction Management Technology, Aviation Sciences, and Hospitality and Tourism Management are unique to both the state and the region. UMES was ranked in the top 25 among Historically Black Colleges and Universities (HBCU) in 2014 (University of Maryland Eastern Shore, 2014) and the acceptance rate for applying students was 62.4% with the majority of students coming from the Mid-Atlantic region, more specifically the Baltimore and Washington D.C. urban centers.

The University of Maryland Eastern Shore, like all other U.S. institutions, has a required general education curriculum designed to build a comprehensive core educational base upon which a student's major concentration is constructed. According to the Middle States Association of Colleges and Schools, the competencies identified in the Middle States' Characteristics of Excellence Standard 12, General Education are written and oral communications, scientific and quantitative reasoning, critical analysis and reasoning, technological competency, and information literacy. The same five competencies are also required by the Maryland Higher Education Commission in order to meet the Student Learning Outcome and Assessment Report standards.

In terms of technological competency, the overarching desired student learning goal is that students be able to use technology in the analysis and communication of ideas and in the management, organization, and examination of information. Specific Student Learning Outcomes are that students able to:

- describe essential components of a computer system;
- define and identify the basic components of a database;
- identify and define basic internet terminology and activities;
- demonstrate the ability to create and edit documents, author reports and newsletters, prepare mailings, create templates, merge documents, prepare brochures and posters, and create tables and charts;
- demonstrate their knowledge and skills to create and edit spreadsheets, conduct calculations, and create and print graphs;
- use an email program to organize, compose, edit, and send messages;
- use presentation software for the delivery of professional presentations, the preparation of slide shows, and the development of web-enabled video files; and
- use a variety of search services to locate and evaluate resources.

A survey of UMES entering freshmen in 2009 found that, with respect to their prior and current use of digital technologies, most students self-reported that they were strong in the use of Email, the World Wide Web, and basic use of Microsoft Word. Less experience, however, was found when other key applications used to develop spreadsheets, create databases, prepare presentations, and develop newsletters, brochures, reference lists, and mailings were considered. In 2010, in response to the survey findings as well as feedback from faculty involved with the teaching and coordination of the computer concepts courses, a committee was formed and the technological and information literacy learning goals of the University were reexamined. It was decided that a significant population of freshmen may be adept users of social technologies yet lack the foundational digital skills to effectively perform basic academic tasks essential for success in college. As such, they fall behind simply because they aren't able to access, process, utilize, and exchange information at the speed of their peers. A detailed review of available options was considered and it was decided that an instrument designed to provide external professional validity for meeting digital literacy would be adopted and used as a placement test for freshmen. Several options were considered and the IC³ examination was selected.

The IC³ is the abbreviation and registered trademark of the "Internet and Computing Core Certification." The IC³ is a global certification program that is designed to certify an individual's digital literacy skills. IC³ is the first computer certification to be recognized by the National Skill Standards Board (NSSB) (Certiport, 2016). Since 2011, at UMES all freshmen students are required to take IC³ exam. Each IC³ examination consists of multiple choice, matching, and "hands on" performance-based questions. The exam is comprised of three major coverage areas: computer fundamentals, key applications, and living online (see Figure 1.)

The IC³ Fast Track has no established passing score; rather this decision is left to the discretion of the adopting institutions. The test is based on a combined score of 1000 points generated through completion of three sections. The passing score for UMES was established by the Office of the Vice President of Academic Affairs at the time of adoption and was set at 500 out of 1000. As of the fall of 2016, 2690 IC³ Fast Track examinations had been administered to students.

The IC³ is used to assess students' technological readiness, identify student weaknesses, and provide remediation services through use of the Internet and Computing Mentor remediation system. The tutoring functionality of the Internet and Computing Mentor enhances the digital learning experience for users by offering multiple levels of assistance. If a question is answered incorrectly, the system will graphically guide them in finding the correct answer. In addition, study guides enable prescriptive/just-in-time learning. Finally, the Mentor's reporting capabilities allow users to assess current status of skill sets, required remediation, skills progression, and testing readiness.

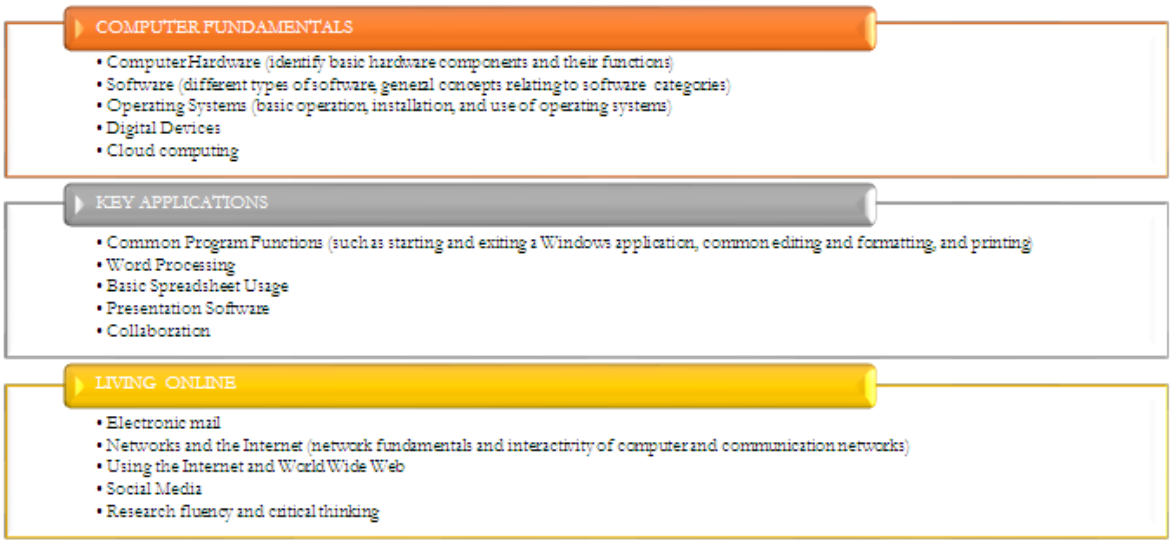

Figure 1: IC3 Exam Sections

In addition to use of the IC³, computer concepts and applications courses offered by the University were redesigned and a Center for Student Technology Competency and Certification (CSTCC) was created, which delivers Microsoft Adobe and Comptia Certifications, runs technology workshops, administers IC³ testing, provides remediation services, avails technical assistance and a staffed lab space, and supports students registered in core computing courses including providing assistance with e-portfolios and the SAM simulated learning and assessment system.

Students receiving a passing score on their first attempt have been encouraged to continue forward throughout their degree program and to take whatever technology course is required for their program (usually BUED 212: Computer Concepts). Particularly, high scoring students are encouraged to take the more advanced BUAD 213: Business Software Applications as well as to attend voluntary Microsoft Office Specialist training sessions in order to earn professional certification. Students who do not pass on their first attempt have been able to attend review sessions and utilize the Internet and Computing Mentor in order to enhance and build their skills as well as prepare for, and take, retests. For students, who either fail to return for retesting or who do not pass after two attempts, no specific additional program has been introduced; however, they are urged by representatives of the UMES CSTCC to attend additional trainings and enroll in BUED 212: Computer Concepts without hesitation. It is important to note, that student participation in remediation and/or training sessions is completely voluntary.

The two courses that were redesigned as part of this initiative include BUED 212: Computer Concepts (an introductory general education course required by most majors at the University, and therefore taken by the majority of all students) and BUAD 213. BUAD 213: Business Software Applications is an intermediate level course. BUAD 213 is required for business and STEM majors. While, some students elect to take both BUED 212 and BUAD 213; the 212 is not a pre-requisite for 213. Both BUAD 212 and BUAD 213 are offered both in-person and online, and highlights include information literacy sessions held with the assistance of library staffers, a critical thinking research project, skill building using the SAM (Skills Assessment Management) system, and the development of e-portfolios.

In 2017 an evaluation of 5 years' worth of IC3 test scores were conducted (Buzzetto-Hollywood, 2017) concluding that freshmen students arrive with a basic level of information literacy, a rudimentary knowledge of computer fundamentals, and are well-versed in social media and the World Wide Web. However, when it comes to the use of core computer applications, students were found to be woefully deficient. This paper builds on and extends the findings of this earlier study. It more specifi-

cally considers the impact and efficacy of the computer concepts and applications courses. Additionally, this paper delves deeper into the examination of the technological readiness of students attending a Mid-Atlantic minority serving university through a survey of students following course completion.

LITERATURE REVIEW

There is a common and growing misbelief that students enter higher education with the computer skills necessary for success, therefore, making computer applications courses unnecessary; however, the research shows major skill deficiencies among students (Buzzetto-Hollywood, Elobeid, & Elobaid, 2017; Hanson, Kilcoyne, Perez-Mira, Hanson, & Champion, 2011; Mishra, Cellante, & Kavanaugh, 2015). Hargittai (2005) explains that students express this inflated sense of confidence in their digital literacy because they have mastered the small portion of familiar technologies that they use on a daily basis.

Information literacy is the ability to collect, evaluate, assemble, reflect upon, and use information in order to learn and inform problem-solving and decision making (Bruce, 2003). Technological literacy, which is increasingly being tied into information literacy, is the understanding of the uses, functions, and purposes of technology for the achievement of goals (Buzzetto-More, 2009; Pearson & Young, 2002). Both are skills that are increasingly playing an important role in lifelong learning and that are dependent on the ability to engage in critical and reflective thinking (Bruce, 2003; Buzzetto-More, 2009).

Mishra et al. (2015) explained that, while students are generally proficient in the locating of information online through search engines, they are less skilled in the use of productivity software commonly found in business and industry. In particular, they noted that technology terminology, use of spreadsheets and databases, operating systems, core software applications, computer ethics, and cyber security are all areas which they found lacking when students were pretested prior to taking a college-level introductory computing course. As a result, they concluded that entering freshmen have not developed the basic technology skills in order to be successful in academia and the workplace and that computer concepts courses are crucial at rectifying these deficits.

Similiarly, Nataraj (2014) concluded that students do not develop the necessary technology skills in high school which must, therefore, be addressed by colleges early in the academic experience. Nataraj used pre and post testing of freshmen students enrolled in a course titled Introduction to Computers and found that an introductory computer course offered early in the academic experience result in a significant improvement in students' computer literacy.

Heerwegh, DeWit, and Verhoeven (2016), understanding the crucial role that computers play in the training of future scientists as well as in the profession, tackled the misconception that most students have mastered basic ICT skills. They built on the body of research that has examined the technological inequities of students finding that ICT self-efficacy was greater for students who believed computer are both useful and necessary for their work as well as the belief that the individual has control over computing technologies.

Following an examination of the extent that computer-related factors affect the success of nontraditional college students, Henson (2013) concluded that reduced confidence adversely affects the entire college experience for students and, ultimately, successful employment. After further considering a number of indicators, the author concluded that high school access was the most significant factor in determining computer efficacy in college students. In a follow up paper, Henson (2014) went on to explain that fewer high school graduates and limited numbers of skilled employees are predicted to cause labor shortages in technical fields unless more is done to increase the computer efficacy of non-traditional college students.

First-generation college students are those whose parents have not attended college or earned a four-year degree. They represent about 20% of students entering college and have been found to face additional psychological challenges due to a lack of intergenerational continuity, fewer resources, breakaway guilt, and a lack of familiarity with college expectations (Banks-Santilli, 2015).

A detailed study that focused on the digital and information literacy skills of primarily first-generation students attending a mid-Atlantic historically Black university was conducted (Buzzetto-Hollywood et al., 2017). According to the data:

- incoming college freshmen have a very basic level of information and technological literacy;
- arrive with a rudimentary knowledge of computer fundamentals;
- are proficient in the use of email, social media, conducting online searches, and navigation of the World Wide Web;
- are terribly deficient when it comes to the use of core computer applications used for academic and professional productivity.

Socio-economic factors and issues of the digital divide are consistently found to be significant. Subramony (2014) explains that the digital divide remains one of the biggest social challenges in modern times despite the ubiquitous nature of technology. This was similar to a study by Ritzhaupt, Liu, Dawson, and Barron (2013) who examined 5,990 students from 13 school districts across the state of Florida and found that the digital divide remains prevalent in the United States. It was further confirmed by Buzzetto-Hollywood et al. (2017) who found that students attending a mid-Atlantic historically Black university arrived on campus with severe deficiencies when it came to the use of core computer applications.

Almost one-fifth of U.S. households don't have internet access, and these families are more likely to include first-generation college and low-income college students (Williams, 2017). This was especially highlighted in a 2016 Pew Research Poll (Anderson, 2017), which revealed that lower income households have lower levels of tech adoption, are less likely to use the internet as a source for learning, and are less likely to be confident in their digital technology skills. Conversely, individuals with high incomes were found to own multiple devices capable of accessing the internet and World Wide Web. Also, 2/3 of adults living in high-earning households have home broadband services, a smartphone, a desktop or laptop computer, and a tablet, compared with 17% of those living in low-income households. Additionally, many lower-income Americans are relying more on smartphones as their only technological device. In 2016, one-fifth of adults living in households earning less than $30,000 a year were "smartphone-only" internet users, who owned a smartphone but did not have broadband internet at home. This is an increase from 12% in 2013 and contrasts with only 4% of those living in households earning $100,000 or more who fell into this category in either year. Finally, disparities in online access were found in what Pew has called the "homework gap," referring to the divide between school children with respect to technology and internet access.

In a large-scale study reported by Library Journal (Dixon, 2017), first-year college and university students enter with widely varying levels of information literacy that is compound by a national funding crisis that has left so many K–12 public schools without functioning school libraries and trained school librarians/media specialists. According to the report, less than one-third (28%) of first generation college students enter with proper research skills, which means that they're unable to establish a research topic and design objectives, conduct effective searches, use optimal electronic information databases and resources, evaluate the credibility of sources, and properly cite sources. Further, the article explained that first-year students sometimes lack an understanding of what they need to learn or how research can benefit them. This problem is exacerbated by student's overconfidence, apathy, and short attention spans which make them less willing to attend or absorb new training. Other librarians cited problems such as student apathy and a lack of attention span as additional challenges.

Similarly, a study in Spain showed the presence of "asymmetries" among university freshmen when it came to use of ICTs and concluded that the inequalities that exist among university students are the source of an important problem (Ricoy, Feliz, & Couto, 2013). Further, a 2013 paper published in the Journal of Higher Education (Relles & Tierney), which examined the technology skills of low income students enrolled in remediation courses, found that a lack of computer literacy and the technology demands placed by the remediation software required further exacerbated the preparation gap and academic challenges of students. Finally, Zielezinski (2017) found that bridging the digital divide is an urgent need and that, despite the preponderance of hardware and software in American K-12 schools, it is not equitably applied with K-12 schools in low-income neighborhoods primarily using technology for remediation purpose.

Specifically targeting minority-serving institutions, a study conducted at the University of Maryland Eastern Shore and Fayetteville State University (Buzzetto-More & Sweat-Guy, 2007) examined the perceptions and experiences of freshmen students at two Historically Black Universities with respect to their technology ownership and usage and their information acquisition habits. The findings showed that technology access and ownership is less prevalent than what has been reported out of majority institutions, but more importantly, that HBCU freshmen are less prepared to use the internet and digital library/scholarly resources for academic pursuits.

There are 101 accredited HBCUs in the United States educating nearly 300,000 students at tuitions averaging 30% less than those charged by comparable institutions. Approximately 80% of their students are African American, and >70% are from low-income families. While they account for only 3% of public and not-for-profit private institutions receiving federal student aid, they enroll 10% of African American college students nationwide, produce 17% of the bachelor's degrees earned by African Americans, 24% of the degrees earned by African Americans in science, technology, engineering and math, and are the top producers of African American Ph.Ds (UNCF, 2017). HBCUs have never abandoned their mission of providing educational opportunities to students who may be otherwise marginalized; however, they are currently facing a number of challenges including declining enrollment numbers and lower-than-average graduation and retention rates (Seymour & Ray, 2015). Nevertheless, HBCUs are found to provide deeply supportive educational environments that are unparalleled elsewhere with black graduates of HBCUs more likely than black graduates of other institutions to be thriving (Seymour & Ray, 2015). Responsible for creating the Black middle class, they were found in a 2017 Brookings report to provide a foundation for economic growth and development that, with more investment, can revive some of America's most struggling cities (Perry, 2017).

METHODOLOGY

This study sought to examine the efficacy of institutional efforts to address the digital literacy skills of students. A multi-methodological approach was applied, which relied on placement test scores, survey results, and pre and post skill testing. Pre and post testing of students enrolled in BUED 212 was conducted in the spring of 2017using the IC^3 test administered during the second and 15th week of the academic term. Instructor permission had to be obtained before the assessment could be administered, and the test could only be administered to in-person course sections held on campus in order to comply with Certiport Authorized Testing Center agreement requirements. As such, students enrolled in the fully online sections could not be included. Pre and post test scores were compared in order to consider degree of change. Additionally, post test scores were compared to five years 5 years of IC^3 scores of incoming freshmen used as a placement test. Finally, an online student perception and satisfaction survey was administered to all students enrolled in the courses under consideration during the fall of 2017. The survey included a combination of dichotomous, Likert-scaled, and ranking questions and was administered using the Survey Monkey system. The data was subsequently exported to Microsoft Excel and SPSS where descriptive statistical analyses were conducted. During the analyses the following hypotheses were explored.

H_1- Computer applications courses are effective at building the technology skills of students.

The computer concepts and applications courses BUED 212 and BUAD 213 were considered when examining this hypothesis. With the introductory course, BUED 212, emphasis is placed on various computer concepts with respect to hardware, networking technologies, and software applications. Contemporary computer software for word processing, presentation delivery, spreadsheet design, and basic database development relevant to business and industry are explored. The intermediate BUAD 213 course covers computing concepts; basic networking topologies and concepts; the internet and World Wide Web; using and configuring the MS Windows Operating System; intermediate/advanced desktop publishing using MS Word 2016; advanced presentation design, customization, and delivery in MS PowerPoint 2016; email communications and time management in MS Outlook 2016; use of MS Access 2016 to create and customize a database, prepare forms, run reports, filter data, and run queries; information literacy skills; and use of MS Excel 2016 to create spreadsheets, apply mathematical and statistical functions, manage and protect large notebooks, prepare pivot tables and pivot charts, create a variety of formulas including logical functions to inform decision making, advanced charting and conditional formatting, trend analyses and forecasting, and development of macros.

In the spring of 2017, four sections of BUED 212, representing 58 students, were considered and pre and post testing utilized. The scores were subsequently compared and an improvement of >20% was set as the target. The BUED 212 scores were also compared to 5 years of IC^3 scores of incoming freshmen.

Finally, a survey was administered to students who had completed BUED 212 and BUAD 213 and responses to three Likert-scaled survey statements were considered in the analyses with means of >3.0 set as the target. The statements were the following: 1) my technology skills have improved as a result of this course, 2) I have become more skilled at using computer applications as a result of this course, and 3) this course has helped me become better prepared for my future career.

H_2- Students attending a minority serving institution do not come to college with the technology skills needed for success.

This preponderance of literature indicates that students entering higher education are arriving with deficiencies in their computer skills, and this is a particular issue among minority students. This hypothesis was measured with two five-point Likert-scaled survey statements: 1) My high school prepared me with all the computer skills I needed to succeed in college, and 2) I wish I had come to college with better computer applications skills. It was decided that if a mean of >3.0 was achieved on one and <3.0 on the other, then the threshold for affirming the hypothesis had been met.

H_3- Computer applications courses are a necessary part of a college curriculum.

This hypothesis is predicated on the idea that students in higher education do not possess the computer applications and technological skills necessary for academic and career success and that accordingly computer applications courses offered early in a student's college experience remedy these deficiencies and enhance students' skills. This hypothesis was measured with an examination of agreement to a Likert-scaled survey statement, "It is important for college students to take computing courses." Whereas if means of >3.0 was achieved, then the threshold for affirming the hypothesis was viewed as having been met.

H_4- Use of a simulated learning and assessment system is perceived as effective by students learning computer concepts.

Skills Assessment Manager (SAM) is an online learning environment designed to help students master Microsoft Office skills and computer concepts. SAM engages students in self-paced learning through interactive guided tutorials and real world simulation projects that are system graded and that provide automatic and targeted feedback. This hypothesis was tested with a Likert-scaled survey statement, "Use of the SAM system enhanced my under-standing of course con-tent." If means of >3.0 is achieved, then the threshold for affirming the hypothesis is viewed as having been met.

FINDINGS

The sample size for this study was well over 2,800 individuals coming from three distinct data sets. The first group of participant data came from 2,690 IC^3 tests administered over a five year period as placement tests where scores were scrutinized. The second set of participant data came from 160 completed surveys from the fall of 2017 of students enrolled in BUED 212 and BUAD 213 representing >71% and >90% response rates respectively. This survey data was collected and basic statistical analyses applied. The third data set came from a random sample of 65 students enrolled in BUAD 212 who were selected to complete pre and post testing. These three points of data were used to test five hypotheses. In this section, each of the hypotheses are tested and related back to the literature.

H_1- Computer applications courses are effective at building the technology skills of students.

In the spring of 2017, four sections of BUED 212 representing 65 students were considered and pre and post testing utilized. The scores were subsequently compared and an improvement of >20% was set as the target. Additionally, completion scores were compared to 5 years of IC^3 scores of incoming freshmen as well as student responses to a survey question. The results are depicted in multiple tables.

Table 1 presents the IC^3 scores of 2690 entering freshmen who had taken the test between 2011 and 2016. Students are allowed multiple attempts on the test with students who do not pass on their first attempt able to attend review sessions and utilize the Internet and Computing Mentor in order to enhance and build their skills in preparation for retesting. It is important to note that student participation in remediation and/or training sessions is completely voluntary. Table 1 presents the final scores for students, whether or not they choose retesting, and indicates an average final pass rate of 73% based on a passing score of 500 out of a possible 1,000.

Table 2 presents the results of the BUED 212 students IC^3 pre and post testing from the spring of 2017 where the findings show an initial mean score of 532 with a pass rate of 58% on the pre-test administered in the second week of the academic term and a mean score of 672 with a pass rate of 88% on the post test administered during the 14th week of the term. With a pass rate improvement of greater than the 20%, the threshold set to validate the hypothesis was met.

Table 3 presents the student responses to the Likert-scaled survey questions. With respect to the statement "*My technology skills have improved as a result of this course"* there was a mean of 4.17, a standard deviation of 0.898, and a confidence interval at 95% of 0.139. Additionally, responses to the Likert-scaled survey question "*I have become more skilled at using computer applications as a result of this course"* were also examined and a mean agreement of 4.23, a standard deviation of 0.859, and a confidence interval at 95% of 0.133 were found. Finally, responses to the Likert-scaled survey question "*This course has helped me become better prepared for my future career"* were examined and a mean of 4.04, a standard deviation of 0.942, and a confidence interval at 95% of 0.146 were observed.

Table 4 examines skill level attainment by category as measured by the degree of change from the pre and posttest as administered in BUED 212. Accordingly, the computer fundamentals portion of the test includes knowledge of basic hardware components and their functions, types and uses of software, basic use of operating systems, cloud computing, and digital devices. The pass rate went from 52.7% to 75.9%, an overall pass rate increase of 23.2% or a pass rate percentage change of 44%. The living online section is based on knowledge of network fundamentals and the interactivity of digital computer and communications networks, use of the Internet and World Wide Web, social media, searching, research fluency, and electronic mail. The pass rate went from a 63.6% to a 96.6% an overall pass rate increase of 33% or a pass rate percentage change of 52%. The key applications section considers a student's ability to use core computer applications in order to engage in word processing, basic spreadsheet usage, presentation software, printing and editing, and collaboration. The pass rate increased by from 43.6% to 75.9%, an overall pass rate increase of 32% or a pass rate percentage

change of 51%. Based on these findings, the most significant area of improvement for students following completion of an introductory computer fundamentals course was in the area of computer applications; however, positive skill level attainment was shown across categories.

As a result of the findings, Hypothesis 1 is affirmed and is evidence that computer concepts and software applications courses offered early in the academic experience result in a significant improvement in students' computer literacy. These finds are consistent with what has been reported in the literature (Buzzetto-Hollywood, 2017; Mishra et al., 2015, Nataraj, 2014).

Table 1: IC³ Exam Results Of Entering Freshmen 2011-2016

Academic Year	N	Weighted	Final Pass Rate	UMES Passing Score *Out Of 1000*	Mean Score	Variance
2011-2012	172	0.0639	62.21%	500	530.2	11.1
2012-2013	624	0.2319	75.8%	500	573.1	10.4
2013-2014	489	0.1817	71.12%	500	561.3	11.1
2014-2015	589	0.2189	70.54%	500	566.9	12.3
2015-2016	816	0.3033	76.23%	500	571.4	12.1
TOTAL	**2690**	**1.00**	**73.34%**	**500**	**557**	**11.4**
WEIGHTED	**2690**	**1.00**	**73.06%**	**500**	**566.34**	**11.5**

Table 2: IC³ Exam Results Of BUED212 For 4 Sections

Academic Year Spring 2017	Number Of Students	Pass Rate	Target/Passing Score *Out Of 1,000*	Mean Score
Pretest 2/2017	55	58%	500	532.5
Posttest 5/2017	58	88%	500	672.4
CHANGE		**+51%**		+139.9 points

Table 3: Student Perceptions Of Course Learning

N=160	**My technology skills have improved as a result of this course**	**I have become more skilled at using computer applications as a result of this course**	**This course has helped me become better prepared for my future career**
Mean	*4.17*	*4.23*	*4.04*
Standard Deviation	*0.898*	*0.859*	*0.942*
Confidence @95%	*0.139*	*0.133*	*0.146*

Table 4: IC3 BUED 212 Exam Results By Section For Skill Level Attainment				
Spring 2017	N	**Computer Fundamentals Pass Rate**	**Living Online Pass Rate**	**Key Applications Pass Rate**
2/2017	55	52.7	63.6	43.6
5/2017	58	75.9	96.6	75.9
% Change		44%	52%	74%

H_2- Students attending a minority serving institution do not come to college with the technology skills needed for success.

This preponderance of literature indicates that students entering higher education are arriving with deficiencies in their computer skills and that this is a particular issue among minority students. This hypothesis was measured with two five-point Likert-scaled survey questions. The first question "*My high school prepared me with all the computer skills I needed to succeed in college*" had a low mean indicating disagreement of 2.94, a standard deviation of 1.294, and a confidence interval at 95% of .203. The second question "*I wish I had come to college with better computer applications skills*" had mean indicating agreement of 3.56, a standard deviation of 1.166, and a confidence interval at 95% of 0.183. With a mean on the first question of less than <3.0 and a mean for the second question of greater than >3.0 the hypothesis is viewed as having been met. These findings are demonstrated in Table 5 and show that students attending a minority serving institution do not feel that their high schools adequately prepared them with the technological skills needed for college and that most students wish they had arrived on campus more prepared. These findings are further supported with Table 6 that considers weighted IC^3 exam scores for 2690 entering freshmen with a mean score of 566.34 out of 1,000 observed. Holistically, all of this information is considered positive confirmation that students do not come to college with the technology skills needed for success and are consistent with what has been reported by Hanson et al. (2011), Marakas, Johnson, and Clay (2007), Mishra et al. (2015), and Nataraj (2014) as well as in the literature focusing on the technological readiness of students attending minority institutions, such as Buzzetto-Hollywood et al. (2017), Buzzetto-More and Sweat-Guy (2007), Relles and Tierney (2013), and Zielezinski, (2017).

Table 5: Student Perceptions Of Their Technological Readiness For College

N=160	**My high school prepared me with all the computer skills I needed to succeed in college**	**I wish I had come to college with better computer applications skills**
Mean	*2.94*	*3.53*
Standard Deviation	*1.294*	*1.166*
Confidence @95%	*.203*	*0.183*

Table 6: Ic^3 Exam Results Of Entering Freshmen 2011-2016			
Academic Year	N	Mean Score Out Of 1,000	Variance
2011-2016	**2690**	**566.34**	**11.5**

H_3- Computer applications courses are a necessary part of a college curriculum.

This hypothesis was measured by considering agreement to the statement "*It is important for college students to take computing courses*." These results are presented in Table 7 and show a mean indicating agreement of 4.12, a standard deviation of 0.931, and a confidence interval at 95% of 0.144. With a mean of >3.0 achieved, the threshold for affirming the hypothesis is viewed as having been met. These finds are consistent with what has been reported in the literature (Buzzetto-Hollywood, 2017; Mishra et al, 2015; Nataraj, 2014).

Table 7: Student Perceptions Of The Necessity Of Computer Applications Courses

N=160	**It is important for college students to take computing courses**
Mean	*4.12*
Standard Deviation	*0.931*
Confidence @95%	*0.144*

H_5- Use of a simulated learning and assessment system is perceived as effective at enhancing learning by students learning computer concepts.

This hypothesis was measured by considering agreement to the statement "*Use of the SAM system enhanced my understanding of course content*" These results are presented in Table 8 and show a mean indicating agreement of 4.38, a standard deviation of 0.847, and a confidence interval at 95% of 0.157. With a mean of >3.0 achieved, the threshold for affirming the hypothesis is viewed as having been met. These results are consistent with what has been reported in the literature by such authors as Buzzetto-More and Ukoha (2009), Husain (2010), and Joyce (2016).

Table 8: Efficacy Of A Simulated Learning And Assessment System

N=160	**Use of the SAM system enhanced my understanding of course content.**
Mean	*4.38*
Standard Deviation	*0.847*
Confidence @95%	*0.157*

DISCUSSION

All too many individuals in higher education falsely believe that students enter college with the information and digital literacy necessary for success, therefore, rendering additional coursework unnecessary. This paper extends what has already been found in the literature whereas major skill deficiencies of students entering higher education are consistently found (Buzzetto-Hollywood et al., 2017; Dixon, 2017; Mishra et al., 2015; Hanson et al., 2011; Relles & Tierney, 2013) through an examination of five years of student performance on an international assessment of digital and information literacy. Further, student perception surveys were included in this study and, similar to what has been reported by ECAR (Dahlstrom, Walker, & Dzuiban, 2014), students expressed that they wished they had come to college more prepared to use computer software applications and that their high school had not adequately prepared them for use of technology in higher education.

The practical implications of this study are that computer applications courses remain an effective enhancement to students' college experience. In particular these courses are especially relevant with underserved and underprepared learners. This study used an approach similar to Mishra et al. (2015) and Nataraj (2014) in that utilized pre and post testing of students in order to determine the efficacy of computer applications and concepts courses. Where this study extended the discourse further is that it also included an analyses of survey questions that considered student perceptions of the importance and usefulness of courses with students reporting that it is important for college students to study computing.

Use of a performance-based simulation in computing courses was also explored as a teaching strategy through the examination of student responses to a Likert-scaled survey question. According to the findings, use of the SAM system helped students learn and understand course concepts that, individuals like Husain (2010) explain, transforms computing education to a more effective and constructivist learning experience.

The findings of this study indicate that institutions of higher education should invest in a thorough examination of the information and technology literacy skills, needs, and perceptions of students both coming into the institution as well as following course completion. This investigation should be ongoing in order to reflect the evolving technology skill expectations desired in higher education and the workplace. Student surveys should also be used to explore student perceptions and satisfaction with regard to course content, coverage, and teaching strategies and tools.

LIMITATIONS

The greatest limitation of this study is that is focused exclusively on students attending a single institution. However, at the same time, this study provides research on a population that is expanding in numbers in higher education and that many educators, and much research, reports as being underprepared for academic success (Adams, 2012; Allen, 1987; Morgan & VanLegen, 2005; Pearson & Young, 2002).

CONCLUSIONS

The digital divide is a serious concern for higher education, especially as schools seek to increasingly reach out to underserved populations. In particular, this paper documents the efforts of a mid-Atlantic minority serving institution as it seeks to assess and address the digital and information literacy skills of underserved students. The results of this study show that students attending a minority serving institution do not come to college with the technology skills needed for academic success, with readiness even lower for first generation college students. Pre and post testing of students as well as survey questions have proven the efficacy of computer applications courses at building the technology skills of students. These courses are viewed overwhelmingly positive by students with respondents reporting that they are a necessary part of the college experience that benefits them academically and professionally. Use of an online simulated learning and assessment system with immediate automated feedback and remediation was also found to be particularly effective at building the computer and information literacy skills of students.

The results of this research should shed light on a problem that desperately needs to be addressed by institutions of higher education, which is the realities of the digital divide and the under preparedness of entering college students, in particular those who are from low income, first generation, and minority groups. This research should be expanded to more institutions across the United States as well as abroad. This particular research protocol is easily replicated and can be duplicated at both minority and majority serving institutions enabling greater comparisons across groups.

As part of a commitment to assurance of learning, institutions of higher education should invest in a thorough examination of the information and technology literacy skills, needs, and perceptions of

students both coming into the institution as well as following course completion. These types of activities are a necessary for continuous improvement.

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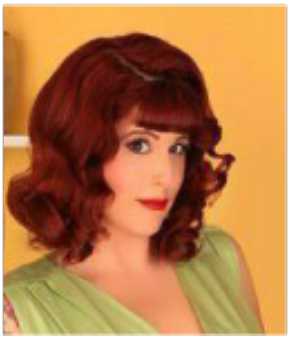
BIOGRAPHIES



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