How Can Universities Best Encourage Women to Major in Information Systems?

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How Can Universities Best Encourage Women to Major in Information Systems?

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Abstract:

Despite both government and industry initiatives, the under-representation of women in information systems (IS) continues. Can academia help right this imbalance by helping fill the pipeline for technically qualified female employees? We analyze the results of four experimental interventions based on empirical studies and prior surveys designed to address this issue. We conducted these interventions as projects in an introductory undergraduate IS class in a public university in the western US. Sadly, none were effective in encouraging more female students to consider majoring in IS.

Keywords: Gender, Choice of University Major, IS Major, Gender Gap in IT.
1 Introduction

The under-representation of women in information systems (IS)\(^1\) is a well-documented, persistent, and global issue (Barr, 2017; Bear & Woolley, 2011; Downey, Bartczak, Young, & England, 2016; Hewlett, 2008; ISACA, 2017; Muckler, 2016; Pappas et al., 2016). In the United States, only about 26 percent of all IS employees are women despite the fact that women comprise 47 percent of the national workforce and 57 percent of professional occupations (Ashcraft, McLain, & Eger, 2016; ISACA, 2017; Prinster, 2015). Globally, the percentage of women in IS is even lower and hovers around 17 percent (Morbin, 2014; Paredes, 2015). The proportion of female employees at many well-known technology companies—usually praised for their progressive hiring policies—is also low: it averages about 15 percent as Figure 1 shows.

![Figure 1. Percent of Female Employees at Selected Technology Companies (Prinster, 2015)](image)

According to the Bureau of Labor Statistics (BLS), the gender gap in IS has not deviated from 24 percent of overall STEM workers in the new millennium. However, in this same period, there has been a decline in the percentage of women working in computer-science fields—from 30 to 27 percent (Beede et al., 2011).

Information systems is hardly the only gender-dominated profession—nursing, dental hygiene, and grammar-school teaching are other examples—but there are several reasons why the gender gap in IS is particularly worrisome. First, the U.S. Government expects the number of information systems jobs to grow significantly more than the national average in the period from 2014-2024, and the supply of qualified workers will not be able to meet the demand (United States Department of Labor, 2016). Because interest in IS by men is also declining (Christensen, Knezek, & Tyler-Wood, 2014; Joshi & Kuhn, 2011; McLachlan, Craig, & Coldwell-Neilson, 2016), increasing the participation of talented women is an important way of growing the technology labor pool.

Second, the gender gap provides prima facie evidence for discriminatory hiring and retention policies. For example, current statistics support the claim that the industry creates a hostile work environment for females and, therefore, is fertile ground for litigation (Prinster, 2015). These numbers also challenge the claim that women are fully participating in a growing field of employment that provides above-average compensation (United States Department of Labor, 2016).

Third, many organizations also miss the benefits that accrue from a more gender-balanced workplace. Prior studies suggest that gender parity contributes to: 1) more effective and productive teams (Bear & Woolley, 2011), 2) increased business profits (Badal & Harter, 2014; Herring, 2009; Hoogendoorn, Oosterbeek, & Van Praag, 2013; Richard, Kirby, & Chadwick, 2013; Romney, 2015; Woetzel et al., 2015), 3) better-quality work (Campbell, Mehtani, Dozier, & Rinehart, 2013), 4) potentially more innovative and expansive product development (Krivkovich, Kutcher, & Yee, 2016; Olbrich, Trauth, Niedermann, & Gregor, 2015), and 5) improved equity in salary between genders in the workforce (Bear & Woolley, 2011; Prinster, 2015).

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\(^1\) Prior research uses the terms “information systems” (IS) or “information technology” (IT) to encompass those academic and professional disciplines focused on helping people make more effective use of computer technology for individual and organizational activities. We use IS in this paper to align with prior research that would categorize this study as related to IS workforce (ISWF) (Trauth, 2013).
Dezsö & Ross, 2012; Krivkovich et al., 2016). Put simply, studies suggest that gender diversity leads to improved performance—especially when businesses focus on innovative outcomes (Bear & Woolley, 2011; Dezsö & Ross, 2012).

Because many IS jobs in the US require a college degree, a common refrain is that higher education should help expand the pipeline of women who can join the IS workforce. But while the number of women who major in STEM disciplines is trending upwards, the number of women earning degrees in technology-related disciplines is not. For example, while women earned about 58 percent of the STEM-related degrees in 2014, they earned only about 18 percent of the degrees awarded in computer and information sciences in 2014—down from a peak of 37 percent in the mid-1980s (National Center for Education Statistics, 2015; Sax et al., 2017; Wang, Hong, Ravitz, & Ivory, 2015).

Over the last two decades, many studies have queried women about their interest in technology-related disciplines using surveys, focus groups, and direct interviews (Beyer, 2008, 2014; Buschor, Berweger, Frei, & Kappler, 2014; Cory, Parzinger, & Reeves, 2006; Geyfman, Force, & Davis, 2016; Joshi & Schmidt, 2006; Merhout, Havelka, & Rajkumar, 2016; Stout, Grunberg, & Ito, 2016; Wang et al., 2015; Zhang, 2007). These studies have found that parental influence, role models, stereotypes, knowledge of the field, influence of peers, self-efficacy, and external encouragement are important factors that affect women’s interest in IS. Recent studies that have examined implicit stereotypes to understand whether people implicitly relate technology to gender and also whether implicit gender identity predicts female interest in IS have found that implicit gender identity may guide “career choice” (Serenko & Turel, 2016; Stout et al., 2016; Zitelny, Shalom, & Bar-Anan, 2017).

If educational institutions are a good place to influence these factors, academics must grapple with how best to create environments that facilitate and encourage female involvement. Past interventions such as high school summer camps, peer mentoring, presentations, and conferences have met with mixed success, but the reasons for those that were failures remain unclear (Craig, 2015; Downey et al., 2016; DuBow & James-Hawkins, 2016; DuBow, Farmer, Wu, & Fredrickson, 2013; Fuller, Turbin, & Johnston, 2013; Guzdial, Ericson, McKlin, & Engelman, 2014). Few studies have conducted controlled experiments to test our understanding and evaluate our underlying assumptions of past surveys and interventions, which is why we conducted our current study.

In this paper, we describe an experiment we conducted in an introductory IS class to test whether a university class experience might encourage women to major in IS. The paper proceeds as follows. In Section 2, we review the extant literature on this subject, which provides the basis for our study and the factors that are of interest for experimentation. In Section 3, we describe our experimental design and present our results. In Section 4, we discuss these findings and discuss our study’s limitations. Finally, in Section 5, we provide some suggestions for future research and conclude the paper.

2 Literature Review: Understanding Women’s Interest in the IS Major

Prior research offers valuable insight into the complex and nuanced reasons why many women do not major in a computer-related discipline. Early studies that have examined and explained the low participation rate for women in computer science have identified men’s and women’s differing social expectations, noted gender stereotyping, and reported hostile academic environments as key factors that dissuade women from participating in the discipline (Gerwer, 1986; Kay, Lublin, Poiner, & Prosser, 1989; Spertus, 1991). Since those early days, researchers have conducted many surveys to expand and understand those factors as we discuss in more detail below.

2.1 Factors Affecting Interest in IS

Some researchers have asked women directly why they were not interested in IS using surveys, focus groups, and direct individual interviews. Over twenty years of studies have identified the following factors:

- Lack of access to computers at an early age (Adya & Kaiser, 2005; Serapiglia & Lenox, 2010; Taylor & Mounfield, 1994).
- Negative (or positive) influence of parents (Adya & Kaiser, 2005; Leppel, Williams, & Waldauer, 2001; Zhang, 2007). Some of these studies found that fathers encourage daughters to pursue non-traditional careers, while mothers influence daughters to pursue more stereotypically “feminine” careers.
Lack of female role models (Beyer, 2014; Jepson & Perl, 2002; Stout, Dasgupta, Hunsinger, & McManus, 2011). These studies show that women who are exposed to female role models (teachers, professionals) who work in IS are more interested in IS.

The belief that working in IS is a masculine endeavor (Cory et al., 2006; Fuller et al., 2013; Joshi & Schmidt, 2006; Lang, 2012; Sax et al., 2017; Serenko & Turel, 2016; Stout et al., 2016; Zitelny et al., 2017). These studies found that both men and women attribute such “masculine” characteristics of IS careers as isolation from other people, focus on self-promotion rather than group communion, lack of empathy, and aggression. In addition, these studies found that younger women are not aware of the interest other women show in IS and, thus, label it a “masculine” profession.

Low self-efficacy and low confidence in their personal knowledge and abilities in technology. This point is hardly limited to IS; women display less confidence in their knowledge and abilities in general (Beyer, 2014; DuBow & James-Hawkins, 2016; Geyfman et al., 2016; Jung, Clark, Patterson, & Pence, 2017; Sax et al., 2017).

Concern about the level of difficulty and workload associated with technology-related majors (Jung et al., 2017; Pappas et al., 2016).

Incomplete or inaccurate knowledge of IS. Women routinely claim that IS is both isolating and uncreative (Beyer, 2014; Lang, 2012), that “technology” means only using Office software (Beyer, 2014; Lenox, Jesse, & Woratschek, 2012), and that IS employees do not impact or help other people (Beyer, 2014; Weinberger, 2004).

Lack of interest in the IS curriculum taught in primary and secondary school. Studies have found that some women find computing-related curricula to be boring, mundane, and irrelevant (Lehman, Sax, & Zimmerman, 2017; McLachlan et al., 2016; Sax et al., 2017). Authors posit that much of the K-12 curriculum focuses on computer literacy and developing “user” skills rather than explaining and demonstrating the ability to interact with computers as a “developer” (Ashcraft, Eger, & Friend, 2012; Fisher, Lang, Craig, & Forgasz, 2015; McLachlan et al., 2016).


Unfortunately, these factors fail to provide a solid foundation on which to build interventions. First, no universal factors spanned all studies and surveys. Different groups of women, organized across varying temporal and geographic lines, identified overlapping and competing factors that discouraged them from majoring in IS and pursuing careers in IS. Second, the impact of these factors can change over time. For example, Taylor and Mountfield (1994) noted that the lack of access to computers at a young age negatively affected a young woman’s success in computer science, but, when Adya and Kaiser (2005) completed their evaluation of the literature, computer access from the home had become prevalent and they hypothesized that computer usage might be more important than computer access. By the time that Jung et al. (2017) completed their survey, gender parity had been achieved regarding computer access, but the survey did not test men’s and women’s understanding of the differences in skills required for those who use a computer versus those who create with a computer. Their survey found that more exposure to computer courses and access to computers did not “positively improve women’s decision to major in technology”, but the authors did not ask about what tasks students completed in those courses. Others have posited that computer literacy courses focus on developing user-related skills rather than highlighting the malleability of software and creating developer-related skills (Ashcraft et al., 2012; Sax et al., 2017). Thus, our understanding of what women mean when they respond to the survey questions could be incomplete.

### 2.2 Interventions to Encourage Interest

While no clear factor or set of factors appears to affect women’s interest in a computer-technology-related major, the list above provides a starting place for devising interventions that might encourage greater interest in the field. Activities such as summer camps, all-girl computer clubs, computing award programs, presentations, and conferences address many of the factors. These interventions potentially generate interest in technology by:

1. Helping students understand the diverse activities of an IS professional (Downey et al., 2016; Fisher et al., 2015)
2. Trying to change the stereotypes of technology work and tackling the negative image of IS work for women (Fisher et al., 2015; Fuller et al., 2013; Master, Cheryan, & Meltzoff, 2016; Whitney, Gammal, Gee, Mahoney, & Simard, 2013)

3. Providing a method of direct, focused encouragement for women by providing peers and role models (DuBow et al., 2013; Fisher et al., 2015; Guzdial et al., 2014)

4. Creating ways to share information among women (DuBow et al., 2013; Fisher et al., 2015; Payton et al., 2016a; Whitney et al., 2013), and

5. Improving the technical skills of potential female IS employees (Clayton, Beekhuyzen, & Nielsen, 2012; Downey et al., 2016).

Empirically, the outcomes for such interventions have been mixed. For example, in describing the results of an all-girl computer club for women aged 10-14 that was designed to provide a “gender-relevant” experience with IS, Fuller et al. (2013, p. 511) state “whilst the girls-only, female-friendly nature of the club appealed to participants…there was very little evidence that membership in the club had encouraged more girls to pursue IT-related courses post-16, or to consider careers in the IS industry”.

Downey et al. (2016) report similar findings with a computer camp targeting 14-17 year-old students. While the researchers increased awareness and understanding of IS as a major, they could not “dispel some of the more negative beliefs, including the ideas that IS professionals are nerdy, must have strong math/science skills and interact with computers and not people” (Downey et al., 2016, p. 11). They also noted that, critically, “none of the four items on major and career intentions significantly changed at all. Indeed, in three of these items, the post-camp average was slightly lower than the pre-camp average” (p. 12).

There have also been some success stories. Carnegie Mellon University, for example, experienced better success attracting women to its computer science program by changing its culture (Frieze & Quesenberry, 2015; Frieze, Quesenberry, Kemp, & Velazquez, 2012). Frieze and her colleagues attribute the 40 percent representation of women in their program to a change in the culture and environment of their program rather than to a change in curriculum. They selected new student recruits purposefully to create a more diverse student body by combining students who did and did not have prior experience in computing, interviewing prospective candidates, and providing a strong women’s organization to disseminate information and encourage women’s engagement with both their fellow classmates and the external community. Thanks to Carnegie Mellon’s relatively low acceptance rate (about 24%) and high average SAT scores (1440), the computer science program could be more selective than other institutions without suffering lagging student demand.

A six-year project in the Georgia in the US used summer-camps, after-school programs, and classroom training for 4th-12th graders to enhance student knowledge and encourage greater participation of girls and minorities in technology-related activities (Guzdial et al., 2014). While the study did not provide evidence of increased female enrollment in technology programs in higher education institutions, the women did show significantly increased interest in such programs in middle school and high school after participating (Guzdial et al., 2012). It is possible that the interest may eventually translate into more IS majors.

The Students and Technology in Academia, Research, and Service (STARS) Computing Corps in the US is a set of regional partnerships among community organizations, K-12, and higher education that focus on increasing the participation of women in technology (Payton et al., 2016a). Researchers have devised a variety of different interventions under the STARS umbrella including peer mentoring of K-12 students by college students, coding camps for middle and high school students, lecture series, national conferences, community outreach development projects, undergraduate research opportunities, and changes to the K-12 computing curriculum in selected geographical areas. While no controlled experiment results have yet been reported from the STARS projects, surveys of undergraduate student participants have found that they positively perceive the experiences; in particular, female participants have rated the service learning projects as a way to encourage a strong sense of community (Payton, Barnes, Rorrer, Buch, & Nagel, 2016b).

In her multi-case analysis of 14 major intervention programs in Australia, Craig (2015) tried to understand why some programs work and others do not. She notes that the intervention programs “had not articulated explicitly the ‘problem’ they were setting out to solve nor a measurable goal for the program” (p. 606). In addition, she emphasizes that the design of any intervention program should be based on a theory that explains why a particular result should be expected.
In summary, many factors could potentially encourage women to major in IS, but empirical studies have failed to flesh them out through controlled, replicable experiments. In short, we still do not fully understand what factors influence a woman’s choice of major or how relatively effective interventions are at attracting women to technology-related majors in post-secondary education.

3 An Experiment with Interventions

Given the many hypotheses surrounding which factors are critical to spurring women’s interest in IS but the dearth of controlled studies, we designed an experiment to test some of the key factors reported in the literature. We were especially interested in determining whether one could positively influence the attitudes of female students towards majoring in IS in a classroom setting at a university. Thus, we focused on the factors that one can control in a classroom situation. In addition, we were interested in those factors reported most often in the literature and that appeared in the most recent literature related to gender differences. Figure 2 provides a conceptual model of the four factors that compose our study.

Figure 2. Four Factors that Could Affect the Likelihood of Women to Major in IS

These four factors are based on the results of empirical studies published in the academic literature that we discuss in Section 2. The factors come from the published results of surveys, focus groups, and direct interviews of female students. We could not reasonably address some of the factors we note, such as parental influence, childhood computer access, implicit beliefs in stereotypes, or low self-efficacy, in an experimental structure in a university class, so we excluded them from the study. Further, we could not test the relative interaction of the factors due to the limitations prescribed by our Institutional Review Board. We selected the following factors for purposeful interventions in this study:

- Lack of knowledge about the IS major and resulting careers. Prior research shows that people do not know: 1) what types of classes compose an IS major; 2) what career options are available to those who take that major; 3) what jobs are currently available; and 4) what responsibilities, salaries, and career growth potential come with entry-level IT jobs (Beyer, 2014; Croasdell, McLeod, & Simkin, 2011; Joshi & Kuhn, 2011; Lang, 2012; Lehman et al., 2017).

- Belief that IS is not creative or useful to society as a whole. Prior research shows that women identify IS careers with using tools such as Microsoft Office (Lang, 2012). Most have not developed software or used a computer as a creative outlet (Ashcraft et al., 2016; Downey et al., 2016; Sax et al., 2017). Women also believe that IS has relatively little potential social impact to help other people (Lang, 2012; Roach, McGaughey, & Downey, 2011; Weinberger, 2004)

- Belief that IS is a stereotypically “masculine” occupation. Prior research shows that women believe that it is necessary to have “masculine” characteristics to succeed in IS. They also believe that relatively few other women choose to participate in technology-related disciplines
(Cory et al., 2006; Fuller et al., 2013; Jung et al., 2017; Lang, 2012; Roach et al., 2011; Weinberger, 2004).

- Lack of female role models. Prior research shows that women are not exposed to professional women in IS and are not aware of the opportunities available to women (Downey et al., 2016; Fuller et al., 2013; Guzdial et al., 2014; Jung et al., 2017).

In Section 3.1 and 3.2, we describe our experimental design and explain how we operationalized each of these factors.

3.1 Study Hypotheses

We examined the question: “How can we best encourage female students to major in IS?”. Based on the literature, we chose to test the following hypotheses.

H1: Undergraduate women choose to major in something more familiar because they are not familiar with the activities of IS professionals.

H2: Undergraduate women choose a major other than IS because they do not recognize that IS work could be creative or have an impact on society.

H3: Undergraduate women choose a major with more visible female peers.

H4: Undergraduate women choose a major with more visible female role models.

3.2 Experimental Design

Our research design included a “treatment” or “intervention” operationalized as a project that addressed one of the four factors identified above. We designed each intervention as a class project requirement; we intended each intervention to address a specific reason proposed in existing literature as to why females do not major in information systems. Each treatment required a student to complete one, and only one, project. Table 1 summarizes the four projects that the students completed and their relationship to the hypotheses. Appendix A provides more details about each of these projects.

We conducted our experiment in a large (200-student), lecture-based introductory information systems (IS101) class offered by a college of business of a public university in the Western United States. We included two sections of the course in the study each semester over three semesters; in all, almost 1,000 students participated over those three semesters. The same instructor taught all of the sections of the course during the three semesters of the study. We treated the first two semesters as pilot studies while testing the pre-experiment and post-experiment survey instruments and the project requirements for the treatments. We modified the projects over the three semesters based on students’ feedback. For example, we used three different projects to test H2 over the three semesters in order to identify a project that students considered both “creative” and could have a potentially positive impact on society. Because the three semesters did not use fully comparable projects, we report only the results from the third semester.

We followed the following experimental process: 1) students completed a pre-project survey at the start of the semester; 2) students selected a project option; 3) students completed the project; and 4) students completed a post-project survey (the same survey given pre-project) and decided whether we could include their data in the study. We allowed each student to select which term project they preferred and to enroll in one (and only one) of the four project options for the semester. (We reasoned that allowing students to self-select their project option maximized the likelihood of interest in the selected choice and, therefore, the treatment’s effect on students. In addition, the Institutional Review Board (IRB) recommended that students should select the project.) We grouped male and female students into separate sessions for the projects that represented hypotheses H3 and H4. Thus, male students had male peer mentors and IS professionals, and female students had female peer mentors and IS professionals.

Regardless of which project a student chose, the deliverable from that project counted as 10 percent of the student’s final course grade. We allowed students to self-select into any one group they wished until it reached enrollment capacity (one quarter of the class per project). After that, students had to select an alternate choice.
Table 1. Descriptions of the Four Experimental Treatments

<table>
<thead>
<tr>
<th>Treatment project</th>
<th>Problem</th>
<th>Description and deliverable</th>
<th>How graded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1</strong> Term paper</td>
<td>Unfamiliarity with the work performed by IS professionals.</td>
<td>Write a paper describing what IS professionals do. This project required students to research work performed by IS professionals and to identify specific job functions completed by entry-level professionals. This project helped familiarize students with the actual work that current IS professionals perform. <strong>Deliverable: paper</strong></td>
<td>Used grading rubric; look for reasonable answers to specific questions.</td>
</tr>
<tr>
<td><strong>H2</strong> IS project</td>
<td>Unfamiliarity with creative IS projects that have social benefits.</td>
<td>Create a website that focuses on sharing information for a non-profit organization. This project required students to go beyond simply “using” software to also “develop” something new. While the rest of the class focused on developing user-related skills, this project helped students understand how to use software to create a new website. In addition, this project highlighted the use of computers for communication and group work that could benefit society. <strong>Deliverable: a working website</strong></td>
<td>Contains required minimum content and functions correctly.</td>
</tr>
<tr>
<td><strong>H3</strong> Student role models</td>
<td>Women majoring in IS are invisible to other women.</td>
<td>Attend 4 or 5 meetings in which women IS majors serve as peer mentors, explain IS opportunities, and answer questions about the major. Twenty-seven percent of the students that major in IS at this university were women, so it was possible that incoming female students were not aware that there were women in the major. This project introduced women to others who chose to major in IS, established a mentoring relationship, and encouraged networking among students. <strong>Deliverables: attendance at sessions and a journal that described each session in 250 words or more.</strong></td>
<td>Attendance: 60% Journal: 40%</td>
</tr>
<tr>
<td><strong>H4</strong> Professional women in IT</td>
<td>Women working as IS professionals are invisible to other women.</td>
<td>Attend 4 or 5 meetings in which students interact with professional IS women. Students had the opportunity to hear how women entered and succeeded in IS. They could to ask questions and find out about local job opportunities from successful female IS professionals. <strong>Deliverables: attendance at sessions and a journal containing descriptions of 250 words or more about each session.</strong></td>
<td>Attendance: 60% Journal: 40%</td>
</tr>
</tbody>
</table>

### 3.3 Experiment Sample Demographics

Our study focused on two sections of an entry-level information systems class (IS101) that all business-degree majors must take and that the university strongly recommends for many other majors. Most students take this class in their freshman (first) year, though our classes had students at different years, too. Our final sample included only first-year and second-year students because they had a greater likelihood of changing their majors. We did not include third-year or fourth-year in the final sample because it would be much more difficult for them to change their majors and that additional challenge could influence the study results. Finally, we report results for only those students who consented to be part of the study.

For the entire sample of 262 students, 154 (59%) were males and 108 (41%) were females. The mean age and age range for males and females were identical: 18.9 years and 18-22 years, respectively. Students in the college of business are classified as “pre-business” and do not officially declare a major until their third year. Table 2 presents the survey results to the question “What is your major or intended major” disaggregated by gender. Table 2 X shows, more female than male students were undecided or were majoring in a field outside the college of business.

We were also interested in prior computer experience, which we defined to mean “formal coursework in high school”. Table 3 shows that most students had at least one semester’s training on computer subjects in high school, although, for many, this “training” amounted to little more than keyboard familiarization and the use of simple office software. This result is very similar to that reported in prior studies (Jung et al.,
2017; Sax et al., 2017). Percentage wise, males had more training on average than females past this first-year cutoff.

<table>
<thead>
<tr>
<th>Major or intended major</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Percent</td>
<td>Count</td>
</tr>
<tr>
<td>Accounting</td>
<td>19</td>
<td>12%</td>
<td>10</td>
</tr>
<tr>
<td>Economics</td>
<td>8</td>
<td>5%</td>
<td>4</td>
</tr>
<tr>
<td>Engineering or science (outside COB)</td>
<td>13</td>
<td>8%</td>
<td>2</td>
</tr>
<tr>
<td>Entrepreneurship</td>
<td>2</td>
<td>1%</td>
<td>0</td>
</tr>
<tr>
<td>Finance</td>
<td>16</td>
<td>10%</td>
<td>7</td>
</tr>
<tr>
<td>Information systems</td>
<td>15</td>
<td>10%</td>
<td>3</td>
</tr>
<tr>
<td>International business</td>
<td>7</td>
<td>5%</td>
<td>5</td>
</tr>
<tr>
<td>Management</td>
<td>21</td>
<td>14%</td>
<td>16</td>
</tr>
<tr>
<td>Marketing</td>
<td>21</td>
<td>14%</td>
<td>24</td>
</tr>
<tr>
<td>Undecided</td>
<td>16</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>Other (outside COB)</td>
<td>16</td>
<td>10%</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>100%</td>
<td>108</td>
</tr>
</tbody>
</table>

Table 3. Number of Semesters of High School Training on Computer Subjects

<table>
<thead>
<tr>
<th>Number of semesters computer training in high school</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Percent</td>
<td>Count</td>
</tr>
<tr>
<td>No answer</td>
<td>7</td>
<td>5%</td>
<td>3</td>
</tr>
<tr>
<td>none</td>
<td>24</td>
<td>16%</td>
<td>22</td>
</tr>
<tr>
<td>1 semester</td>
<td>57</td>
<td>37%</td>
<td>57</td>
</tr>
<tr>
<td>2–3 semesters</td>
<td>49</td>
<td>32%</td>
<td>17</td>
</tr>
<tr>
<td>4–5 semesters</td>
<td>10</td>
<td>6%</td>
<td>7</td>
</tr>
<tr>
<td>More than 5 semesters</td>
<td>7</td>
<td>5%</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>100%</td>
<td>108</td>
</tr>
</tbody>
</table>

3.4 Study Results

To assess the effectiveness of our interventions, we compared the answers to questions posed to students in two separate surveys—one administered to students at the beginning of the semester (pre-project survey) and one at the end of the semester (post-project survey). Question 5 constituted a crucial question in each survey: “How likely is it that you will declare a major in information systems?”. Possible responses were: “1—won’t major in information systems”, “2—probably won’t major in IS”, “3—might major in IS”, “4—likely to major in IS”, and “5—very likely major in IS”. Because first-year students in our college cannot formally declare a major until their third year, we used “intent to major” as a surrogate measure.

Out of 108 female students who opted to participate in this study and completed the surveys, three did not complete the experimental project. As a result, the results below pertain to 105 female students. Of the 105, five indicated they were “likely” or “very likely” to major in information systems (i.e., chose answers 4 or 5 for our declaration-of-major question (see Table 3)—an intended declaration rate of 4.8 percent (a percentage about equal to our existing declaration rate for female students of 5.2 percent for the college as a whole). In other words, and despite our focused interventions, almost the same percentage of females planned to become IS majors as our benchmark declaration rate of existing female majors—in effect, a “no change” result.
To test for differences in the likelihood of majoring in IS, we calculated the difference in the “likelihood to major in IS” response between the beginning of the semester survey versus the end of semester survey for each of the participating female students. Table 4 shows the results for the mean and median differences for each treatment.

Table 4. Sample Sizes, Potential Major Selections, and Mean and Median Differences for Answers to Question 5 on Survey instrument

<table>
<thead>
<tr>
<th>Project:</th>
<th>H1: term paper</th>
<th>H2: term project</th>
<th>H3: IS female student mentors</th>
<th>H4: professional female role models</th>
<th>Totals or overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N:</td>
<td>27</td>
<td>27</td>
<td>28</td>
<td>23</td>
<td>105</td>
</tr>
<tr>
<td>Potential majors</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Mean difference (question 5)</td>
<td>.111</td>
<td>-0.148</td>
<td>-0.036</td>
<td>.174</td>
<td>NA</td>
</tr>
<tr>
<td>Median difference (question 5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NA</td>
</tr>
</tbody>
</table>

Because our survey largely produced ranked ordinal data with mean differences that were not normally distributed, we used the non-parametric Kruskall-Wallace test to look for any significant differences in medians among the four treatments (substituting for the parametric ANOVA) and the Wilcoxen sign rank test to test the hypothesis that a treatment resulted in an increased likelihood of majoring in IS (i.e., the median difference in likelihood was positive when we substituted the Wilcoxen sign rank test for the parametric matched pair t-test). Table 5 reports the results of a Kruskall-Wallace rank test for differences in medians among the four interventions. Table 6 reports the results of the Wilcoxen test for each individual paired difference. The statistical results confirm our simpler major-declaration findings (i.e., none of the four treatments significantly encouraged females to major in IS).

Table 5. Kruskall-Wallace Test Results

<table>
<thead>
<tr>
<th>Ho: all medians are equal</th>
<th>Ha: at least one median is different</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DF</td>
</tr>
<tr>
<td>Results not adjusted for rank ties</td>
<td>3</td>
</tr>
<tr>
<td>Results adjusted for rank ties</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 6. Wilcoxen Signed Rank Test Results

<table>
<thead>
<tr>
<th>Ho: median difference = 0</th>
<th>Ha: median difference ≠ 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N*</td>
</tr>
<tr>
<td>Treatment 1</td>
<td>13</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>10</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>8</td>
</tr>
<tr>
<td>Treatment 4</td>
<td>9</td>
</tr>
</tbody>
</table>

*Difference in sample size for test resulting from ties in ranks

2 Number of students who were definitely or very likely to become an IS major.
3.5 Discussion

Our results seem unequivocal—none of our interventions appeared to lead to increased interest in the IS major among the study's participants. Given the time and effort required to create, organize, and coordinate our projects, peer mentors, and IS professionals, these results were disappointing. Although other studies have also failed in this endeavor (Downey et al., 2016; Fuller et al., 2013), we take little solace in such parallel findings. After all, our mutual goal is to address an existing gender imbalance in a very important industry and to encourage more women to major in IS.

Future research would benefit from knowing why our interventions were not more effective. One possible explanation is that, according to the sixth question in our pre-project survey, over 42 percent of our students reported that they had decided on a college major while still in high school. At the outset, we did not believe that these decisions would necessarily impede students from becoming IS majors—we had all begun our first year of university with other interests and had become IS majors over time. It is possible that students will change their minds from their high school decision if another major looks more interesting. But it is also possible that today's students have firmer commitments to their chosen fields of study or that pressure to complete school quickly makes switching to alternative majors more difficult now. If true, then we should focus our energies on creating interventions earlier in a student's education.

A second explanation might be that our interventions tried to counteract 18 years of social influence with 6 weeks of a limited intervention. Are we doing too little too late? Similar interventions to the ones in this experiment but that start in middle and high school and continue the intervention over a longer time have shown to be effective in changing female's perceptions of IS (Fisher et al., 2015). It is possible that the focus should be on creating long-term interventions at the K-12 level rather than at the university level.

A third explanation, which we derived from previous research, suggests that women think negatively about careers in technology and that this thinking is reinforced over time (Master et al., 2016; Stout et al., 2016). An experiment conducted with high school students in the US found that female students reacted more positively to computer classrooms that exhibited fewer artifacts associated with traditional computer science (i.e., Star Trek posters, stray equipment parts, science fiction books, video games) and incorporated more neutral objects (i.e., art and nature posters, water bottles, general magazines, plants), which resulted in their being more willing to take a high school class in computer science (Master et al., 2016). This work demonstrates the need to be more sensitive in placing physical objects in the classroom.

A fourth explanation comes from the theory and literature regarding individual differences among people. According to Trauth, Quesenberry, and Morgan (2004), we might understand female underrepresentation in IS by looking at the “similarities among men and women as individuals, and the variation among members of each gender group with respect to IS skills and the inclination to participate in the IS sector” (Trauth et al., 2004, p. 116). This nascent “individual differences” theory of gender views both “gender” and “IS” as socio-culturally constructed at the individual level. While its creators developed this theory in relation to retaining, rather than recruiting, women to IS disciplines (Trauth, Quesenberry, & Huang, 2009), the theory can help illuminate the research results we present here. In particular, our interventions were possibly ineffective because they targeted an arbitrary grouping; it would be more effective to seek out what is exciting and interesting in technology for any individual regardless of gender.

Beyer (2008) surveyed a small group of men and women IS majors and non-IS majors at a university to see whether female IS majors had more in common with male IS majors than with female non-IS majors. She found that the intra-gender differences, such as the amount of time using a computer for enjoyment, the amount of experience in programming, confidence in learning new software packages, and level of expertise in “opening up a computer”, were more significant than the inter-gender differences. She also found inter-gender differences; for example, women had inaccurately low computer self-efficacy when compared to men and were more reliant than men on role models and direct encouragement to become IS majors.

Lang (2002) conducted a particularly telling qualitative study that aligns with individual difference theory by interviewing different groups of males and females in school years 8, 10, and 12 to determine which factors were more influential for student major and career choices (Lang, 2012). Lang found that there were far more similarities than differences between the genders regarding computer use, attitudes, and attraction of IS as a major/career choice. Few students at any age or of either gender were considering majoring in IS. As the student groups aged, they became less interested in IS and considered it a “low status” career choice. Both genders considered it boring, isolated, sedentary, poorly paid, and uncreative,
which could explain the general decrease in IS majors that has recently been noted in the literature (ISACA, 2017; McLachlan et al., 2016; Merhout et al., 2016).

The question remains about how we should proceed. Rather than focusing on the differences between the genders as many prior studies have done, individual differences theory encourages researchers to use “the individual” as the unit of measure and to incorporate all genders in gender studies (Trauth, 2002, 2013; Trauth et al., 2009). Our experiment viewed the genders as dichotomous, but we suggest that it may not be appropriate to presume the existence of only two genders. A growing body of literature analyzes gender on a spectrum (Delphy, 1993; Greaves, 2015; Zinn, Hondagneu-Sotelo, Messner, & Denissen, 2015), which helps researchers focus on the differences among individuals and create categories other than gender that might be more helpful in devising interventions to attract people to the IS major.

Some additional insights about the decision making process in choosing a major also emerged from the comments that some of our respondents provided. These comments were voluntary, but about 90 percent of the students made them. One category of remarks confirmed the commitment of some students to alternate career paths. Examples of such comments from males and females include:

The project opened my eyes to a lot of career options with an (sic) information systems, however I am still set on my intended major in management and I don't have time to pick up a minor.

I make short films and do other video work.

I think IS is an amazing career for some people. In my case, I feel I have a stronger passion to be working throughout the community and helping people with their health. I love the science in life, more than I love working with computers…

The project opened my eyes to a lot of career options with an (sic) information systems, however I am still set on my intended major in management and I don't have time to pick up a minor.

Another category aligns the literature regarding low self-efficacy. Examples of such comments from females include:

I think IS is cool. I don't think I am smart enough to handle it though.

I don't work well with computers.

Like I said earlier my dad has a job working in IT and given his work schedule, and the how stressful it is, it would not be in my best interests to pursue this because I don't have a passion for IS and having to do what he does would be horrible for me.

I love the subject, professor and class. I just do not believe Information Systems and I are a perfect match.

I am not that good with computers and especially Microsoft Office. Therefore I do not think I would be good at this major and it would not be the best fit for me.

Finally, many female students commented that they would be willing to change their major if they found something more “interesting” or that they “loved”. In answer to the question “Briefly describe what would make you change your major before graduation”, female students said:

I would change my major if I took a class that interested me more than accounting.

If there was another subject I found more interesting.

Taking a class that interests me.

If a certain class seemed more interesting to me than the ones pertaining to my current major.

If I find something that I'm more passionate about, and if the work I'm doing for that major doesn't feel like work.

If I fell in love with another major.

If I found something I loved.
4 Limitations

Several factors limit our results. Here, we discuss six of them.

1. **We conducted the study at only one school.** We have little reason to believe that our students differ from those at other schools. Nonetheless, we conducted our experiment in only one class, at one school, and with only one professor as the teacher, which limits the generalizability of our results.

2. **The experimental treatments might have been more effective with alternate resources.** Time and other resource issues limited us to four projects that served as the experimental treatments. To test H2, for example, we selected a Web-design project but recognize that such a project may not have been the best task to use in this experiment. We refined the projects over two semesters using student feedback, but we do not know if other projects would have been better in encouraging female students to major in IS. Similarly, we employed current female student mentors or local IS professionals that were available or kind enough to help us with this project. It is possible that alternates might have been more effective in attracting female students to the field.

3. **Students did not enroll in the treatment section most likely to attract them to an IS major.** As we note above, students self-selected into a treatment section. We have informal evidence that most students chose paths of least resistance (i.e., chose to enroll in the option they thought was most convenient to their schedules or that required the least amount of work). This reasoning, we believe, explains why the signups for H1 (writing a paper) and H2 (completing a project) filled up first but why H3 and H4 (that required four or five obligatory meetings with peer mentors or IS professionals and, therefore, attendance at in-class meetings) were less popular.

4. **Treatments were not intensive enough.** We speculate that, like a weak dose of an effective medicine, our students may not have been exposed long enough, or strongly enough, to the palliatives we tested here. For example, we do not know whether more exposure to the development aspects of IS (H2), women peer mentors (H3), or women IS professionals (H4) would have made a difference.

5. **“Intent to major” is not the same as “did major”.** At our college, students cannot declare a major until they have completed a set of nine business core classes and reached third-year standing at the university. Because most of the students in this class were first-year students, the best we could measure was their intentions. In the future, tracking students over a broader period of time may yield better results. Such results could occur, for instance, if the projects we required of our students planted seeds that resulted in higher declarations of IS majors among our female students in the future. Using larger sample sizes may also prove beneficial in assessing the effectiveness of individual treatments.

6. **Influence of the instructor.** Even an interesting field can be boring if taught by an uncaring or non-dynamic professor. The instructor of record (male) for this class has a reputation as an excellent teacher and, in fact, won our college’s teacher-of-the-year award the same semester we conducted our survey. Several student comments in that survey also gave him high marks for teaching. It is still possible that this instructor negatively influenced the desire to major in information systems, but we doubt it.

5 Summary and Conclusions

By almost any measure, women are underrepresented in the IT industry with subpopulations as low as 10 percent in specific segments of the IT workforce. Can universities help right this gender imbalance? This paper reports how four experiments (interventions)—1) a term paper on the topic “what do IT employees do?”, 2) a hands-on Web-development project, 3) extra classes that required students to meet with female peer mentors, and 4) extra classes that required students to meet with female IS professionals—conducted in a first-year introductory IS class addressed this problem. We based all of these interventions on prior empirical studies. But, both statistically and practically, none of these interventions noticeably increased interest in majoring in IS among our female students. The best we can say is that we now know four palliatives that are not likely to achieve this desirable outcome.
Based on our findings and information in the literature, we speculate that interventions such as the ones we used may also prove more effective if conducted sooner in a young woman's education—for example, before biases or ingrained but inaccurate impressions impact the choice of college major. By the time students reach their first year of college, we found that many women had already committed to alternate majors. Conducting experiments in high school or middle school may prove more effective in changing these perceptions and positively influencing a woman's choice of major.

The role of external influences is another rich area of future research. At present, for example, we do not know how much the influence of a parent or mentor impacts a woman's decision about her college major or the influence of media or teachers. We also know that women are much less confident about their abilities than men. Thus, how much more important is it for women to have direct encouragement/influence than men to help them develop greater confidence? We can also wonder about the influence of male-biased computer games. Would female-oriented games make a difference? At present, these questions remain open and, thus, require additional research. Finally, comments from female students made it clear that they would be willing to change majors if they found interest in an alternate major. Research needs to drill down more deeply to understand what specific aspects of IS could be of greater interest to both men and women.

Acknowledgments

We are indebted to Vale Trujillo, Amoolya Rao, Sofia Aaron, Matt Satre, and Yuvaraj Gaddam for their grading assistance, the student mentors and IT professionals for help with this project, and to the dean’s office of the college of business for financial support.
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Appendix A: Project Descriptions

This appendix contains the assignment descriptions, deliverable statements, and grading rubrics for each of the four projects used in this experiment.

Project H1: Term Paper

Students had to answer the overall question “what do IS professionals do?”. We intended the question to help students become more familiar with some of the tasks that IS employees perform and perhaps dispel such myths as that IT employees mostly sit in windowless cubicles, eat Cheetos, and program in the dead of night. The major deliverable was a four-page term paper (not including bibliography), properly cited, that answered such specific questions about the IS professionals and type of work professionals they do as:

1. What do IS professionals do? Do all professionals work in the same type of job, or are their several categories of jobs? Are most of these jobs at the same level of an organization chart, or are some jobs higher than others?
2. How much training do IS professionals need? What skills are required by IS professionals? Do most such professionals need a bachelor’s degree in computer science, or do training needs vary by job, company, or some other criteria?
3. How much money do IS professionals earn? Do all IS workers earn about the same amount, or do their salaries vary from person to person? Are there any hourly workers? Do IS salaries vary by type of job or by area of the country? How do these salaries compare to other professional jobs like accounting?
4. Are there professional certifications that IS personnel can obtain? What organizations administer these certifications? What are the requirements for maintaining these certifications, are there continuing credits needed?
5. What are some of the concerns about gender in the IS workplace? Why are they concerns? What are businesses doing to address them?

The correct answers to the above questions were worth 60 percent of the project grade. We evaluated the answers in the term paper on a 0 to 5 point scale: missing = 0, poor = 1-2 correct, average = 3 correct, good = 4 correct, and excellent = 5 correct. Providing the correct citations and bibliography entries was worth 20 percent of the students’ grade for this project. The final 20 percent of the grade was for proper writing mechanics such as grammar, spelling, punctuations, and so on.

Project H1: Deliverables

This project had two deliverables:

1) Term paper. Paper should be a minimum of four pages in length, (not including your bibliography). Paper should address each of the five questions above. Your paper should cite specific examples or statistics rather than (your) opinion. Mostly, these facts or examples will come from other sources that should be properly cited with references embedded in the text of your paper. Each such citation should have a matching reference in the bibliography portion of your paper. Format of paper should conform to the MLA documentation style.

2) Bullet point table. All of the questions above should be discussed in your paper. To make it easier to find, create a table and include it in your paper that shows where the question is discussed in the paper by paragraph number. The format of the bullet point table is given below.
Project H2: Website Design

We intended this project to help students better understand the ways in which information systems can benefit society as a whole. In order for them to explore these possibilities, they created their own charity (even if it was similar to one that already existed) and designed a website that acted as a tool to share information about and promote your charity. To be successful in this project, students needed to complete the following deliverables:

1. **Create a professional website.** Create a professional website using WordPress as a content management system. The website needed to be visually appealing using a quality theme and must include a minimum of three pages with content (text and images) that is specific to the charity. Some examples of pages include “home”, “about the charity”, “how you can help”, “contact us”, and so on.

2. **Design a logo.** Using Adobe Photoshop, which is available on the COBA Lab computers, design a professional logo and incorporate this logo into the website. It should be easily identifiable as a logo.

3. **Create a small community using a blog post.** Create a single blog post on the website that is easily accessible and solely intended to build awareness about the charity. Students could simply post about why they chose the charity and why they found it to be important, or they could be more creative and do something such as create a fake fundraising event that they used their blog to provide information about. We encouraged the students to be creative with their blog post topics. Regardless of the topic, they needed to find four other students (not necessarily in IS101) that would read their blog post, create accounts on their website, and comment on their post. In turn, they needed to respond to each of the comments.

4. **Write a 1-2 page report.** This report needed to briefly detail the charity that students created and the website they created to promote that charity. Assuming social networks like Facebook, Twitter, LinkedIn, and so on did not exist (because they are also just websites), students had to discuss how they would have accomplished the same goal of providing information about their charity and creating a community of individuals to read about and share their cause without a website. They needed to consider the difference in time, money, and resources that would have been necessary to accomplish the same goal without a website and include their thoughts on those differences.
Project H2: Deliverables

This project had three deliverables:

1) **Professional website w/logo incorporated.** Each website needed to have a professional theme installed and activated (not one of the preinstalled WordPress themes). It needed to include a logo in the header and at least three pages with quality content (text and images).

2) **Blog post with community interaction.** Students needed to select a blog topic to raise awareness about their charity and write a blog post on that topic. They needed to find four separate students (not necessarily in IS101) to create accounts on their website and comment on their topic. They needed to interact with them by replying to the comments.

3) **Report.** The report needed to provide detail about the charity the students created, why they found it to be important, the experience they had creating the website, and give some insight as to how they would reach the same goals of raising awareness without a website.

### Grading Rubric

<table>
<thead>
<tr>
<th>Description</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Missing</td>
</tr>
<tr>
<td>Professional Website w/Logo</td>
<td>0</td>
</tr>
<tr>
<td>Blog Post w/Community Interaction</td>
<td>0</td>
</tr>
<tr>
<td>Report</td>
<td>0</td>
</tr>
</tbody>
</table>

*Figure A4. Project H2 Grading Rubric and Table Format*

Project H3: Student Mentor Assignment

We assigned advanced-level students from among the information systems student population as student mentors to different groups of incoming students from the IS101 class; we assigned female mentors to female students and male mentors to the male students from the class. The mentors met regularly throughout the semester with their student groups at scheduled meetings.

Attendance at the group meetings was worth 60 percent of the student’s grade for this project, and students had to attend at least four of the five one-hour meetings in order to obtain full credit for the project. In addition, students had to write four journal entries of approximately 250 words in length detailing what they learned from each meeting, which was worth 20 percent of the project. We evaluated the completed journal entries on a 0 to 5 point scale: missing = 0, poor = 1, average = 2, good = 3, and excellent = 4. The journal entries had to contain one entry per meeting and relate what the student learned from their mentors based on the following questions:

- **A)** What classes are required to become an information systems professional?
- **B)** What types of activities are completed in an information systems class?
- **C)** What prerequisite preparation is needed to succeed in an information systems class?
- **D)** How do the study techniques that you actually used in high school differ from those required to succeed in college?
- **E)** What kinds of study techniques help students succeed in information systems classes?
- **F)** What are the general policies required in information systems classes, (homework, attendance, hours of work, etc.)?
- **G)** Is it necessary to work as part of a group in all information systems classes?
- **H)** How much experience with computers do other students have when they start a degree in Information Systems?
I) What is the background of the mentor you are meeting with, (did they start college intending to major in information systems, did they work with computers in high school, what are their favorite classes, etc.)?

J) How do the classes for an information systems professional differ from those required for a computer scientist?

K) What careers are available for students majoring in information systems?

L) Are there any clubs/student organizations available for students majoring in information systems?

M) What activities should the student do to make themselves more employable after graduation?

N) Do you need to know about different types of computers to be successful in an information systems major?

The final 20 percent of the students’ grade for this project was based on the student’s submitting a table that indicated the location where they discussed each of these questions in their journals.

**Project H3: Deliverables**

This project had three deliverables:

1) **Attendance at group meetings with other IS101 students and advanced-level information systems students.** There were five one-hour group meetings scheduled during the project time period. Students had to attend at least four of the meetings to get full credit for the assignment. For each additional meeting that they missed, they lost 15 percent of the points for the project.

2) **Journal.** The journal had to detail what the students did and learned at each meeting with the advanced-level information systems student assigned to their groups. Their journal entries needed to provide information about what they learned related to the bullet points A to N. Each meeting needed one entry, and each entry needed to be approximately 250 words in length.

3) **Bullet point table.** Students needed to discuss most of the 14 questions above (A-N) somewhere in a journal entry. For example, they could have learnt about the background of the advanced-level information systems student in the first meeting, so they could have written about the bullet point I in their first journal entry. To make it easier to find the questions, they had to create a table on a separate page in their journals that showed where they discussed each one. We show the format of this table below.

```
<table>
<thead>
<tr>
<th>Bullet Point</th>
<th>Journal Page</th>
<th>Bullet Point</th>
<th>Journal Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>H.</td>
<td>B.</td>
<td>I.</td>
</tr>
<tr>
<td>C.</td>
<td>J.</td>
<td>D.</td>
<td>K.</td>
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<tr>
<td>E.</td>
<td>L.</td>
<td>F.</td>
<td>M.</td>
</tr>
<tr>
<td>G.</td>
<td>N.</td>
<td></td>
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```

**Grading Rubric**

<table>
<thead>
<tr>
<th>Description</th>
<th>Missing</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Attendance (60% of the project)</td>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4-5</td>
</tr>
<tr>
<td>4 journal entries (20% of the project)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Bullet Point table: Journal entries address all 14 bullet points (20% of the project)</td>
<td>0</td>
<td>1-4</td>
<td>5-7</td>
<td>8-10</td>
<td>11-14</td>
</tr>
</tbody>
</table>

*Figure A3. Project H3 Grading Rubric and Table Format*
Project H4: IS Professional Role-model Assignment

Professionals from the IS community volunteered their time to speak with the students in one-hour Q&A sessions. The professionals related their experiences and the particular paths they took to become IS professionals. We conducted the sessions over an eight-week period and segregated them by gender: female professionals spoke with the female students and male professionals spoke with the male students.

Students had to write a report for this project between 1,200-1,600 words worth 25 percent of the points for the project. We evaluated the report based on a 0 to 4 point scale: missing = 0, poor = 1, average = 2, good = 3, and excellent = 4. The report had to contain a different section for each professional with the professionals responses to the below questions along with the students’ view of the professional and what they might have learned that they could apply to themselves.

A) What is the professional's career journey-line?
B) How does the professional stay current with technology?
C) What are the basic company statistics where the professional is currently working?
D) What type of networking events has the professional attended or do they plan to attend?
E) What opportunities have the professionals taken to give back to the community?
F) What are the professionals’ career goals for the future?
G) What does a typical day/week look like for the professional?
H) What part of their job would the professional change if they could?
I) What current issues are facing the professional?
J) How does their family life impact their work life and vice versa?
K) What did you think of the professional?
L) What have you learned that you can apply to yourself?

The final 15 percent of the students’ grade for this project was based on the students’ submitting a table that indicated the paragraph location for each of the questions that they discussed in their reports.

In total, seven women professionals came to the university to speak with the female students from the IS101 class. They ranged from applications specialists and analysts that the university employed to IS managers and system analysts that various companies from the community employed. Their individual years of experience ranged from 10 years to over 30 years in the IS field.

Six of the women professionals spoke at two different sessions, while one professional only spoke at one session. Most sessions were evenly attended, though 24 female students attended at the heaviest attending of the sessions and four female students attended at the least attending of the sessions. The attendance averaged out to about 17 female students’ hearing each women professional speak.

Project H4: Deliverables

This project had three deliverables:

1) Attendance at group meetings with professionals from the industry. We scheduled eight one-hour Q&A sessions scheduled during the project time period. Students needed to attend at least four of the meetings to get full credit for the assignment. For each meeting that they missed, they lost 15 percent of the points for the project.

2) Report. Students had to write one report (about 1,200-1,600 words for the project). They had to make sure that the report contained a section for each of the professionals that they met. The final section of the report needed to discuss bullet point L.

3) Bullet point table. Students needed to discuss most of the questions (A to L) in the report. To make it easier to find the questions, they had to create a table on a separate page in their journals that showed where they discussed each one. We show the format of this table below.
### Grading Rubric

<table>
<thead>
<tr>
<th>Description</th>
<th>Missing</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Attendance (60% of the project)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4-5</td>
</tr>
<tr>
<td>1 Report (25% of the project)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Bullet Point table: Reports entries address all 12 bullet points (15% of the project)</td>
<td>0</td>
<td>1-3</td>
<td>4-6</td>
<td>7-9</td>
<td>10-12</td>
</tr>
</tbody>
</table>

*Figure A4. Project H4 Grading Rubric and Table Format*
About the Authors

Lisa Anderson has been working in the technology industry in the Reno area for over 20 years. She earned a BS in ACC/IS at the University of Nevada, Reno before going on to earn an MBA and an MIS Master degrees from UNR. She has also received her PMP Certification in Project Management. She is a Manager of Integration Support for Coupa Software, a leader in e-procurement in the business spend industry, where she manages the Americas support team. She is a part-time faculty member lecturing for the College of Business where she shares her passion for IS with her students in the Managing Information Systems class.

Dana Edberg has been on the faculty of the University of Nevada, Reno since 1983. She serves as department chair of Information Systems. She has taught a wide variety of classes in information systems including database design, data resource management and systems development. Her research explores the types of interpersonal and learning relationships developed in organizations to best support the implementation and use of technology. Her work has been published in journals such as Journal of Management Information Systems, Journal of Information Systems Applied Research, Health Systems and Information Systems Management. Her technology-related professional work experience includes software engineering project management, database design, and the implementation of large scale systems in government and industry. She is currently researching health information systems and worked with a team from the university to evaluate the implementation of a statewide health information exchange.

Adam Reed is an Information Systems Lecturer at the University of Nevada, Reno. He has been a member of the faculty since 2014 teaching introductory and intermediate Information Systems courses, which primarily focus on spreadsheets, database design and development, web development, information systems in business, and general computing concepts. He has an array of technology-related work experience in the corporate world where he has worked with companies such as Google, Dell, and Walmart to facilitate process improvements around product logistics. He came to the University of Nevada Information Systems department after working for three years in a government role where he worked with the local school district to utilize technology in order to enhance processes associated with the understanding and analysis of student learning and growth for K-12 students.

Mark G. Simkin is a professor of information systems in the College of Business at the University of Nevada. Prior to joining the faculty in 1980, he taught at the University of Hawaii and worked for the Industrial Development-Finance division of IBM. The 14th edition of his book, Accounting Information Systems (coauthored with James Worrel and Arline Savage), will be published by John Wiley and Sons this fall. His publications include works in the Isaca Journal, the Journal of Business Ethics, the Journal of the American Statistical Association, Decision Sciences, Communications of the Association for Information Systems, and the Communications of the Association for Computing Machinery. His research interests include the study of gender equity in information systems, student conduct in information systems, and pedagogical theory and practice as it applies to IT.

Debra Stiver is a lecturer and business statistics coordinator for the Department of Economics at the University of Nevada, Reno. She has been a statistical consultant for a variety of organizations and agencies including the U.S. Chamber of Commerce, Nevada State Board of Nursing, Nevada Department of Wildlife, and the Washoe County Regional Transportation Authority and has held several positions for the Nevada Chapter of the American Statistical Association, where she currently serves as the state president. Her primary research interests are centered on economic development and environmental issues in developing countries. She is a senior board member for International Development Missions, Inc., a northern Nevada NGO that focuses on education, women's issues, healthcare, clean water, environmental and other community projects, primarily in East Africa.

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