ASSESSING PERCEIVED DIGITAL LITERACY BETWEEN COMPUTER SCIENCE MAJORS AND INFORMATION SYSTEMS MAJORS: A PILOT STUDY

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ABSTRACT

Digital literacy is critical to the success of both Computer Science and Information Systems majors in the 21st century. This generation of computing majors must be prepared to thrive in today's online environment, regardless of their computing major. The research took place in a large urban university. This study looks at the perceptions of these majors about their digital literacy abilities. We used a 10 item survey based on Renee Hobbs' digital framework to measure differences in perceived digital literacy between Computer Science students and Information Systems students, and between different demographics among all computing students. Our research results indicate that Computer Science students consider themselves significantly more positive in their ability to use the Internet to connect with others than do Information Systems students. In addition, Native English speaking students are significantly better able to examine the quality and credibility of content of messages and to understand the meaning of copyright compared to their non-native English speaking counterparts. Finally, female students are better able to develop multimedia creations and to reflect on their online conduct and online social responsibilities than are male students. We suggest appropriate curriculum enhancements to address these issues.

Key words: digital literacy; Computer Science; Information Systems; Internet citizens, curriculum; curriculum enhancement

INTRODUCTION

Computing is a growing field and is expected to grow 12% between 2014 and 2024, faster than any other occupation (Bureau of Labor Statistics). Judging from enrollment statistics undergraduates are returning in great numbers to computing as a course of study. At the same time, there is significant concern about developing and maintaining up-to-date curriculum for these students.

More broadly, the use of computing has become an essential skill in all professions, from accounting to medicine to marketing. Furthermore, in order to function as a fully engaged citizen requires a degree of expertise with respect to computing. Basic government tasks such as getting a copy of a birth certificate or renewing a driver's license require computing skills and access to the Internet.

Current literature emphasizes the growing importance of digital literacy in the online world of the Internet. Academic and professional success depends on building digital literacy competencies. Friedman (2015) provides a useful definition of Digital Literacy: the ability to find, evaluate, utilize, share and create content using information technologies and the Internet. Digital literacy includes but is not limited to computer literacy and Internet know-how. "It's about understanding how information can be found and communicated through computer hardware and software, the Internet, smartphones, tablets, and other digital devices, and knowing how to use these digital outlets to interact with society in a morally responsible way" (Friedman 2015).

As early as 2007, Lauden & Lauden noted that most Fortune 500 companies had a visible on-line presence in the form of corporate twitter accounts and other forms of technical communication (Lauden & Lauden, 2007). Comparing the Fortune 500 companies in 2007 with the 2015 list reveals that 240 companies remain, while 260 have fallen off the list. Disruptions in the market place with new digital models has contributed to this turnover. Failure of corporations to adapt to a changing digital age is due in part to a major shift to a shared economy, based on individual transparent transactions that directly interact with service providers. Uber, TaskRabbit, Amazon, and eBay are four typical examples. Transactions within the shared economy depend on a digitally literate on-line clientele.

The academic environment is the incubator for those students who will create future digital opportunities. This research discovers and addresses important similarities and differences in perceived digital literacy among Information Systems (IS) majors and Computer Science (CS) majors.

BACKGROUND

The global economy is driven by the Internet and its vast storage of knowledge. It is practically impossible to function professionally today without digital literacy and fluency in all aspects of Internet use. Students today are native speakers of the digital language of computers, video games and the Internet (Meyerson, 2016).

A 2016 Pew Research Center survey found approximately 9 out of 10 U.S. adults and 98 percent of adults with some college use the Internet. Among younger adults 18-29, 50% go online multiple times per day. The higher the educational level and the higher the income, the more online usage. By 2015, 29% of college educated adults were online "almost constantly" (Perrin & Duggan, 2015). This online engagement in global networks has created a need for students to become responsible economic global citizens. In addition to basic digital literacies, social and ethical responsibilities are also necessary.

Components of digital literacy

According to the 2003 UNESCO definition, "Literacy is the ability to identify, understand, interpret, create, communicate, compute and use printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve their goals, to develop their knowledge and potential, and to participate fully in their community and wider society".

Literacy can be applied to specific domains by identifying a baseline cognitive fluency, and demonstrating how this fluency supports a more engaged citizenry. Examples include

information technology literacy (Snyder et al. 1999), information and communications technology e-readiness (Gomez & Turoff, 2007), and quantitative literacy (Meyer & Dwyer, 2006).

DIGITAL LITERACY MODELS

Digital Literacy models encompass competencies necessary to function effectively in a digitally enabled society. Gilster introduced the term 'digital literacy' in 1997. He defined the term as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster 1997, p. 1). Chan, Churchill & Chu (2017) identify several current definitions of digital literacy, including Martin's comprehensive 2008 description of a digital literate person as someone with the ability to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources.

Digital literacy models usually include lower technical layers, such as the basic skills required to use computer technology, and the Internet layers composed of skills needed to consume digital information, such as a facility with browsers. Gilster's original model, for example, implied two layers: a layer represented by computers and a second layer where the information is formatted from a wide range of sources. Typically, the next layers involve abilities to interact with internet content, and the top layers address requirements to digest and use online information. As information technologies and systems mature, the digital literacy models included more competencies; for example, Snapchat presupposes the ability to be visually literate and includes creating and consuming memes. The newer models of digital literacy also focus on the abilities related to social and societal requirements for internet and digital competency. An example is Eshet-Alkalai (2004) comprehensive five- skill conceptual model for digital literacy. This model consists of five layers: (a) photo-visual literacy-- learning to read from visuals, (b) reproduction literacy-- the art of creative duplication or recycling of existing materials, (c) branching literacy-- hypermedia and non-linear or multi-domain thinking-- (d) information literacy-- the art of skepticism, and (e) socioemotional literacy.

Rheingold introduced mindfulness as a key determinant of digital literacy in 2012. His focus is the intelligent, humane and mindful use of the Internet. He outlines five fundamental digital literacies. *Attention* that leads to the ability to focus on the tiny relevant portion of the incoming tsunami of information*, participation*, *collaboration*, understanding *networks and network building*, and *"crap detection"* defined as the critical consumption of information (Rheingold, 2012).

The descriptions and components of digital literature continue to expand to accommodate new populations and technologies. For example, Apple released the first iPhone in 2007 changing the nature of personal communications and digital literacy. In March of 2010 Sprint launched the first 4G enabled mobile phone. With the new 4th Generation 100 Megabit per second speed came the ability to transmit visual information as easily as text. Visual literacy thus became an essential part of the linguistics of digital literacy. As of September 2016, FactTank: News in the numbers reported 87% of persons in the United States and 40% of the world population use the Internet (3.7 billion people out of 7.5 billion) (Pew Research Center, 2016).

RENEE HOBBS DIGITAL LITERACY MODEL

Hobbs authored one of the most comprehensive contemporary conceptual descriptions of digital literacy competencies in the white paper *Digital and Media Literacy: A Plan of Action*

(Hobbs, 2010). This white paper explicates the plan developed by a premier group of scholars at the Aspen Institute and the Knight Commission on the Information Needs of Communities in a Democracy.

Renee Hobbs subsequently enumerated a list of ten generic competencies, abilities that are required of a digitally literate citizen today: They include:

1. The ability to analyze messages in a variety of forms, including identification of the author, purpose and point of view of the message.
2. The ability to evaluate the quality and credibility of content in a message (e.g., distinguishing between "a marketing ploy for nutritional supplements and solid information based on scientific evidence" or quality content and junk journalism).
3. Knowledge of and the ability to use powerful search strategies.
4. The ability to develop multimedia creations.
5. The ability to use the Internet to connect with others with shared interests.
6. The ability to reflect on online conduct and online social responsibilities.
7. The ability to use the power of communication as a tool for advocacy.
8. Understanding of "copyright".
9. The ability to apply social responsibility and ethical principles to communication behavior.
10. The ability to work collaboratively to solve problems in the civic sphere, which will require many of the other capabilities listed above.

ASPECTS OF HOBBS' DIGITAL LITERACY MODEL

Hobbs' Model outlines the framework of digital literacy skills needed to build successful professional careers. Computer Science and Information Systems professionals require an especially high level of digital literacy. This includes the ability to analyze messages from internal and external sources; to discern the purpose and point of view of the authors messages; and to creates better understanding of professional goals and communications. Competency in analyzing these online interactions leads to a clearer understanding of design and implementation requirements. Computing professionals constantly need to research and evaluate new technologies and computing methods, and must have the ability to evaluate the quality and credibility of web information. These professionals need to be able to use powerful search strategies to obtain state of the art materials to inform their problem analyses and solution strategies.

It is rare to encounter a strictly text-based message on the Interactive Web. White papers, social media, resumes, online interviews and research papers all depend on multimedia to communicate their messages. Competency in authoring multimedia messages assists computing professionals in disseminating their work, communicating with in-house and external clients, and in furthering their careers. Better Internet literacy in research, multimedia, message creation and message evaluation all lead to better communication and the ability to connect to others with shared interests. It is imperative that computing professionals and others have an awareness of their online conduct and have the ability to reflect on their online social responsibilities. The ability to use internet media as a tool for advocacy is essential not only professionally, but also to fulfill one's responsibilities as a citizen in this digital age. Nowhere is it more critical than in the computing disciplines to act in a socially responsible and ethical manner in online activities. Finally, the entire fabric of the information age depends on the ability to collaborate to solve civic and professional problems ethically.

Description of Computing School Majors

The subjects of this pilot study attend a university that has a separate school of computing (hereafter referred to as The Computing School). The Computing School offers programs in Computer Science and Information Systems for undergraduates and graduates. Undergraduate degrees include a BA and BS in Computer Science, and both a BS and BBA in Information Systems, plus a BS major in Information Technology (grouped under Information Systems for the purpose of this study). The school also offers Masters Degrees and Doctoral degrees.

The Computing School is dedicated to developing abilities that enhance individual and community effectiveness, extend knowledge, and enhance critical understanding of the culture. The educational process is concerned with the development of personal, professional, and social responsibility.

Computer Science majors generally focus on the computer and communications' technologies rather than their contexts of use. The curriculum in Computer Science is based upon algorithms and data structures, the principles of programming languages, computer architecture, data communications, and theoretical foundations. It includes advanced work in various areas including software engineering, security, operating systems, compilers, artificial intelligence, telecommunications and graphics.

The Information Systems programs focus on the computer within an organizational context. This discipline emphasizes the interactions with business and functional areas. This liaison role is at the center of much of the Information Systems' curriculum. The context of computing includes emphasis on requirements gathering, data design and analytics, systems analysis and design, and the acquisition, deployment, and management of information technology resources and services. The curriculum includes advanced work in database programming, data mining, networks and internet security, and multimedia.

THE RESEARCH STUDY

It is extremely important for Computer Science and Information Systems students to be highly functional as they enter the global economy. We believe that the digital literacies described above in the Hobbs Model are important to facilitate that functioning. This study explores the perceptions of these majors of their own digital abilities.

Research Question

Our research hypothesis, stated in the null, is: "There is no significant differences between Computer Science majors and Information Systems majors with regard to ten questions that measure digital literacy defined by the Hobbs' Digital Literacy Model."

Subjects

The sample for this pilot study is taken from the population of undergraduate and graduate students majoring in Computer Science and Information Systems at a large northeastern private university. The subjects include 36 Computer Science students and 41 Information Systems students. 72% of these subjects are under 25 years of age, while 28% are 25 years of age or older.

International students make up 34% of the subjects, while 66% are native English speakers. Sixty-nine percent are male and 31% are female.

Research Instrument

The survey instrument uses items from the Hobbs Digital Literacy Model (Hobbs, 2010). This model represents ten generic abilities that represent digital literacy. The model was originally published in 2010 and is still relevant as a model of digital literacy today. The survey relies on self-perceptions and is measured by: a) very low ability (-2); b) low ability (-1); c) neither low nor high ability (0); high ability (1); and very high ability (2). [See Appendix A for the Survey Instrument.][See Appendix B for the Demographics Instrument].

Self-Perception and Actual Ability

Our survey instrument requests respondents to rank their perceived ability and understanding of the ten aspects of digital literacy from Appendix A. The underlying assumption is that these self-perceptions and assessments are correlated with objective measures of actual ability and understanding. There are convincing precedents for making this assumption. For example, Hargittal's (2009) research on survey measures of web-oriented digital literacy compared perceived behaviors and objective measures of skill levels. He found that people's self-rated level of understanding of various computer and internet-related terms on a 5 point scale was a relatively good predictor of how well they were able to navigate online content. In 2014 Zelt and Krizan published a Metasynthesis of 22 meta-analyses of research investigating the correspondence between self-evaluation of ability and objective performance measures. The 22 meta-analyses covered a variety of fields including academic ability, intelligence, language competence, medical skills, sports ability, and vocational skills. Although the overall correlation reported by Zelt and Krizen is moderate, the small standard deviation over the wide breadth of 22 studies supports our assumption that the results we report in this research reflect not only the self-perceptions of the respondents, but also their corresponding objective abilities and understandings.

Hypotheses

We hypothesize, that there is no significant difference between Computer Science students and Information Systems students in their ten digital literacy skills. What follows are our hypotheses stated in the null.

$H1_0$: There is no significant difference between Computer Science and Information Systems students in their ability to analyze messages in a variety of forms, including identification of the author, purpose and point of view of the message.

$H2_0$: There is no significant difference between Computer Science and Information Systems students in their ability to evaluate the quality and credibility of content in a message (e.g., distinguishing between "a marketing ploy for nutritional supplements and solid information based on scientific evidence" or quality content and junk journalism).

$H3_0$: There is no significant difference between Computer Science and Information Systems students in their knowledge of and ability to use powerful search strategies.

$H4_0$: There is no significant difference between Computer Science and Information Systems students in their ability to develop multimedia creations.

$H5_0$: There is no significant difference between Computer Science and Information Systems students in their ability to use the Internet to connect with others with shared interests.

$H6_0$: There is no significant difference between Computer Science and Information Systems students in their ability to reflect on online conduct and online social responsibilities.

$H7_0$: There is no significance difference between Computer Science and Information Systems students in their ability to use the power of communication as a tool for advocacy.

$H8_0$: There is no significant difference between Computer Science and Information Systems students in their understanding of "Copyright".

$H9_0$: There is no significant difference between Computer Science and Information Systems students in their ability to apply social responsibility and ethical principles to communication behavior.

$H10_0$: There is no significant difference between Computer Science and Information Systems students in their ability to work collaboratively to solve problems in the civic sphere, which will require many of the other capabilities listed above.

RESULTS

We hypothesized that there were no significant differences between Computer Science students and Information Systems students in the ten digital literacy skills contained in the Hobbs Digital Literacy Model.

A T-test for Equality of Means was performed using SPSS. The following results show the digital literacy abilities with a p value of less than .20 at the 80% confidence level, rejecting the null hypothesis for Hypothesis 5.

$H5_0$ reveals a significant difference between the perceptions of Computer Science majors and Information Systems majors for Question 5, as Computer Science majors rate themselves significantly higher than Information Systems students in the category of using the Internet to connect with others with shared interests. (Table 1)

TABLE 1
Identification of Significant Differences in Digital Literacy between Computer Science and Information Systems Students on the Hobbs Digital Literacy Model
[Mean from -2 to +2]

	Null Hypotheses	Computer Science students' mean n = 36	Information Systems students' mean n = 41	p value .20
$H1_0$:	*There is no significant difference between Computer Science and Information Systems students in their ability to analyze messages in a variety of forms, including identification of the author, purpose and point of view of the message.*	.84	1.02	.244
$H2_0$:	*There is no significant difference between Computer Science and Information Systems students in their ability to evaluate the quality and credibility of content in a message (e.g., distinguishing between "a marketing ploy for nutritional supplements and solid information based on scientific evidence" or quality content and junk journalism).*	.86	1.000	.472
$H3_0$:	*There is no significant difference between Computer Science and Information Systems students in their knowledge of and ability to use powerful search strategies.*	1.14	1.07	.658
$H4_0$:	*There is no significant difference between Computer Science and Information Systems students in their ability to develop multimedia creations.*	.57	.71	.519
$H5_0$:	**There is no significant difference between Computer Science and Information Systems students in their ability to use the Internet to connect with others with shared interests.**	**1.73**	**1.51**	**.124**
$H6_0$:	*There is no significant difference between Computer Science and Information Systems students in their ability to reflect on online conduct and online social responsibilities.*	1.14	1.32	.380
$H7_0$:	*There is no significance difference between Computer Science and Information Systems students in their ability to use the power of communication as a tool for advocacy.*	1.03	.93	.586
$H8_0$:	*There is no significant difference between Computer Science and Information Systems students in their understanding of "Copyright".*	1.03	1.00	.895
$H9_0$:	*There is no significant difference between Computer Science and Information Systems students in their ability to apply social responsibility and ethical principles to communication behavior.*	1.24	1.32	.622
$H10_0$:	*There is no significant difference between Computer Science and Information Systems students in their ability to work collaboratively to solve problems in the civic sphere, which will require many of the other capabilities listed above.*	.95	.98	.872

When we examined the demographics of our population of Computer Science and Information Systems students, we found significant differences between native English speaking students and non-native English speaking students among Computer Science and Information Systems majors. Native English speaking students perceived themselves as being significantly better able to evaluate the quality and credibility of content of internet messages than non-native English speaking students, based on Question 2 of the Hobbs Model.

Also these same Native English speaking students perceived themselves as being better able to understand the meaning of "Copyright" than non-native English speaking students, based on Question 8 of the Hobbs Model. (See Table 2 below.)

Table 2
Identification of Significant Differences in Digital Literacy between Native English and Non-native English Speaking Computer Science and Information Systems students
[Mean from -2 to +2]

		Native English speaking students' means n = 52	Non-Native English speaking Students' means n = 25	p value .20
Question 2	Ability to evaluate the quality and credibility of content in a message	1.06	.64	**.051**
Question 8	Ability to understand "copyright"	1.12	.76	**.16**

Again when we looked at the demographics of our population of Computer Science and Information Systems students, we found significant differences between female students and male students. Female students perceived themselves as better able than male students to develop multimedia creations, based on Question 4 of the Hobbs Model. (See Table 3 below.)

Based on Question 6 of the Hobbs Model, female students also perceived themselves as better able than male students in their ability to reflect on online conduct and online social responsibilities. (See Table 3 below.)

TABLE 3
Identification of Significant Differences in Digital Literacy between Female Students and Male Students.
[Mean from -2 to +2]

		Female Students n=24	**Male Students n= 53**	**p value .20**
Question 4	Ability to develop multimedia creations	.83	.56	**.20**
Question 6	Ability to reflect on online conduct and online social responsibilities	1.46	1.13	**.099**

We found no differences in any of the 10 hypotheses for students in two age groups: those younger than 25 years old and students who are 25 years old and older.

ANALYSIS OF THE RESULTS

The rejection of Hypothesis 5, "the ability to use the Internet to connect with others with shared interests," suggests that Computer Science students believe they are better able to use the Internet to collaborate with others more so than Information Systems students. College age students today spend the majority of their day connected. Today's average college graduates have spent less than 5,000 hours of their lives reading and over 10,000 hours playing video games. Computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives. As early as 2010 Nielson's research results showed "virtually all students keep one or more tabs permanently opened to social networking services like Facebook" (p 1). What was surprising was that Computer Science majors rated themselves significantly higher than did Information Systems majors on the use of Internet collaboration. One explanation may be in the different levels of technical education the two groups receive.

Our second important finding indicates a significant perceived difference on the part of native English speakers in their ability to evaluate the quality and credibility of content in a message. English literacy is especially critical to understanding the more abstract, language dependent aspects of digital literacy as defined in the Hobbs Model. These abilities require a higher level of English language competency. As there is more and more emersion of non-English native speaking students in our English-speaking classrooms, this result becomes more challenging. Many of these students are not here long enough for them to heighten their ability to evaluate English written messages. Additional instruction in English proficiency, and a longer acculturation time-period over which this happens, would likely narrow these digital literacy differences.

Our third important finding indicates a significant perceived ability on the part of native English speakers in their ability to understanding the meaning of "copyright." Since copyright is a legal right granted by a specific country, it makes since that non-native English speakers would be less aware of the need for, requirements of, and application of copyright in our country. Yet the use of copyright is very important to protecting our creative works, especially related to Internet use.

Our fourth important finding indicates a significant perceived difference between female and male students in their ability to develop multimedia creations, with females having better ability. Research by the New Media Consortium (Becker, 2017) suggests that college students who can create original work using digital tools, can adapt to a wider range of work environments and have better career advancement opportunities. They found that college students who received better digital literacy training in school, had higher promotion rates after college. Note that although female students were significantly better at developing multimedia creations, the mean average for both women and men was the lowest of any of the Hobbs' Model questions. This could be a valuable addition to college curriculum.

Our fifth finding indicates a significant perceived difference between female and male students in their ability to reflect on online conduct and online social responsibilities, with females having better ability. Research by the Pew Research Center (Fallows, 2005) found that both men and women recognized the risks and dangers from online activities. But they found that "women have expressed more fears than men have about the internet being a vehicle for national and worldwide problems. These include general criminal use of the internet, child pornography,

organized terrorism, and hacking into government information. For online chats and discussion groups, women's dramatic decline in participation rates coincided with increased public awareness about worrisome behavior in chat rooms." Also health-care research suggests the need for "careful reflection of roles and responsibilities" and the need to consider the abuse of data found on the internet (Denecke et al, 2015). This paper also warns of the need for "confidentiality and privacy, consent, autonomy and choice, justice/fairness, inclusion, security, and dignity, with project guidelines not necessarily pointing to clear answers and possibly including conflicts between different ethical pointers." With the pervasiveness of the internet, both for personal and professional use, our students must be able to reflect on their online conduct and responsibilities of that conduct.

SUGGESTIONS FOR CURRICULUM ENHANCEMENTS

Based on the findings in our pilot study, we have five suggestions for curriculum enhancements for these subject groups.

First, Information Systems majors are not as adept at connecting with others with shared interests as are Computer Science majors. We need to examine current curriculum content for Information Systems majors to create assignments that will help them connect with others with a shared interest. For example, one could create a database case project with another university where Information Systems students must pair up by university to solve the particular case issues.

Second, the university from which subjects were selected has a large percentage of foreign, non-native English speakers who practice their digital literacy skills in the English language. These students are at a disadvantage when trying to understand the quality and credibility of the content of messages. We need to examine curriculum areas where we can embed projects that enhance these students' understanding of quality and credibility of messages. For example, one could create a categorization game that takes credible and non-credible information sources from the Internet and have students categorize or create a "credibility" score.

Third, these same foreign, non-native English speakers are not as adept at understanding the meaning of "copyright" as native English speakers. We could enhance the curriculum by including discussions of the different types of copyright, what they mean, and how long they last. A guest speaker could easily accomplish this.

Fourth, there is a difference in the consideration of on-line conduct and responsibility between men and women and ethical case studies could be enhanced to create a higher awareness of the need for this consideration by all of our students.

Fifth, the lowest mean average on the ten Hobbs' questions relate to the lack of ability to develop multimedia creations (see Table 1 above.) Our students are woefully lacking in their ability to create and use multimedia. Future project assignments could be enhanced by requiring outcomes that are communicated through multimedia creations. Not only will our students' outcomes be more interesting and creative, but post-graduation opportunities will be enhanced as students incorporate multimedia into their professional lives.

FUTURE RESEARCH

Digital literacy and use of the Internet are global issues. This pilot study indicates great potential for continued research in this area. In general, future research can study the digital literacy abilities between cultures, ages, gender and life/work experiences around the world. In addition,

the issue of language, globally, should be studied. Directly related to this study, we looked only at Computer Science and Information Systems students, yet digital literacy is a necessary component in all areas of life and further study should examine the abilities in all areas of study. We also note that there are a large number of military veterans attending colleges today. Although we did not study this subject group, we believe this is another area for study of digital literacy research. Additionally, in Table 1 above, if we rank order the 10 identified digital literacy skills in the Hobbs Model, results show that, although there is not a significant difference between Computer Science and Information Systems subjects in their use of multimedia, both groups are woefully lacking in their ability to create and use multimedia. This is another area for future research and curriculum enhancement. Lastly, in this small pilot study, there were only 7 graduate students. But our results indicate that undergraduate students significantly perceived themselves as being better able to reflect on online conduct and social responsibility than do our small sample of graduate students.

CONCLUSIONS

The Internet today is inextricably woven into the fabric of our social, economic and societal lives. College students have the advantage of using the Internet to enhance their own well-being. While digital literacy is important to all college students, Computer Science and Information Systems students especially need excellent digital literacy skills to promote their professional grown. The 2013 AACSB Accreditation Standard 9 for accounting programs, which also applies to AACSB accredited Information Systems programs, suggests that students be proficient in analytical thinking; ethical understanding and reasoning; as well as information technology (AACSB 2013). Based on the results of our pilot study, we suggest that curriculum be enhanced to address these issues. At a minimum we should consider increasing instruction in areas where there were significant differences between Information Systems and Computer Science subjects. These skills would include: an ability to use the internet to connect with others; an ability to evaluate the quality and credibility of message content; a better understanding of copyright implications; and the ability to reflect on online conduct and online social responsibilities. In addition, as we prepare students for work in the 21st century, their ability to use multimedia more effectively would enhance their skills.

LIMITATIONS OF THE STUDY

This is a pilot study conducted at one academic institution. In addition the sample size was small. While the study does offer some insight into the self-perceptions of individuals in the Computer Science and Information Systems disciples and their digital literacy skills, generalization to the external population cannot be made.

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Appendix A

Demographics: (Digital Literacy) Please Circle your Responses

1. **Are You a :** **Female** **Male**

2. **How Old Are You:** **Under 25 years old** **Between 25 and 35**

   Between 36 and 50 **Over 50 years old**

3. **What is Your Primary Native Language? _____**

4. **What is your cultural background by continent?**
   a. **North America**
   b. **South America**
   c. **Europe**
   d. **Asia**
   e. **Africa**
   f. **Australia**
   g. **Antarctica**

5. **What is your highest level of education to date**
   (For example, 3rd year of college completed)
   _____
   Year of completion (For example, 2010)
   _____

6. **What was (or is) your major area of study? _____**

7. **How many years have you lived in the United States?**
   _____

8. **What part of the United States have you spent the MOST time of your life in? Circle only one.**
   a. **Northeast**
   b. **Southeast**
   c. **Middle States - North**
   d. **Middle States – South**
   e. **Northwest**
   f. **Southwest**

9. **What is your occupation:**
   1. **Business Management and Administration**
   2. **Communications and Information Systems**
   3. **Engineering and Technology**
   4. **Health Science**
   5. **Agriculture**
   6. **Human Services**
   7. **Other _____**

10. **Comments: e.g., favorite digital equipment, websites, daily digital routine, etc.**
    _____
    _____
    _____

Appendix B

Research Instrument: Digital Literacy

The internet is quickly becoming the critical gateway for addressing jobs, education, health care, government services, and civic participation.

This research studies the life skills needed for digital literacy.

Requirement One: Please **CIRCLE** a response to the following 10 questions.

Requirement Two: Please fill in the demographic survey.

Question 1: Rate your ability to analyze messages in a variety of forms, including identification of the author, purpose and point of view of the message.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 2: Rate your ability to evaluate the quality and credibility of content in a message (e.g., distinguishing between "a marketing ploy for nutritional supplements and solid information based on scientific evidence" or quality content and junk journalism).

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 3: Rate your knowledge of and ability to use powerful search strategies.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 4: Rate your ability to develop multimedia creations.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 5: Rate your ability to use the Internet to connect with others with shared interests.

Very Low Ability	Low Ability	Neither Low Nor High Ability	High Ability	Very High Ability

Question 6: Rate your ability to reflect on your online conduct and your online social responsibilities.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 7: Rate your ability to use the power of communication as a tool for advocacy.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 8: Rate your understanding of "copyright".

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 9: Rate your ability to apply social responsibility and ethical principles to communication behavior.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability

Question 10: Rate your ability to work collaboratively to solve problems in the civic sphere, which will require many of the other capabilities listed above.

Very Low Ability	Low Ability	Neither Low/ High Ability	High Ability	Very High Ability