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Technology Skill Development Among Education Majors

By Chad Sherman

ABSTRACT

This study sought to determine the influence that numerous variables have on the technology skill development of education majors. The study investigated how the participants' age, gender, race, ethnicity, level of comfort with technology, and learning style(s) correlated with their level of digital literacy. The results revealed that level of verbal-linguistic intelligence significantly correlated with the subjects' level of digital literacy, whereas the other seven multiple intelligence variables did not yield significant findings. Further statistical analysis demonstrated that each of the multiple intelligence variables (including level of verbal-linguistic intelligence) had a weak correlation with level of digital literacy when isolated from the other variables. Each one of the independent variables was found to be a poor predictor of the education majors' technology capabilities. Therefore, this article suggests that these variables (age, gender, level of prior technology use, etc.) should not be relied upon to predict a student's technology skills.

Key words: Digital literacy, Multiple intelligences, Educational technology, Learning styles

INTRODUCTION

This study sought to determine the influence that numerous variables had on the development of technology skills in education majors. According to some studies, college students display high levels of use of and comfort with computers and other digital tools (Smith, Salaway, & Caruso, 2009). Several scholars have tried to determine which variables most affect an individual's digital skills, but their findings have been inconclusive. Specifically, education majors are a substantial focus for analysis, because of the importance that has been placed on their digital competency (Banister & Vannatta, 2006). It has also been proposed that the digital skills of education majors are not sufficient for today's world.

PROBLEM STATEMENT

Banister and Vannatta (2006) acknowledged that many teacher candidates have deficiencies in their digital technology skills that should be addressed. Additionally, research is inconclusive about which demographics affect digital literacy (Barbour & Cooze, 2004; Dednam, 2009; Eshet, 2002; Eshet-Alkalai & Amichai-Hamburger, 2004; Eshet-Alkalai & Chajut, 2009; Hargittai, 2002; Hargittai, 2010; Smith et al., 2009). The literature, however, suggests that a student's learning style may correlate with that person's digital literacy. Several theorists have speculated that coordinating learning technologies with a student's learning style can provide a stronger educational experience (Gen, 2000; McCoog, 2007). Empirical evidence also suggests that there is a connection between a student's learning style and achievement in a technology-laden course (Barbour & Cooze, 2004.

Research Questions

The following research questions were developed:

- Does a preservice education major's verbal-linguistic intelligence significantly affect his or her score on a digital literacy assessment?
- Does a preservice education major's visual-spatial intelligence significantly affect his or her score on a digital literacy assessment?
- Does a preservice education major's logical-mathematical intelligence significantly affect his or her score on a digital literacy assessment?
- Does a preservice education major's musical-rhythmic intelligence significantly affect his or her score on a digital literacy assessment?
- Does a preservice education major's bodily-kinesthetic intelligence significantly affect his or her score on a digital literacy assessment?

- Does a preservice education major's interpersonal intelligence significantly affect his or her score on a digital literacy assessment?
- Does a preservice education major's intrapersonal intelligence significantly affect his or her score on a digital literacy assessment?
- Does a preservice education major's naturalistic intelligence significantly affect his or her score on a digital literacy assessment?
- To what degree does the interplay between the eight multiple intelligence learning styles predict preservice education majors' level of digital literacy?

Hypotheses

The alpha level for this study is $p = .05$. The following hypotheses were developed:

- A preservice education major's verbal-linguistic intelligence positively affects his or her score on a digital literacy assessment.
- A preservice education major's visual-spatial intelligence positively affects his or her score on a digital literacy assessment.
- A preservice education major's logical-mathematical intelligence positively affects his or her score on a digital literacy assessment.
- A preservice education major's musical intelligence does not significantly affect his or her score on a digital literacy assessment.
- A preservice education major's bodily-kinesthetic intelligence does not significantly affect his or her score on a digital literacy assessment.
- A preservice education major's interpersonal intelligence does not significantly affect his or her score on a digital literacy assessment.
- A preservice education major's intrapersonal intelligence does not significantly affect his or her score on a digital literacy assessment.
- A preservice education major's naturalistic intelligence does not significantly affect his or her score on a digital literacy assessment.
- The eight multiple intelligence learning styles predict preservice education majors' level of digital literacy.

Review of the Literature

Gardner's theory of multiple intelligences (1983) offered an improved method to describe intelligence and put a focus on individualized education. The theory was developed to focus on how a student prefers to learn--an approach not commonly seen in education until recent decades (Gardner, 2003; Teele, 2000).

Gardner theorized that each student has a unique set of intelligences to which they adapt their learning processes. Each student learns in an individual manner (Gardner, 1993a, 1999, 2003; Teele, 2000). Varying types of instruction are required to stimulate and encourage students to utilize their own unique learning styles. Gardner's theories have been applied mostly to educational psychology, but they also can be applied to digital literacy (Barbour & Cooze, 2004; Gen, 2000; McCoog, 2007; McCoog, 2010) and to education (Campbell, 1990). Gardner (1993b) also theorized that multiple intelligence theory could be combined with digital literacy. He argued that computers can be utilized to match individuals to a mode of instruction that is best suited to their intelligence. Gardner (1995) added that this combination forms the foundation for a great education. Other scholars have argued that digital technology can be used to great such a foundation (Gen, 2000; Grant, 1999; Leu, Leu, & Len, 1997; McCoog, 2007; Silver, Strong, & Perini, 2000).

Limited Effects of Several Demographics

Several demographics may correlate with an individual's digital literacy abilities. However, the literature in this area is inconclusive at best. Because the literature concentrates heavily on these demographics, they will be briefly discussed.

Age

Eshet's (2002) qualitative study suggested that a relationship exists between age and digital literacy. Eshet-Alkalai and Amichai-Hamburger (2004) found that adults scored significantly

lower than other age groups. Eshet-Alkalai and Chajut (2009) conducted a follow-up study and found similar results.

Other researchers have identified mitigating factors. For example, Hargittai (2002) argued that such findings were likely due to their varied levels of comfort with technology. Likewise, van Deursen and van Dijk (2008) similarly suggested that extraneous variables likely were more accountable for variations in digital literacy than age. Other researchers have failed entirely to find a correlation between age and digital literacy (Hargittai, 2012; Koroghlanian & Brinkerhoff, 2008).

Gender

Shashaani (1997) identified significant differences between the attitudes of males and females regarding computers. However, the study specifies that previous experience is likely the source of the difference. Similarly, Comber, Colley, Hargreaves, and Dorn (1997) proposed that males have more confidence when using computers. When previous was controlled for, the researchers found no statistically significant differences.

It has been suggested that men and women also differ in their usage of specific computer technologies. Men are more intensive Internet users than women (Bimber, 2000) and use the Internet more frequently (Jones, Johnson-Yale, Millermaier, & Pérez, 2009). Others (Jackson, Yong, Kolenic, Fitzgerald, Harold, & Von Eye, 2008) have suggested that men and women significantly differ in the intensity and nature of their technology use.

Gender also may predict how an individual applies technology to his or her life. Van Braak, Tondeur, and Valcke (2004) found that male teachers integrate computers into their classrooms more often. Karsten and Schmidt (2008) discovered that female business students scored significantly lower on a measure of computer self-efficacy. Koroghlanian and Brinkerhoff (2008) found significant differences indicating that males have higher digital literacy than do females. Males also scored significantly higher on an assessment of several digital skills (Butler, Ryan, & Chao, 2005).

Socioeconomic Status

Studies have shown that socioeconomic status correlates with an individual's own perception of digital literacy capabilities (Hargittai, 2010). Similarly, Jackson et al. (2008) found that students' socioeconomic characteristics were an accurate judge of the intensity and nature of the students' technology usage.

Race and Ethnicity

According to Hargittai (2010), race affects individuals' self-perceptions of their digital skills. Specifically, African American and Hispanic students rated their digital knowledge more poorly than did Caucasian students. Jackson et al. (2008) found similar differences between African American and Caucasian children in the intensity and nature of their technology use.

Several studies have suggested that race is not an accurate predictor of digital literacy. For example, Jackson et al. (2008) concluded that prior experience with technology is a better predictor. Further, Jackson, Yong, Witt, Fitzgerald, von Eye, and Harold, (2009) failed to identify a significant difference between participants of different races. Also, Jones et al. (2009) failed to find a significant difference between participants of different races.

Technology Experience

Researchers van Deursen and van Dijk (2008) found experience to be a significant predictor of an individual's digital technology capabilities. Both the number of years with technology access and the number of hours spent per week with technology positively relate to an individual's digital skills (Hargittai, 2010). Even students who had taken one advanced computer class did better on several technology assessments (Koroghlanian & Brinkerhoff, 2007). Similarly, the level of integration of technology in high school education has an effect on how much an individual will value technology later (Banister & Ross, 2006). However, some scholars counterpropose that previous experience with computers does not affect a student's digital literacy (Comber et al., 1997).

Education

Some scholars have stated that level and quality of education has an impact on digital literacy. Teske and Etheridge (2010) argued that honor students are more digitally literate than non-honors students. Although, van Deursen and van Dijk (2008) only found education to be

a significant predictor of the time it takes to complete digital tasks. Bonfadelli (2002) contradicted the previous studies and claimed that education level cannot be used to predict digital literacy, but it can be used to predict how an individual may use it.

Education Majors' Multiple Intelligences and Digital Literacy

The digital and technological skills of teacher candidates vary greatly (Banister & Ross, 2006). For these teacher candidates to effectively integrate technology into their future classrooms, they must first acquire the skills themselves. Martinez (2010) similarly posited that education majors must learn the technology skills before they can teach it to others. Teaching cannot be as effective without successful implementation of information and communication technology (Ertmer & Ottenbreit-Leftwich, 2010).

Application of Multiple Intelligences to Digital Literacy

Digital technologies can effectively be used to teach students who have an assortment of intelligences. Gardner (1993b) commended the ability of technology to help students meet and surpass educational goals. He advised that students' primary intelligences should be matched with appropriate technology. This combination is likely to improve the students' learning (Gardner, 1995). Further, several scholars have listed specific digital tools and lessons that can advance the digital classroom experience (Gen, 2000; Grant, 1999; Leu et al., 1997; McCoog, 2007; Silver et al., 2000). Although empirical evidence in the literature is limited, it may be possible to predict a student's score on such digital assessments by knowing his or her dominant intelligence(s). For example, it was found that musical and verbal-linguistic learners performed more poorly in a class delivered online (Barbour & Cooze, 2004). Other scholars also have established that learning improves when the teacher matches the selected digital technologies with the students' intelligence profiles (Gen, 2000; McCoog, 2007). Overall, technology in the classroom is vital because it has an excellent capacity to engage and challenge students (Grant, 1999).

MATERIALS AND METHODS

The study sought to examine the relationship between preservice education majors' multiple intelligence learning styles and their levels of digital literacy. A quantitative survey was employed for this study. The independent variable was the subjects' scores on a multiple intelligences assessment. The dependent variable was the subjects' scores on a digital literacy assessment. The alpha level for this study is $p = .05$.

Procedure

All participants were assigned a username and password for admittance to the digital literacy assessment. Students could not be identified by their usernames. All participants were enrolled in a digital technology course. Their instructors were not informed about which responses were made by any particular student.

Subjects in this study completed three stages of data collection. First, data was collected on the students' demographics. This step was administered to determine the heterogeneity of the sample. This step used a descriptive survey. This survey was administered online through Qualtrics.

Second, the students' learning styles were measured using an assessment developed by Gürcüm (2010). This survey was also administered online through Qualtrics.

Third, each participant's digital literacy was assessed through the Instant Digital Competence Assessment developed by Calvani, Cartelli, Fini, & Ranieri (2009). It was administered online through the Instant Digital Competence Assessment website. Students were required to provide their anonymous usernames for each step so their responses could be matched.

Setting

This study was conducted at Indiana University of Pennsylvania where education majors are required to meet the International Society for Technology in Education's NETS standards. The study was administered online.

Population and Sample

All participants (n =101) included in the study were enrolled in one of ten digital instructional technology courses. Participation in the study was voluntary. Students were not included in the sample if they had previously been enrolled in one of the courses. This was done to control for prior knowledge and to minimize threats to external validity. The survey was administered during the first two weeks of the semester.

Instrumentation

A seven-item descriptive questionnaire was used to describe the sample. The assessment measured several variables recognized in the literature review: age, gender, socioeconomic status, prior technology experience, education level, and race.

Each subject's multiple intelligences learning style was measured using a 142-item multiple intelligences inventory designed by Gürcüm (2010). The inventory was comprised of Likert-type questions. The instrument's coefficient of reliability is acceptable (.943).

The participants' digital literacy was measured through the Instant Digital Competence Assessment (iDCA) developed by Calvani et al. (2009). The iDCA was designed to match the authors' model of digital competence (Calvani et al., 2009).

The assessment was found to be valid by a panel of experts (Calvani et al., 2009). The instrument was found to have an acceptable level of reliability (Cronbach's alpha = 0.79).

RESULTS

The data was coded into an electronic spreadsheet. All data was merged into one electronic spreadsheet. The data was ordered by each participant's numeric username.
Several descriptive statistics were analyzed to describe the sample. This step examined the heterogeneity of the sample. Next, a Pearson's r correlation cross-tabulation was used to determine whether any of the eight multiple intelligence learning style categories correlated with digital literacy. Lastly, a multiple linear regression test was used to determine the degree to which the interplay between the eight multiple intelligence learning style variables predicted the score on the digital literacy assessment.

Description of the Sample

Several statistics were analyzed to describe the sample. The examined demographics were identified in the literature review: age, gender, socioeconomic status, prior technology experience, education level, and race. The statistics indicate that the sample is relatively homogenous.

Age

A majority of the students in the sample were between the ages of 18 and 20 (88.1%). Participants aged 21 years or older constituted 11.9% of the sample. No participants were under the age of 18.

These results were anticipated because most education majors at the host university are required to enroll in the digital instructional technology course during their freshman or sophomore years.

Gender

Most students included in the sample for this study were female (70.3%). Less than one third (29.7%) of participants were male.

Parental Education

A majority of students (77.2%) indicated that their parents' education levels included at least some college. Less than one quarter of the students (22.8%) stated that their parents had a high school degree or less.

According to Sewell (1971), this percentage of college-educated parents indicates that most of the participants in this study had a relatively comfortable socioeconomic status. Therefore, the students included in the sample for this study should have been capable of receiving an acceptable mark on a digital literacy assessment (Hargittai, 2010).

Technology Experience

Most participants (94%) signified that they had familiarity with digital technologies for at least 6 years, and a large proportion stated that they had at least 10 years of experience.

The students had a significant amount of experience using digital technologies. This is comparable to the findings of Smith et al. (2009; however, it does not indicate that the students are also digitally literate. Having access to digital technology does not denote acceptable digital literacy (Hargittai, 2010).

Education Level
A large majority (96%) of the participants held a high school degree and had taken at least one college course. A small proportion (4%) of this sample had previously earned a college degree.

Race/Ethnicity
The majority of respondents (94.1%) identified themselves as White/Caucasian. Small proportions identified themselves as Black/African American (4%), Hispanic (1%), and Asian (1%).

These distributions are not representative of the university. The ratio of White/Caucasian students to minority students is not as exaggerated (Crimson Snapshot, 2011). Because this was a volunteer sample, the results were generalized to a larger population.

The Multiple Intelligence Learning Styles' Relationship To Level Of Digital Literacy
A Pearson *r* correlation cross-tabulation statistic was used to determine if the eight learning styles correlated with the students' digital literacy capabilities. A significant, positive correlation (.188) was found between the participants' verbal-linguistic learning style and their level of digital literacy at the $p = .05$ level. However, the correlation is noticeably weak. The significance (.030) is similarly weak. However, because a positive and significant correlation between the two variables exists, the hypothesis is supported. Correlational analyses failed to find any level of significance between logical-mathematical, visual-spatial, musical-rhythmic, bodily-kinesthetic, interpersonal, intrapersonal, and naturalistic learning style and digital literacy. The hypotheses are, therefore, not supported.

The Multiple Intelligences Learning Styles as Predictors of Digital Literacy Capabilities
A multiple regression analysis was also conducted. The eight multiple intelligence learning styles were used as the independent variables. The students' scores on the digital literacy assessment were used as the dependent variable. This analysis sought to determine how well the multiple intelligence learning styles work together to predict an individual's digital literacy.

The multiple intelligences model as a whole was a poor predictor of the participants' digital literacy ($r = .255$). The low *r*-squared value (.065) similarly supported this finding.

The multiple regression results did not identify any significant correlations between each of the eight multiple intelligences and the digital literacy variable. The strongest coefficient was found with the verbal-linguistic variable ($b = .062$, $p = .019$). This was expected, given the significant finding of the Pearson *r* analysis. The multiple regression analysis minimizes this finding.

CONCLUSION

This section will summarize the outcomes of the previous chapter and include a discussion of the relationship between the eight multiple intelligence variables and level of digital literacy.

Verbal-Linguistic Intelligence

Verbal-linguistic intelligence was found to have a significant, positive correlation to the education majors' digital literacy. This contradicts the findings of Barbour and Cooze (2004), which indicated that verbal-linguistic learners perform more poorly in a digital environment.

Further analysis, however, determined that verbal-linguistic intelligence did not have a significant correlation with digital literacy. This does not support the theories of researchers who theorized that verbal-linguistic learners might perform well in digital environments (Gen, 2000; Jackson et al., 2009; Leu et al., 1997). This finding does not conflict with Gardner's (1983, 1995) notion that a learner's verbal-linguistic learning style should correspond with his/her score on a verbal-linguistic assessment.

The Remaining Learning Styles

The remaining multiple intelligence learning style variables did not significantly correlate with level of digital literacy. This finding contradicts the theoretical base of this study, which was developed from Gen (2000), Grant (1999), Leu et al. (1997), McCoog (2007), and Silver et al. (2000). When the eight independent variables were analyzed as a whole, none were found to have a significant correlation with digital literacy. These eight multiple intelligence variables are not accurate predictors of participants' level of digital literacy. A student's learning style should not be used to predict his/her score on a generalized digital literacy assessment.

Multiple Intelligences as a Model for Predicting Level of Digital Literacy

Gardner's (1983) claim that individualized instruction should be matched with similarly individualized assessment strategies is the foundation of the multiple intelligences theory. The use of a general (rather than individualized) assessment in this study also may explain why the learners' scores varied so greatly—a finding that is reinforced by the work of Banister and Vanatta (2006). Therefore, it is recommended that future studies in this area utilize an individualized assessment plan.

The Other Variables

Several other independent variables similarly were found to be poor predictors of the subjects' technology capabilities. Some of the findings (e.g., gender) support the findings of other notable studies. However, some findings (e.g., level of prior technology use) contradict findings that state that people with higher technology experience should score higher on an assessment of their technology skills. This was not seen in this study, however. Therefore, it cannot be suggested that any of the independent variables analyzed for this study can be claimed as accurate predictors of an education major's technology skills.

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Effect of pre-defined Color Rendering Intents (CRI) on the Hue attributes in a Color Managed Workflow (CMW)

By Dr. Haji Naik Dharavath and Uttam Kokil

ABSTRACT

The purpose of this study is to determine the influence of applied International Color Consortium (ICC) predefined color rendering intents on the digital printing solid colors output (Cyan, Magenta, Yellow, and Black ([CMYK]) hue and gray output (Overlap of CMY: 50%, 40%, and 40% tints) hue variation among the four ICC standard color rendering intents in a color management workflow (CMW). The experiment analyzed the effect of four ICC-specified color rendering intents (absolute, perceptual, relative, and saturation intents) on the digital color output hue of gray and solid colors. The objective of this study allowed testing of an accepted color management practice to gain a better understanding of the presumptions associated with the application of rendering intents. The experiment examined the four ICC color rendering intents as independent groups (K = 4) using a one-way analysis of variance (ANOVA) with equal n's method (at $\alpha = 0.05$) to determine the significant colorimetric variation (COLVA) of hue between the (K = 4, n = 15, and N = 60) group means (averages) color deviations of these intents. With four rendering intents (groups, K = 4), a one-tailed, non-directional hypothesis was established. The conclusions of this study are based upon an analysis of ANOVA test data and associated findings. The data from the ANOVA reveal significant differences in the gray hue deviation of the reproduction among the multiple ICC color rendering intents (CRI). The colorimetric data suggests that selection of a rendering intent is an important activity in a CMW as it relates to obtaining accurate output colors for a desired purpose.

Keywords: Calibration, Color, Colorimetry, Gamut, Profiling, Proof, Color Rendering

INTRODUCTION

Modern printing technology has evolved from the craft oriented field toward a color management science demanding greater color reproduction control among the devices used in the print and imaging industry. Graphic or printing workflow is represented through schematic illustrations of activities that reflect the systematic organization of analog and digital devices used during the print and image production process. In a quest to empower students to better understand the attributes of various hue variables, this work examined standardized rendering defaults similar to those a student would encounter through software that manages color manipulation and drives output (or printing) devices, such as a laser color printer, an inkjet printer, or a digital color press. Hence, for a student to consistently deliver a quality print, managing and controlling color from the input device to a multicolor output device is a major concern for the graphics and imaging educator.

Color can be viewed as a science where the optical aspects of color can be quantitatively analyzed and measured. The human eye, however, perceives color more subjectively, which poses a challenge at times for the print and image reproduction industry. Advancements in science and engineering, however, have allowed print and image professionals to apply scientific research methods across prepress, pressroom, and quality control areas. Teaching these methods to students will heighten their recognition of the importance of proper workflow. Unfortunately, the use of color management systems has not yet solved all of the problems of color reproduction (Fleming & Sharma, 2002), such as acceptance of linear colors, reproduction of neutral gray-balance, effect of rendering intents, level of ΔH or ΔE acceptance, and so forth. Hence, this has given rise to quantification of color problems (Fleming & Sharma, 2002).

Color Management System (CMS)

In a color-managed workflow, the device characterization is presented in terms of specially formatted files (known as profiles or device characterization). A CMS or a CMW uses a set of hardware tools and software applications to create accurate color among various input,

display, and output devices. A CMS consists of device profiles (or characterization of devices), which control and document the working performance of the scanner, monitor, and printer. A device color transformation engine (color management module or CMM) interprets the color data among the scanner, display, and printer. The gamut compensation mechanism of the CMS addresses differences among the color capabilities of input, display, and output devices. The profile connection space (PCS) is a device-independent color space through which all color transformation occurs from one device-dependent color space to another (see Figure 1). The PCS is based on the spaces derived from CIE color space. Apple ColorSync supports two of these spaces: L* a* b* and XYZ. The color conversion from device-dependent color space to device-independent color space is achieved by the use of PCS. The device color characterization file (profile) passes in and out of the PCS to complete the transformation. The PCS of the CMS is the central hub of the CMS in which a particular color value is considered absolute and not subject to interpretation.

ICC Color Rendering Intents

According to ICC, color gamut mapping can be completed by one of the four ICC recognized colorimetric rendering intents: *perceptual, absolute, relative, and saturation*. The rendering intent determines how the colors are processed that are present in the source gamut but out of gamut in the destination (output). Rendering intents compiled by the ICC are "specifically defined for the purpose of cross-media reproduction using color management systems" (Morovic, Green, & MacDonald, 2002, p. 307). In essence, intents are large lookup tables (LUT) that prescribe the range of RGB or CMYK values to an output device. Because the 16.7 million color choices (224) in an eight-bit color scheme (RGB mode) or 4.3 billion color choices (232) in CMYK mode are unmanageable, intents are employed. Each rendering intent tends to be associated with select types of images and/or workflow stage situations, such as characteristics of the original, as well as reproduction media and its viewing conditions. These four intents– *perceptual, saturation, absolute colorimetric, and relative colorimetric*—are intended to produce uniquely different results and thereby have migrated toward selection based on general use guidelines (Green, 2010).

Perceptual, also referred to as the photographic rending intent, is said to emphasize retention of relationship between colors, whereas colorimetric intents are thought to be high accurate in-gamut colors and saturation that deliver more colorful images (Sharma, A., 2004). The aim of the perceptual rendering intent is generally to be pleasing, placing reproduction accuracy secondary while maintaining relationships between colors. This intent compresses or expands the gamut of the image to leverage attributes of the destination device.

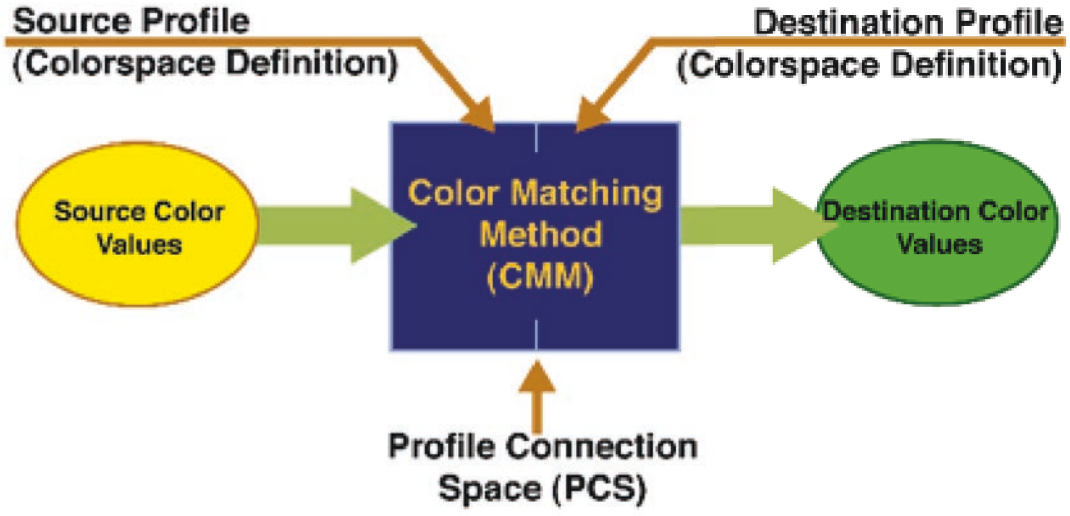

Figure 1. Schematic of PCS of CMS (Courtesy of Adobe Systems, Inc.)

In this case, colorimetric accuracy may be compromised (Morovic et al., 2002).

Saturation rendering is believed to be the vendor-specific intent, because this technique is mostly used with graphics and text with little regard for color per se. By saturating the pixels in the image, hue and lightness are discounted. Similar to perceptual rendering, this intent seeks to adjust for different devices, media, and viewing conditions. Many researchers suggest that it is suited most for images that incorporate charts and diagrams (Sharma, G., 2003).

Absolute rendering intent strives to create exact colors. It is used to predict how an image will appear when printed on a specific substrate. In this situation, although colors that equate between the original and the print are unchanged, those out-of-gamut are clipped. With this intent, the reproduction will theoretically match the original if the paper matched. Proofing often uses this intent.

Relative colorimetric and absolute intents use clipping where a gamut boundary is forced. The relative colorimetric intent, however, relates to a white point on the substrate, best chromatically adapted to D50 conditions, and it adjusts all colors maintaining their relative position to white. Where matches between reproduction and original are sought, this intent often serves as the default.

It may be said that ICC rendering intents invite a heuristic application to a subjective solution. In contrast, psychophysiological evaluation techniques (also known as "the total experience"), have informed findings about colorimetric rending methods (Milkovic, Knesaurek, Mrvac, & Bolanca, 2004) and gamut-mapping algorithms alike (Braun, Bala, & Harrigton, 2005). These techniques seek to quantify perceptible change in color, though studies find that even though CIE describes ΔE of 1 as perceptible, the "average consumer would not detect any difference less than ΔE max value of 5" (Mason, 2007, p. 2). The use of visual qualitative analysis has informed the selection of rendering intents and is commonly a metric incorporated into research about digital proofing (Lin, Zhou, Lin, & Luo, 2009). Illustrative of the debate about generalizing intent usage, Green (2010, p. 28) suggested that, "it is not possible to standardize re-purposing transforms" as they hinge on subjectivity and viewer preferences. Furthermore, Green (2010) also stated that the perceptual and saturation intents are more about repurposing—producing a reproduction on a second medium where viewing conditions might be quite different. Yet, he suggested that the retargeting—intention of matching a reproduction on a different media is more suitable for colorimetric rendering intents.

Further compounding the challenge for color managers is device "personality" (Sharma, A., 2005), which seeks to couple standardized transforming methods (ICC rendering intents) and gamut mapping to establish quality validation. Gamut mapping applies a set of rules to produce the best color match, and rendering intent works to maintain color accuracy while also remapping non-reproducible colors (Berns, 2000). To systematically control for variance, color managers use industry intents that modify the input data by applying linear and nonlinear compression, various cutting techniques, and select algorithms in accordance with ICC standards (Milkovic, Bolanca, Mrvac, & Zjakie, 2006). In short, these intents take visual data from one source, mathematically manipulate this data based on a predetermined industry criterion, and direct that repurposed data to a select output device. Efforts to control device variance are a technological juggernaut for managers, given the characteristic differences of RGB and CMYK, electronic manipulation, and physical manipulation, respectively.

Lightness, Chroma, Hue (L*C*H) and Gray

Each color has its own distinct appearance based on hue, chroma (saturation), and value or lightness (X-Rite, 2007). By describing a color in terms of these three attributes, one can accurately identify a particular color and distinguish it from others. When asked to describe the color of an object, most people mention its hue first. Quite simply, hue is how people perceive an object's color, such as red, orange, or green (X-Rite, 2007). Chroma describes the vividness or dullness of a color: how close the color is to either gray or to the pure hue. For example, the red of the tomato is vivid, but the red of the radish is dull (X-Rite, 2007). The luminous intensity of a color (i.e., its degree of lightness) is its value. Colors can be classified as light or dark

when their values are compared. For example, when a tomato and a radish are placed side by side, the red of the tomato appears to be much lighter. In contrast, the red of the radish seems to have a darker value (X-Rite, 2007).

The L* c* h* color space uses the same coordinates as the L* a* b* color space, but it uses cylindrical coordinates instead of rectangular coordinates. In this color space, L* indicates lightness and is the same as the L* of the L* a* b* color space, C* is chroma, and h* is the hue angle. The value of chroma C* is 0 at the center and increases according to the distance from the center (See Figure 2). Hue angle h is defined as starting at the +a* axis and is expressed in degrees; 0° would be +a* (red), 90° would be +b* (yellow), 180° would be –a* (green), and 270° would be b* (blue). Metric chroma C* and the Metric hue angle h* are defined by the following formulas (Morovic, et al. 2002):

Metric chroma

$$C^* = \sqrt{(a^*)^2 + (b^*)^2}$$

Metric hue angle:

$$h^*_{ab} = \tan^{-1}\left(\frac{b^*}{a^*}\right)$$

where: a*, b* are chromaticity coordinates in L* a* b* color space

Gray balance is the proper percentage of combinations of cyan, magenta, and yellow inks that produce neutral shades of gray. Hue shifts will occur when there is any imbalance of one of the components. The imbalance is due in large part to ink impurities. Gray balance is a significant factor in determining overall color gamut. Gray balance can be determined by careful evaluation of a full set of tint charts printed with process inks. Colorimetric method is used to determine if the hue of gray is desirable in order to make sure that the black ink scale is neutral.Hue difference (ΔH*) is calculated by the following formula (Morovic et al., 2002).

$$= \sqrt{(\Delta a^*)^2 + (\Delta b^*)^2 - (\Delta C^*)^2}$$

$$\Delta H^* = \sqrt{(\Delta E^* ab)^2 - (\Delta L^*)^2 - (\Delta C^*)^2}$$

Purpose of the Research

The experiment was conducted in a color managed workflow to determine the printing colors (solid CMYK) and gray color (overlap of C = 50%; M = 40%; and Y = 40%) hue variation among the four ICC standard color rendering intents. It focused on the application of various color rendering intents to print color images by using CMYK dry toners on a digital color printing device that utilized a color laser digital printing technique (color electrophotography). The objective was to study the influence of

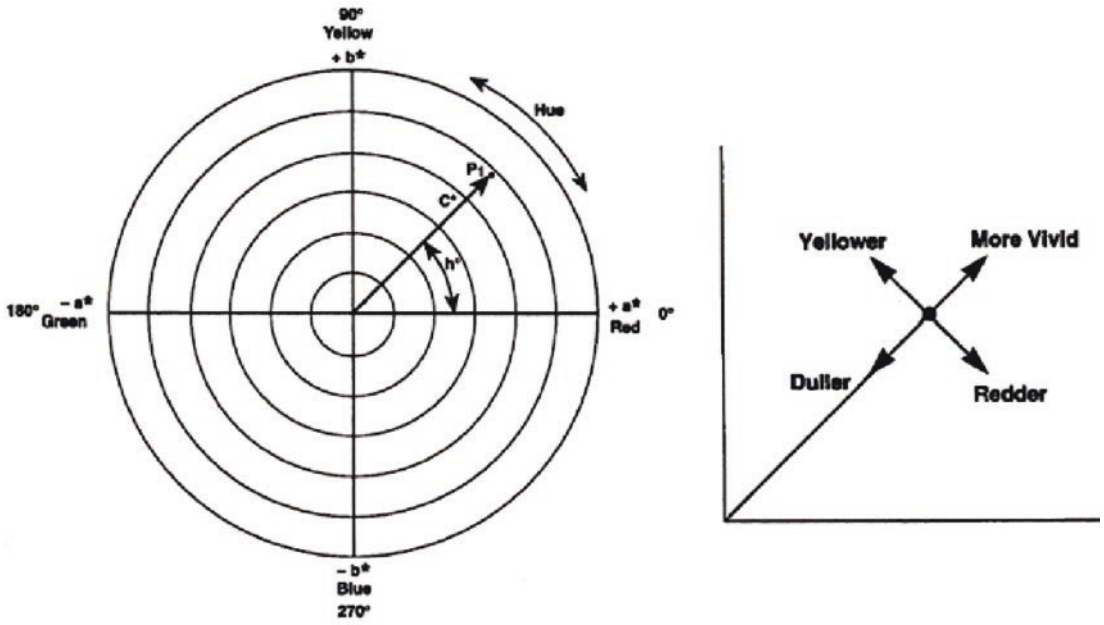

Figure 2. Schematic of L* c* h* Coordinates

applied color rendering intents in the printing color and gray color hue in a CMW. The following one-tailed nondirectional hypothesis was established, because of the multiple rendering intents (groups, K = 4).

> Ho: There is no difference (or relationship) in the printing CMYK ΔH and Gray ΔH (CMY overlap) of multiple color rendering intents, when the printed colorimetry is compared against the reference colorimetry.
>
> Ha: There is difference (or relationship) in the printing CMYK ΔH and Gray ΔH (CMY overlap) of multiple color rendering intents, when the printed colorimetry is compared against the reference colorimetry.

Limitations of the Research

For this experiment, there were limitations to the technology used within the graphics program laboratory. Prior to printing and measuring the samples, the digital color output printing device and color measuring instruments (spectrophotometer and densitometer) were calibrated against the recommended reference. The print condition associated with this experiment was characterized by, but not restricted to, inherent limitations. For example: colored images (IT8.7/4, ISO300, and ISO12647-7) chosen for printing, desired rendering intent applied, type of digital printer for proofing/printing, type of paper for printing, type of toner, resolution, and screening technique, use of predefined color output profiles, and calibration data applied, and so on. Several variables affected the facsimile reproduction of color images in the CMW, and most of them were mutually dependent. The scope of the research was limited to the color laser (electrophotographic) digital printing system (printing proof/printing) and other raw materials and the multiple types of color measuring devices and color management and control applications (data collection, data analysis, profile creation, and profile inspection) used at the university graphic communications laboratory. Findings were not expected to be generalizable to other CMW environments. It is quite likely, however, that others could find the method used and the data of this article meaningful and useful. The research methodology, experimental design, and statistical analysis were selected to align with the purpose of the research, taking into account the aforementioned limitations.

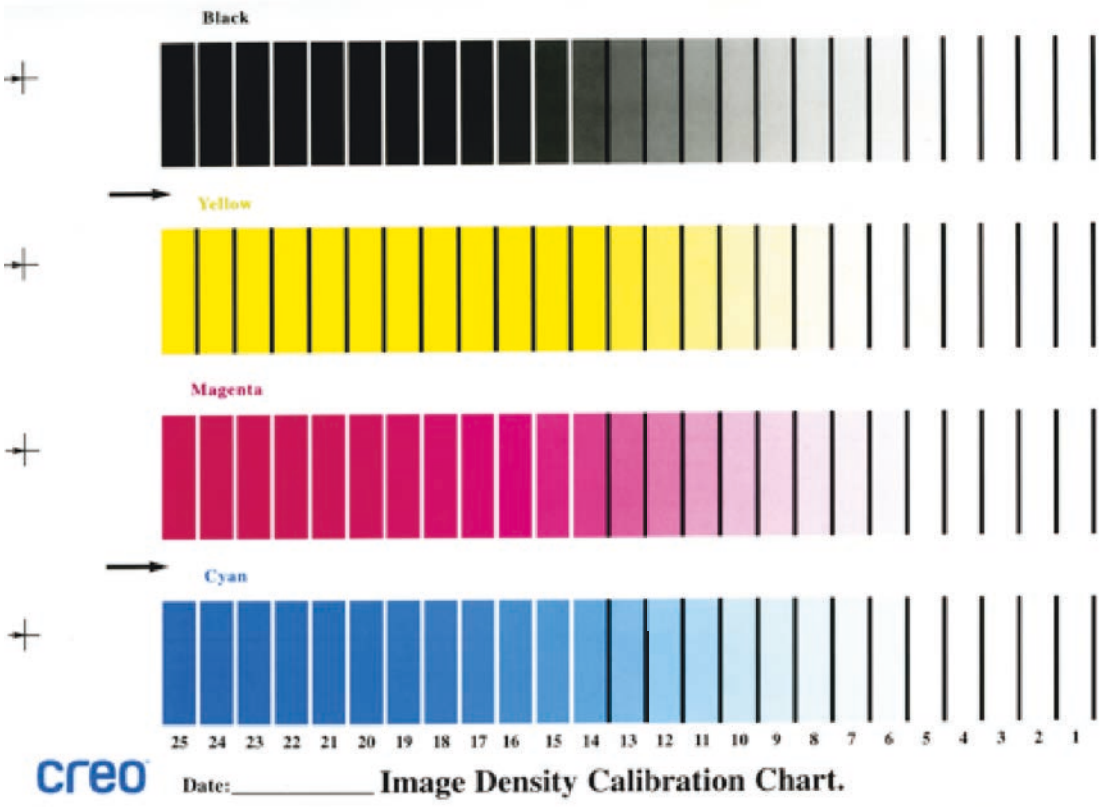

Figure 3. CMYK printer calibration chart (for Xerox DC-250)

RESEARCH METHOD

The digital color output device used in this experiment was a Xerox DC250 CMYK printer (or digital press). It uses a Creo Spire CX250 raster image process (RIP) server (front-end system). This study utilized an experimental research method. MOHAWK brand 80 lb. matte-coated digital color printing paper was used. It was intended to determine the color differences of ICC rendering intents in a color-managed digital printing workflow. ICC specified color rendering intents are: absolute colorimetric rendering (ACR) intent, relative colorimetric rendering (RCR) intent, saturation rendering (SR) intent, and perceptual rendering (PR) intent. Each rendering intent in the experiment was considered as a group, noted by letter "K" (K = 4). Fifteen samples for each group were printed, noted by letter "n" (n = 15). For all the four groups, a total of 60 samples were printed, noted by letter "N" (N = 60). Multiple types of ICC standard based color management applications (software) and instruments were used in the experiment. A detailed method of this experiment is summarized in the following paragraphs. The digital color-printing laboratory made use of CMW for accurate color reproduction.

Printer Calibration

One of the important issues in getting acceptable print quality was the stable level of toner density (printer density). Fluctuation resulted from many controlled and uncontrolled variables, such as room humidity, temperature, printer settings, paper, age of toner, and inaccurate calibration or linearization of the printer. Therefore, calibrating the printer daily was very important. The calibration process for the printer used in the experiment was performed per the guidelines given by the device manufacturer. The CMYK calibration chart (with various tonal gradations) was printed without using any previous calibration data with 200 LPI (see Figure 3). An X-Rite DTP34 Scanning (Quick Cal) densitometer was used to scan the printed chart. The densitometer was calibrated against its reference chart prior to using it to calibrate the printer (or measure the chart). The calibration data (CMYK density ranges) was saved in the calibration lookup tables and a calibration curve was created (see Figure 4).

Test Image for Printing

A one-page custom test image of 8" x 10" size was created for proofing and printing use for the experiment (see Figure 5). The test target

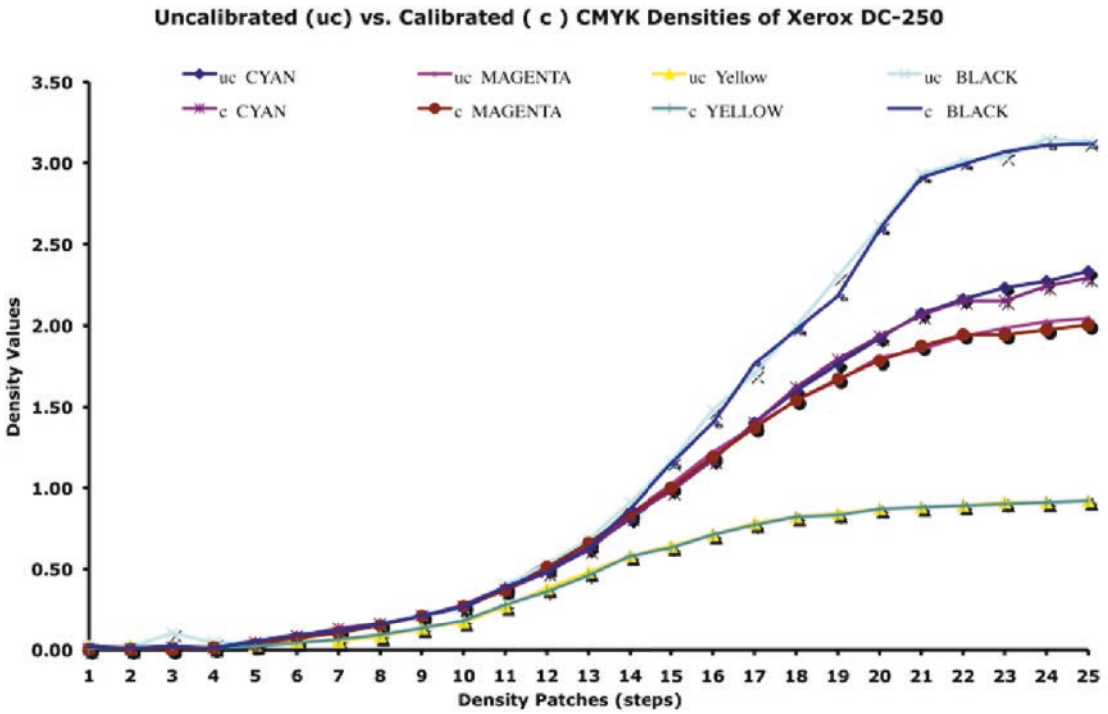

Figure 4. Uncalibrated vs. calibrated CMYK SID curve

contained the following elements: an ISO 300 image for subjective evaluation of color, an ISO 12647-7 control strip, and a SpotOnPress! control strip. Colorimetric data was extracted from both the control strips. Color management settings were disabled in the Adobe InDesign CS-4 page layout application. All of the image elements were imported into the page layout program, and a PDF file was made without compressing the image data. The PDF file was sent to the Xerox DocuColor-250 Digital Press raster image processor (RIP). The press front-end system was powered by CREO Spire cx250 RIP, which runs on a Windows XP platform (Dell computer).

During the printing of the test image, in the color management option of the RIP, adjustments were made to print the test image, which included the following: a specific rendering intent, specific predefined (default) recommended profiles, lines per inch (LPI), and calibration data. In the CMYK emulation option of the RIP, adjustments were made to emulate the printing with a default profile and to print the test image with various ICC rendering intents. A recommended default destination profile was used to print the images. The device manufacturer recommended these two default profiles as predefined printing profiles. The final color printing/output was limited to these profiles, and other image color adjustment techniques were applied (rendering intents, LPI, calibration curve, etc.).

Printed Color Samples for the Analysis

A total of 60 prints (copies) were printed, 15 for each color rendering intent of the same image on 80 lb. matte-coated paper (K = 4, n = 15, N = 60). Colorimetric data for various color quantification for each group was generated from the printed colors (SpotOn! and ISO 12647-7 control strips) by using Eye-One-Pro spectrophotometer with interface applications, such as the SpotOnPress! and Fujifilm Taskero ColorPath Verified. Colorimetric data from SpotOn! was used to create the 2D gamut (profile) of the specific rendering intent. All of the four-color rendering intent 2D gamuts were mapped for the visual comparison (see Figure 5).

Measured colorimetric data (via Fujifilm Taskero ColorPath Verified) from an ISO 12647-7 control strip was used to determine the mean of CMYK ΔH and gray ΔH (CMY overlap) between the printed colors and its reference data (IT8.7/4). Data derived from ISO 12647-7 control strip (sample) is the difference between the characterization data set (full IT8.7/4 target) and the sample. A total of 60 measurements were made, 15 for each color rendering intent (K = 4, n = 15, N = 60). The IDEAlliance ISO12647-7

Figure 5. Test image for printing

control strip contained only a small subsample of IT8.7/4 target. It contained very little patches to prove an accurate match to a specific industry standard. However, it contained enough patches to monitor the accuracy of a color reproduction system against a reference target, such as the IT8.7/4. Table 1 presents the variables, materials, conditions, and equipment associated with the scanner, monitor, and printer of this experiment (see Table 1).

STATISTICAL METHOD APPLIED FOR THE EXPERIMENT DATA ANALYSIS

The Statistical Package for Social Sciences (SPSS) was used to analyze the collected data to determine the colorimetric variation (COLVA). Since the $K = 4$, a one-way analysis of variance (ANOVA) with equal n's method (at $\alpha = 0.05$) was used to determine the significant differences that exist among the ($K = 4$, $n = 15$, and $N = 60$) group means color deviations of the various color rendering intents (Glass & Hopkins, 1996). The F-test is calculated by using the following equation (Glass & Hopkins, 1996).

$$F = \frac{\sigma_b^2}{\sigma_w^2} = \frac{MS_b}{MS_w} = \frac{SS_b / V_b}{SS_w / V_w} = \frac{\sum n_k \left(\bar{X}_k - \bar{\bar{X}}\right)^2 / K - 1}{\sum \left(X_{ik} - \bar{X}_k\right)^2 / N - K}$$

When statistically significant effects were detected among the four groups, the Tukey method—post hoc ANOVA analysis was used to determine which group (K) means were significantly different. The Tukey method, also known as the honest significant difference

Table 1.

Experimental and Controlled Variables

Variable	Material/Condition/Equipment
Test images	A custom Test Target
Control strips	ISO 12647-7, and SpotOn!Press
Profiling Software	X-Rite ProfileMaker 5.0.10
Profile Inspection Software	Chromix ColorThink-Pro 3.0 & Apple ColorSync
Image Editing Software	Adobe PhotoShop CS-4
Page Layout Software	Adobe InDesign CS-4
Source Profile (RGB)	Adobe 1998.icc
Emulation Profile (CMYK)	SpireOptimized.icc
Destination Profile (CMYK)	SpireDC250.icc
Color Management Module (CMM)	Adobe (ACE) CMM
Rendering Intents	ACR, RCR, PR, and SR
Computer & Monitor	Apple Macintosh 10.5.8/LCD
Raster Image Processor (RIP)	Creo Spire x250
Printer	Xerox DocuColor-250 Color Laser
Uncalibrated CMYK SID	C = 1.71; M = 1.68; Y = 1.10; and K = 2.09
Calibrated CMYK SID	C = 1.19; M = 1.23; Y = 0.94; and K = 1.96
Screen Ruling	200 LPI
Print Resolution	2400 x 2400 DPI
Toner	Xerox Color Laser
Paper (sheetfed)	MOHAWK 80 lbs. matte-coated
Type of Illumination/Viewing Condition	D50
Color Measurement Device(s)	X-Rite Eye-One-PRO Spectrophotometer with Status T, 2° angle, and X-Rite DTP34 scanning Densitomter
Data Collection/Analysis Software	FUJIFILM ColorPath Verified, SpotOn! Press, and MS-Excel

(HSD) test between two sample means, can be determined by using the following equation (Glass & Hopkins, 1996).

$$q_1 = \frac{\bar{X}_1 - \bar{X}_K}{S_{\bar{X}}}$$

The *F* distribution and a probability value *p*, which is derived from the *F*, were used to determine if significant differences exist in the output color attributes of multiple color rendering intents. *F* is a ratio of two independent estimates of the variance of the sample, namely between the groups and within the groups ($K = 4$, $N = 60$). A low *p* value (or higher *F* value) is an indication that one should reject the stated null hypothesis (Ho) in favor of stated alternative hypothesis (Ha). This indication implies that one of the rendering intent means is significantly different. It suggests that there is a strong support that at least one pair of the rendering intent means is not equal. The higher the *p* value (or lower *F* value) indicates that the means of various color attributes of the color rendering intents are not statistically different. The value of *q* is the difference between the larger and smaller means of the two samples. Differences among the means at $p \leq 0.05$ are considered to be statistically significant among all the groups ($K = 4$) or color rendering intents. The main effect that the color rendering intents had on the digital color output in a CMW was determined by using the above-stated methods (*F* and *q*). The HSD multiple comparison test (with $\alpha = 0.05$) in the experiment enabled the researchers to identify the significant difference from one group to another. In other words, which color rendering intent differs significantly from one another?

DATA ANALYSIS AND RESEARCH FINDINGS

The ANOVA method was used to analyze the collected data. Color hue differences (ΔH) and gray hue differences were also derived to examine the noticeable color hue differences that exist among the various rendering intents. As stated in the previous section, the digital color prints (or proofs) printed with various rendering intents were analyzed by using ColorPath Verified against the IT8.7/4 reference data to determine the colorimetric deviations for Printing Colors Delta H (ΔH) and Gray ΔH (CMY overlap). Average deviations of these

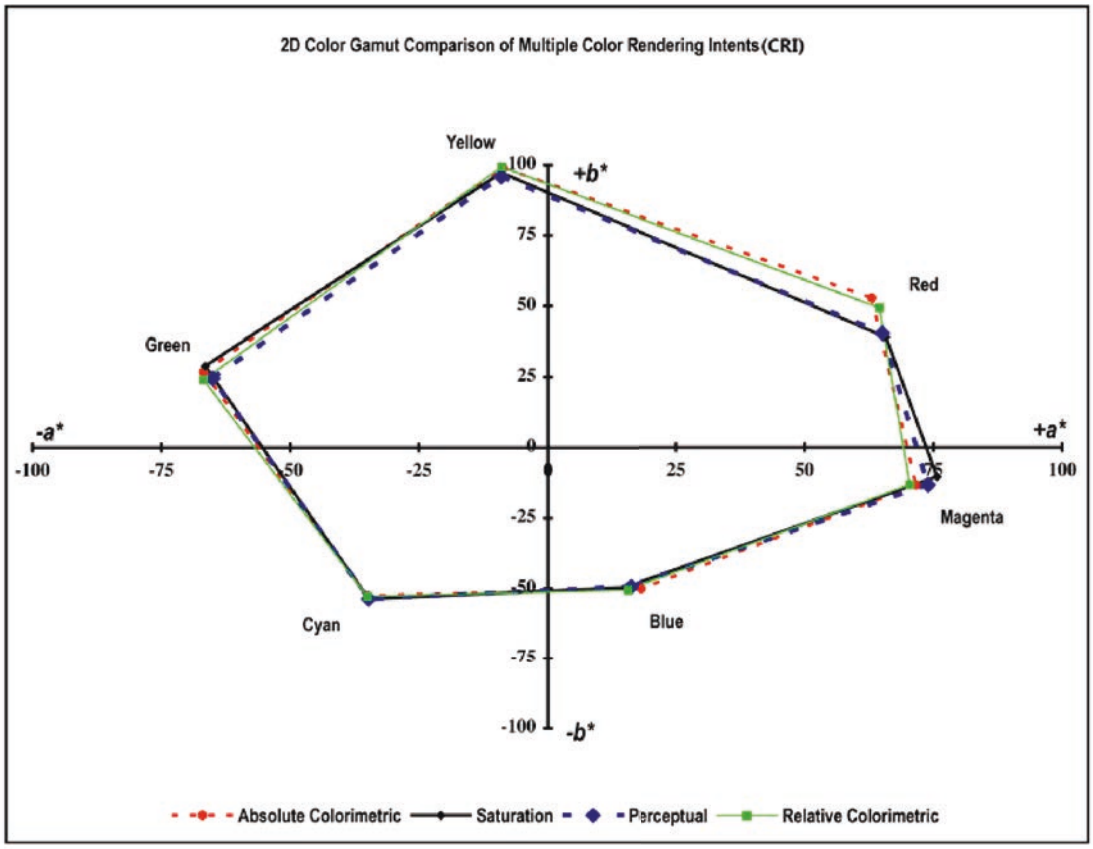

Figure 6. A 2D gamut comparison of multiple CRI

attributes were mapped (bar chart) for visual comparison (See Figure 7). Colorimetric data from SpotOn! was used to create the 2D gamut (profile) of the specific rendering intent. All the four-color rendering intent 2D gamuts were mapped for the visual comparison (see Figure 6). Subjective judgment on color difference was not used in this study. The subjective judgment of color difference could differ from person to person. For example, people see colors in an image not by isolating one or two colors at a time (Goodhard & Wilhelm, 2003), but by mentally processing contextual relationships between colors where the changes in lightness (value), hue, and chroma (saturation) contribute independently to the visual detection of spatial patterns in the image (Goodhard & Wilhelm, 2003). Instruments, such as colorimeters and spectrophotometers, could eliminate the subjective errors of color evaluation perceived by human beings.

Printing Colors (CMYK) Hue Deviation (ΔH): Reference vs. Printed Colorimetry

The average primaries ΔH were different from one rendering intent to the other. As such, the ANOVA test was conducted to determine if there was any significant difference, $p \leq 0.05$ among the primaries ΔH of the rendering intents. The test showed that there was no statistical significant difference among the primaries ΔH, $F(3, 56) = 1.21, p = 0.31$; hence, the established hypothesis was accepted. This means, the applied color rendering intent did not significantly influence the primary colors ΔH (see Table 2) between the reference vs. printed colorimetric measurements. Post hoc analysis using Tukey HSD criterion for significance among the multiple color rendering intents primaries hue means was not required.

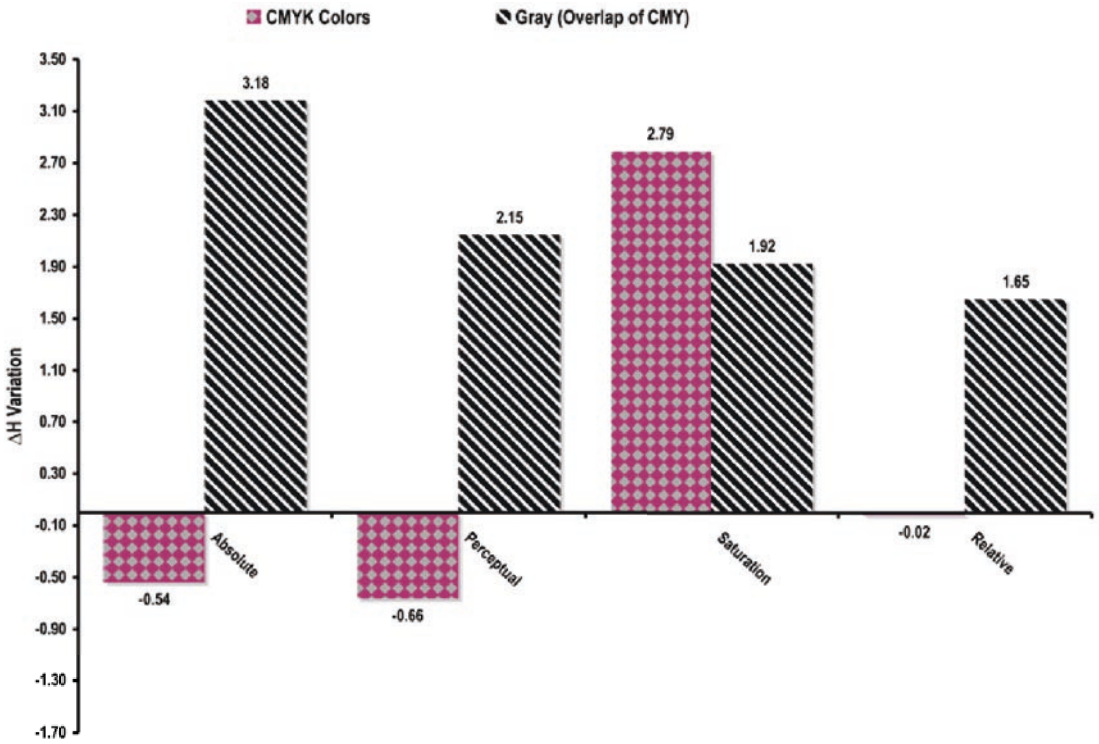

Figure 7. ΔH Comparison of multiple Color Rendering Intents (CRI)

Table 2

Summary of ANOVA for Multiple CRI Influence on the Primaries ΔH

Source of Variation	*Sum of Square*	*df*	*Mean Square*	*F*	*Sig.*
Between Group	118.26	3	39.42	1.21	0.31
Within Groups	1824.90	56	32.59		
Total	1943.16	59			

No Significant Difference [(α = 0.05 < 0.31) (F = 1.21 < 2.77)]

Gray Color (Overlap of CMY) Hue Deviation (ΔH): Reference vs. Printed Colorimetry

An ANOVA test revealed that there was a significant difference among the gray ΔH produced by each (multiple) color rendering intent, *F (3, 56) = 5.09, p = 0.000*. Data indicated that each of the rendering intents altered the printed gray colors differently. As such, the effect was significant at the $p < 0.05$ for all four rendering intents (see Table 3). Post hoc analysis using the Tukey HSD criterion for significance among the multiple color rendering intents means indicated that when comparing absolute rendering intent (1) with other rendering intents (3 and 4), there was a significant statistical difference in the gray ΔH produced by various color rendering intents (see Table 4) at the $p \leq 0.05$. The Tukey HSD test also indicated that the mean score of gray ΔH rendering intent 1 ($M = 3.18$, and SD = 1.40) was significantly different from the rendering intents 3 ($M = 1.92$, $SD = 1.02$), and 4 (1.64, $SD = 1.02$). The absolute rendering intent resulted in producing the highest gray ΔH, whereas relative rendering intent produced the lowest. No significant difference was found among gray ΔH mean scores of rendering intents 1 and 2 (absolute and perceptual) and 2, 3, 4 (perceptual, saturation, and relative).

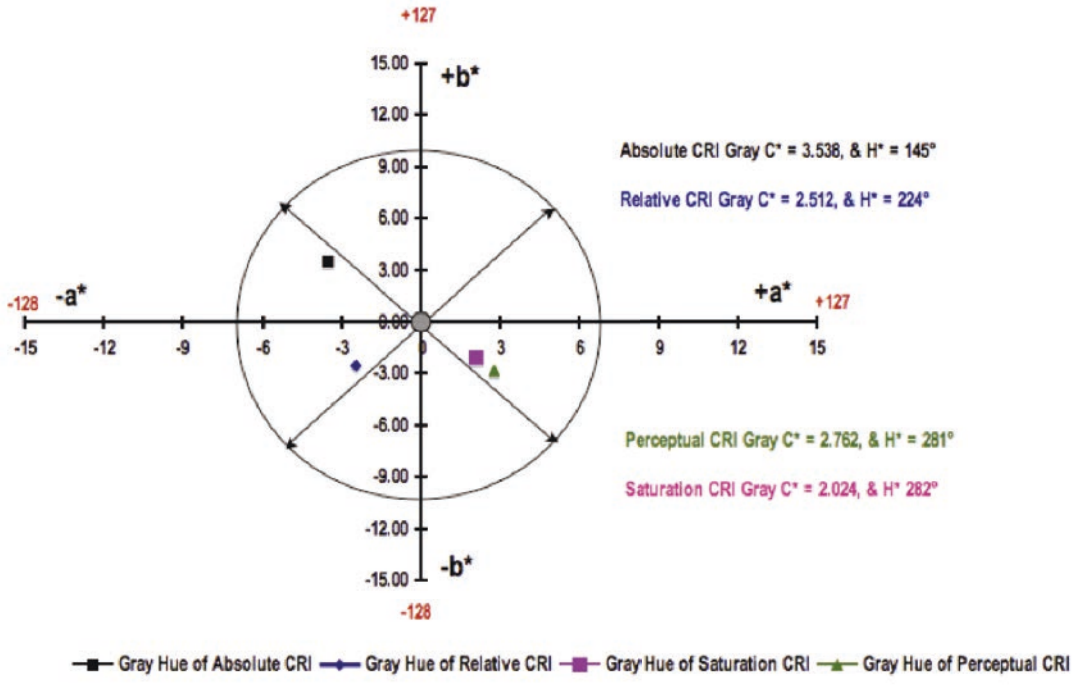

Figure 8. 2D gamut of gray hue and chroma angle position of multiple CRI

Table 3

Summary of ANOVA for Multiple CRI Influence on the Gray ΔH

Source of Variation	*Sum of Square*	*df*	*Mean Square*	*F*	*Sig.*
Between Group	20.18	3	6.73	5.09	0.000*
Within Groups	74.09	56	1.32		
Total	94.28	59			

**Significant Difference [(α = 0.05 > 0.001) (F = 5.09 > 2.77)]*

Table 4

Tukey HSD multiple comparison multiple CRI influence on the gray ΔH

Comparison	*Mean Difference*	*SD Difference*	*Sig.*
1 vs. 2	1.027	0.314	0.081
1 vs. 3	1.249	0.393	0.022*
1 vs. 4	1.525	0.393	0.003*
2 vs. 3	0.222	0.079	0.952
2 vs. 4	0.498	0.079	0.640
3 vs. 4	0.276	0.000	0.913

** $p \leq 0.05$ and ** $p \leq 0.001$ (1 = Absolute, 2 = Perceptual, 3 = Saturation, and 4 = Relative)*

CONCLUSIONS

This research demonstrates the use of ANOVA to determine the influence of applied ICC color rendering intents in the primary colors and gray color hue variation among the four ICC standard color rendering intents in a color management workflow (CMW) on the digital color output. The findings of this study represent specific printing or testing conditions. The images, printer, instrument, software, and paper that were utilized are important factors to consider when evaluating the results. The findings of the study cannot be generalized to other CMW. However, other graphic arts educators, industry professionals, and researchers may find this study meaningful and useful. For example, educators can implement similar models, the presented model, or this method to teach a color management module. The colorimetric data of this experiment led to the conclusion that the selection of a rendering intent of a choice is an important step in a CMW in order to output accurate colors of choice for a desired use/purpose.

The conclusions of this study are based upon an analysis of the ANOVA test data and major findings (data and experience of the experiment). The data from the ANOVA test revealed that there were significant differences in the color reproduction among the multiple ICC color rendering intents (CRI). No significant differences were found in the CMYK color hue deviation (ΔH) of solid printing colors of these four-color rendering intents. In other words, the chosen rendering intent did not influence the outcome of printing color hue variation. There were significant differences found in gray color hue variation. The ΔH was statistically higher for absolute colorimetric rendering when compared with other CRI. Also, statistically, it was found that there was no difference among the remaining color rendering intents gray hue variation.

Furthermore, the experience of the experiments (visual comparison) and analyzed data proved that there were no color differences among the printed samples (photographs, commercial, and digital printing) of rendering intents, such as the

absolute, relative, and perceptual. One could achieve the same color output regardless of which rendering intent was used among the three (absolute, perceptual, and relative colorimetric rendering intents). However, one should be cautioned to use the saturation intent because this intent produced the highest color deviation when compared with other intents. Higher color deviations (ΔE or ΔH) mean that the printed colors could be out of established deviation tolerances. Numerous reports reveal that the saturation intent was the least used in the industry, because it merely tries to produce good colors without any concern for the color accuracy.

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Examining the Impact and Cognition of Technology on Preservice Teachers of English in Swaziland

By Patrick M. Mthethwa

ABSTRACT

This study examined the impact and cognition of technology on preservice teachers of English in Swaziland, where English is taught as a second language (ESL). Colleges and universities in Swaziland embarked on an initiative to equip preservice teachers with technology skills. However, despite that every preservice teacher who graduates from either a university or college must complete a module in technology, it has not been established if preservice teachers perceive technology as useful, and if they are prepared to integrate it into their future teaching experiences. One hundred and thirty-five ESL preservice teachers participated in this study. They completed a 20-item questionnaire that was later analyzed using quantitative methods. Subsequently, follow-up interviews were conducted with 23 participants. Overall, the results revealed that while preservice teachers had positive perceptions of the usefulness of technology in language teaching, they were less likely to integrate technology into their language teaching experiences.

Keywords: Technology, English as a second language, computer-assisted language learning, preservice teachers.

INTRODUCTION

Teachers of English as a second language, whether new or old, in the teaching profession would often agree that educational technology has infiltrated educational settings throughout elementary, primary schools, high schools, colleges, and universities. As a result, it is common to find different types of technology in schools, colleges, and universities around the globe; their curricula are continuously modified to accommodate changes advanced by educational technology. The introduction of technology in educational institutions has been realized in various forms, such as the introduction of information and communication technology (ICT). ICT in schools and institutions of higher learning is often inspired by a widespread and technocentric belief about the transformative nature of technologies (Watson, 2006). This belief nurtures the notion that technology changes the way we perceive realities in the 21st century, such as the way we teach and students learn. Thus, to a large extent, technology is seen as a "golden key" for facilitating technology-enhanced and student-centered teaching environments (Hannafin & Land, 1997).

Putting students at the center of teaching has become the hallmark for constructivist's theories. Essentially, there are many benefits of integrating technology with language instruction. A number of research studies such as Blake (2000); Brett (1997); Fin & Inman (2004) confirm that using technology in language teaching does benefit learners' educational outcome and their overall language proficiency. Also, learners' exposure to technology introduces them to a variety of online materials that are useful for authentic learning; these authentic learning materials are important to buttress instruction at any level of education. For instance, the use of multimedia, the Internet, and educational computer applications is associated with learners' motivation and autonomy (Armstrong & Yetter-Vassot, 1994; Blake, 2000; Brett, 1997; Pusack & Otto, 1990).

Motivation and autonomy are essential components of a desired student's learning behavior, synonymous with success in the language classroom. Each of these components keeps a student focused and goal oriented. However, not every researcher agrees that technology improves students' language proficiency, some studies report the contrary. For instance, authors such as Lasagabaster and Sierra (2003) and Stepp-Greany (2002) reported negative results about the adoption of technology to support language teaching. These studies, for instance, reported that no gains were found in

[1] The author is aware there are many types of technology tools. However, in this study, the author uses the word technology with reference to the use of computers in the classroom for educational purposes.

students' language proficiency when technology was used in the language classrooms. However, despite reported technology failures in some cases, technology has continuously gained popularity in many language-teaching contexts, including ESL.

In some ESL contexts, especially in developing countries, the popularity of technology has been a driving force for its adoption to support teaching. Because of limited educational resources, such as English language teaching materials in some ESL contexts, technology is used to buttress teaching and further alleviate the problem of insufficient teaching/learning materials. As a result, most ESL contexts prioritize the integration of technology with language teaching and, in some ESL cases, ICT is adopted to support instruction.

The success of integrating technology in ESL classrooms, however, depends on many factors, such as the availability of resources, teachers' dispositions about technology, technical support, and (to a certain extent) showing teachers how to implement technology in the classrooms. These factors are some of the determinants of whether or not the integration of technology in the ESL classroom will be successful. That said, teachers' positive cognition of technology is a centerpiece for guarantying the possibility of integrating technology with language instruction. If language teachers, for instance, raise serious concerns about technology, it is not a good sign that they will use technology in their language-teaching experiences. Liu, Theodore, and Lavelle (2004) noted that teachers' concerns about technology negatively affect the adoption and the integration of technology into teaching. Therefore, positive cognition of technology is a cornerstone for its successful integration into the classrooms, and the reverse is true.

ICT Initiative in Swaziland

Because of the belief that technology has capabilities of improving instruction in ESL, educational institutions in Swaziland embarked on an initiative to improve teaching by using technology. As a result, the Ministry of Education took major initiatives to introduce technology to support instruction in schools, colleges, and universities. These initiatives have been realized in many forms. For instance, UNESCO, the Swaziland Computer Education Trust (CET), and the Open Society Initiative for Southern Africa (OSISA) donated computers to schools, with the aim of improving education and overall instruction in Swaziland. CET installed 20 computers in 40 schools and provided technical support for each school (Ministry of Education Report, 2008). These computers have been used to support both teaching and learning in the recipient schools. Recently, an initiative by the Ministry of Education to integrate technology to support instruction has been the focus of current educational policies and strategic plans. Essentially, the strategic plans require institutions of higher learning to restructure their curriculum to accommodate technology. Thus, in teacher education colleges, the Ministry of Education built computer laboratories and installed over 40 computers in each college's computer laboratory as a way of implementing the strategic plan, and these computer laboratories are used as ICT centers. Every student who enrolls in the teacher colleges is expected to take ICT as a component of this program of study (Ministry of Education Report, 2008). The rationale behind encouraging every college student to take ICT modules is to ensure preservice teachers are computer literate and can integrate technology into their future teaching experiences. The major challenge though is whether or not preservice teachers in Swaziland share the same vision with the Ministry of Education, regarding the objectives of the ICT initiative.

The Status of English in Swaziland

English is a second language in Swaziland. It is used as both an official language and medium of instruction in schools. The status of English in Swaziland makes teaching it a huge task because there is a lot expected from teachers of English. Precisely, English-language teachers are viewed as the "heart" of the entire education system. The use of this metaphor describes the situation at its best. Like in the body, when the heart fails, all the other organs become dysfunctional. In Swaziland's case, the heart is English language and the other organs are the other subjects, such as geography, science, math, literature, and science, to name but a few. Thus, teachers of English have a task for scaling up the

learning of English, by equipping students with language skills essential for upscale performance across the entire curriculum. For instance, in a geography class it is expected that a student should distinguish a question that requires him/her to describe, from one that requires him/her to discuss. For each question, the student should know the relevant intellectual skills involved, and these intellectual skills are grounded on analytical knowledge acquired from English-language classes. As a result, students who are proficient in English have greater chances of performing well across all the disciplines, and the reverse is true.

Overall, in Swaziland, English-language teachers are largely responsible for preparing students to perform well across all the disciplines and, on top of that, to ensure students are proficient in both spoken and written forms of English. However, there are challenges English- language teachers encounter in ensuring that this task is executed properly. The challenges range from insufficient teaching materials to lack of exposure to authentic cultural target language materials, usually available on the Internet. As a result, ESL teachers in Swaziland rely on textbooks that eventually deprive learners of the significance of authentic voices of the target language, which are provided by online educational videos. Therefore, when the Ministry of Education took the initiative to introduce technology in teacher colleges and universities, the idea was to ensure that preservice teachers access more materials to support teaching; it was also to orient learners to technology in schools. However, ever since technology was introduced in teacher colleges, it is not known if preservice teachers perceive technology as a useful tool for supporting instruction, albeit evidence that teachers' use and knowledge of technology are significantly related to their perceptions (Atkins & Vasu, 2000). The more at ease teachers are as they use technology, the more they develop positive perceptions of technology, leading to its integration with instruction (Lam, 2000).

THEORETICAL FRAMEWORK

This study examined the impact and cognition of technology on preservice teachers of English in Swaziland, using existing theories of the adoption of technology. As stated in the previous paragraph, ever since the introduction of ICT in teacher colleges in Swaziland, little is known about the impact of technology, preservice teachers' perceptions of technology, and its integration into language teaching. Also, it is not known how critical decisions that evolve around pedagogy, policy, and the curriculum are influenced by research findings. The lens through which this study investigated the phenomena is the diffusion of innovations theory.

The diffusion of innovations theory focuses on the process by which innovation is adopted and accepted by individuals or members of a community (Rogers, 2003). This theory represents a number of subtheories, such as the systems and change theory (Fullan, 2001) that were relevant for this study. The system and change theory advances the idea that schools are decentralized organizations, with systems embedded in it. The embedded systems are students, teachers, classrooms, and other subsystems, whose primary function is to ensure that the schools deliver essential services to students, realizing goals and mission statements. The study therefore adopted this theory to investigate the overall phenomena, within which preservice teachers, ESL students, and the education system in Swaziland work together to realize educational goals, strategic plans, and mission statements. However, because the diffusion of innovations theory could not explain causation in this study, the grounded theory (Strauss & Corbin, 1990), mainly the constant comparative method was used to explain causation.

RELATED LITERATURE

Beginning teachers often view the integration of technology with language teaching as a distractor that destabilizes the classroom routine, including norms and space (Somekh, 2008). These routines are subconsciously established by both the traditional way of teaching and, sometimes, by the mentoring teacher. Unfortunately, traditional ways of teaching do not provide spaces for technology because they are much older than the advent of technology, and teachers who are accustomed to the traditional ways of teaching often think of technology as a distractor (Williams et al., 2011). As a result, some teachers develop negative perceptions of technology due to the notion that technology is a distractor. Researchers in this area, such

as Yildirim (2000), attest that appropriately designed teachers' training programs are essential in shaping teachers' perceptions and cognition of technology. Also, some studies, such as Egbert, Paulus, and Nakamichi (2002); Lam (2000); Oh and French (2007) found that the results of a meticulously developed teachers' training program accounts for teachers' improved technology capabilities and increased levels of confidence, leading to the adoption of technology in language classrooms.

There are many factors, however, that affect preservice teachers' perceptions of technology and integrating it into their teaching practices. For instance, teachers' attitudes toward technology have a significant influence on the adoption of technology (Atkins & Vasu, 2000). As a result, perceptions and attitudes toward the use of technology have been studied from both sides, that is, from learners and teachers. From the side of learners, Torkzadeh, Pfughoeft, and Hill (1999) observed that perceptions and attitudes toward computers influence an individual's mind or frame of reference. Their study reported that learners' exposure to computers or computer-related devices at an early age influenced their perceptions and attitudes toward technology later. Conrad and Munro (2008) added that someone with a negative experience and low efficacy of technology may eventually form negative cognition about technology and, in a worse scenario, avoid thinking about or contact with technology.

From the teachers' side, researchers such as Kim (2002); Redmond, Albion, and Maroulis (2005) noted that critical factors affecting the successful integration of technology into the language classrooms were largely associated with teachers and not the learners. Thus, Kim (2002) contended that teachers' perceptions of technology could either inhibit or enhance its adoption. To a certain extent, whether teachers' perceptions of technology inhibits or enhances its adoption is a function of the teachers' background and orientation with technology. Redmond, Albion, and Maroulis (2005) noted that teachers' personal backgrounds are important factors in determining the adoption of technology. Several factors are essential in establishing positive cognition of technology and its adoption. For instance, studies such as those by Lee and Son (2006); Shin and Son (2007); Suh (2004); and Yildirim (2000) posited that factors such as availability of computer facilities, students' easy access to technology facilities, and teachers' prior experiences with ICT or similar programs are strongly related to either the success or failure of the adoption of technology.

In addition to the list of factors affecting teachers' cognition of technology suggested by the researchers in the previous paragraph, there are myriad other factors. These factors include large classes of students, insufficient or restricted work stations, slow-processing computers, frequent computer freezes, and lack of technical support, including peer support. These factors impact the success of the adoption of technology and compromise the teachers' positions regarding its integration with instruction. Also, teachers' previous exposure to any form of technology, such as ICT, determines their perceptions of technology (Egbert, Paulus, & Nakamichi, 2002). Teachers' previous exposure to technology may be a function of work experience, training, or curiosity about technology and its uses. For instance, Egbert, Paulus, and Nakamichi (2002) noted that teachers with previous technology experience are likely to integrate technology activities into their teaching.

Furthermore, Warschauer (2003) noted that technology tools such as computers are powerful tools to use in supporting students with low language proficiency. In other words, students benefit from using technology, both inside and outside the classroom. Inside the classroom, computers promote individualism and independence from a single source of information, whereas outside the classroom students use computers to access unlimited amount of educational resources (Blake, 2000; Kuang, 2000; Loucky, 2005). Therefore, technology provides invaluable benefits to students; it affords interactive, collaborative, and socially situated features on the Internet (Kramsch & Anderson, 1999; Mallette & Mthethwa, 2012). Armstrong, Yetter-Vassot (1994) and Blake (2000), for instance, reported that students' exposure to technology offsets limits set by geographical boundaries. From one point of view, Kramsch and Anderson (1999) reported how Messenger, Skype, and Second Life facilitated discussions across cultural boundaries. On the contrary, and despite these documented advantages of using technology in class, some studies such as Lasagabaster and

Sierra (2003) and Stepp-Greany (2002) reported failure in using technology for learning. For instance, these studies reported that technology did not improve the learners' knowledge dispositions. However, be that as it may, there is documented evidence that technology does benefit learners around the globe, in terms of opening new language-learning experiences (Blyth, 1999; Bradely & Lomicka, 2000). Also, technology bridges diversity in students' cultural backgrounds that is now a common feature in 21st century classrooms.

TECHNOLOGY CHALLENGES IN AFRICA

The use of educational technology in Africa is not as vibrant as it is in developed countries. In developed countries, for instance, technology is used in many educational settings, for various purposes, ranging from registration for classes to actual teaching of specific content materials. In contrast, in developing countries such as Swaziland, the use of technology is still limited to basic skill development. That is, teachers use technology minimally, especially when it is used to access and retrieve online materials for supporting instruction. In some places though, such as South Africa, the use of technology (i.e., ICT) is thriving, and as a result, the role of technology is documented. For instance, Jaffer, Ng'ambi, and Czerniewicz, (2007) noted:

> ICTs can play a role in shaping curriculum design at the micro-level. ICTs open up new ways of accessing information thereby changing the relationships between students and between students and their teachers. Access to primary sources in the form of video, audio and photographs that may be contained in digital archives have the potential to influence the content of curricula because it makes previously inaccessible information available. In addition, ICTs enable lecturers to transform their teaching practices by facilitating student-student discussion and collaboration or by simulating 'real-world' problems thus providing students with authentic learning experiences. (p. 6)

In Swaziland, however, there are still many challenges facing the use of technology. These challenges range from lack of infrastructure to lack of qualified personnel who are knowledgeable in merging technology with the curriculum to support content area instruction. Also, some students come from diverse cultures and underprivileged backgrounds. As a result, some students come to schools, colleges, and universities with technology phobia or even stereotypes, some of which are detrimental in learning environments. A majority of students, for instance, start using technology when they come to educational settings such as schools, colleges, and universities. Otherwise, before they come to these institutions, some know little about using technology, especially computers. That problem notwithstanding, and as noted before, attempts have been made by the Ministry of Education to provide opportunities for computer literacy to all college and university students. Thus, the introduction of technology to colleges and universities, especially with regard to preservice teachers, is to realize this goal and also to ensure that the use of technology is extended to all classrooms, from primary to high schools.

The Present Study

As observed by Atkins and Vasu (2000), teachers' cognition of technology is an important determinant of the integration of technology with instruction. For this reason, first, this study investigated if there were similarities between preservice teachers' perceptions of the usefulness of technology and using technology for language teaching. Second, the study investigated if there was a relationship between preservice teachers' perceptions of the usefulness of technology and using technology in their future teaching experiences. Third, the study investigated if there was an interaction by age and year of study on how preservice teachers perceived integrating technology with language teaching. Lastly, the study investigated if preservice teachers were likely to use technology in their language teaching, and why. The fourth qualitative question actually came as a follow-up question, arising from the quantitative data analysis.

METHODOLOGY

This study was a mixed method research design. It used both quantitative and qualitative modes of inquiry. This design was useful to understand the phenomena under study more broadly, than if one research paradigm (i.e., quantitative or qualitative) were used (Johnson & Christensen, 2012). For this study, the mixed

method research design was appropriate; it allowed complementary strengths between the quantitative and qualitative components (Creswell, 2003; Johnson & Christensen, 2012). As a result, combining these modes of inquiry expanded the breadth of this study. Overall, the study used identical samples for both the quantitative and qualitative inquiries. Data for this study was collected sequentially. That is, the quantitative data was collected first, and the qualitative data was then collected.

Participants

This study surveyed 135 preservice teachers (n =135) from Space Teachers' College (STC) in Swaziland. This included 73 females (54.1%) and 62 males (45.9%). They were between 20 and 39 years of age. Students who enroll at STC must complete high school, obtaining grades between A and D in primary teachable subjects such as English, math, home economics, sciences, and social studies. Because of a backlog of applications every year, students wait for several years before they are admitted to the college. Thus, the college rarely admits new graduates from high school, and this explains why there is large variability between the participants' ages in this study. The typical length for the program of study at STC is three years, after which the graduates are certified to teach in primary schools. Every student from first to the second year must enroll in academic communication skills (ACS), English language, and literature. Even though in the third year students specialize in different concentration areas such as languages, sciences, social studies, math, and applied sciences, they still must enroll ACS as a component of their study. As a result, during this study, all participants were enrolled in at least one of the English language courses.

Instrument

The instrument used in this study was a 20-item questionnaire, which was developed for this study. In the questionnaire, three items asked participants' demographic information such as age, gender, and year of study, while 17 items asked construct-related information. The

Table 1. *Reliability Statistics*

Cronbach's alpha	*Standardized*	*Number of Items*
.675	.718	16

[2] Space is a pseudo name for the teachers' college where data was collected.

Table 2. *Scaled Items: Mean, Standard Deviation, and Total.*

Scaled Items	***M***	***S D***	***N***
Technology makes language learning interesting	4.20	0.83	20
Technology motivates learners	3.90	1.07	20
Technology provides new learning experiences	4.45	0.76	20
Technology provides opportunities for language learning	3.95	0.89	20
I am familiar with Google documents	3.70	1.34	20
I am familiar with online dictionaries	2.00	1.34	20
I am familiar with PowerPoint	3.15	1.50	20
I am familiar with YouTube	2.05	1.36	20
I can use technology to download teaching material	4.75	0.55	20
I can use technology to keep students grades	4.85	0.37	20
I can use technology to prepare lessons	3.35	1.09	20
I can use technology to search material on the Internet	4.30	0.98	20
I will use technology to teach reading	3.35	1.27	20
I will use technology to teach grammar	4.05	1.10	20
I will use technology to teach speaking	3.10	1.29	20
I will use technology to teach vocabulary	4.25	0.97	20

continuum on each item ranged from 1 to 5. One was the lowest score and five was the highest score. The rating was assumed to be interval with higher values indicating more endorsement of the statement. The values on the rating scale were based on an underlying continuum defined by the anchors and typically in a more ascending way, reflecting more of the property being rated as one goes higher on the scale (Gamst, Meyers, & Guarino, 2008).

Before the study was conducted, the instrument was tested on 20 preservice teachers, who did not become part of the study. Cronbach's alpha was conducted to estimate the internal consistency of the items. The coefficient alpha for the 17 items was 0.683. However, one item was removed from the instrument because it did not measure the intended construct. Therefore, 16 items remained, excluding items on demographic information. The remaining items' overall internal reliability increased to 0.718, which is acceptable for conducting research (Nunnally, 1994). Table 1 shows the reliability statistics, and Table 2 shows the mean, standard deviation, and total number of the norming participants.

Data Analysis

Data were analyzed using quantitative methods. A sample *t*-test was conducted to establish if there were similarities between preservice teachers' perceptions of the usefulness of technology and using technology for language teaching. For the second analysis, Pearson *r* correlation coefficient was conducted to establish if there was a relationship between preservice teachers' perceptions of the usefulness of technology and using technology for language teaching. And lastly, the analysis of variances (ANOVA) was conducted to determine if there was an interaction by age and year of study on how preservice teachers perceived integrating technology with language teaching.

RESULTS

Because the study was a sequential mixed method design and collected two sets of data, the results are presented in the same logic, starting with the quantitative portion and then the qualitative portion. However, later in the discussion section, the findings from both data analysis are triangulated and synthesized.

QUANTITATIVE RESULTS

The results for the first research question revealed that there were no similarities but differences between preservice teachers' perceptions of the usefulness of technology and using technology for language teaching, and the differences were significant. Table 3 presents the results for the first research question.

As shown by Table 3, the mean for perceived usefulness of technology ($M = 48.11$, $SD = 7.92$) was significantly greater than the mean for potentially using technology for language teaching ($M = 36.43$, $SD = 6.70$, $t\,(134) = 16.97$, $p = .001$ (two-tailed). It should be noted that having significant differences between these variables in this study is an indication that teachers were less likely to use technology for language teaching, even though they thought highly of its usefulness. The second research question investigated if there was a correlation between preservice teachers' perceptions of the usefulness of technology and using technology in future language teaching. The results are presented below.

Table 3. *Usefulness and Potential Use of Technology for Instruction*

Category	*N*	*M*	*SD*	*Min*	*Max.*	*t*	*Sig (2-tailed)*
Usefulness of technology in teaching	135	48.11	7.92	28.00	48.11	16.97	.000**
Potential use of technology in teaching	135	36.43	6.70	15.00	36.43		

Note: * = significant at alpha < .025; ** = significant at alpha < .001

As shown by Table 4, there was a positive correlation between participants' perceptions of the usefulness of technology and using technology for language teaching, r (134) = 0.412, p = .001. That is, as their perceptions of the usefulness of technology increases, the potential to use technology for language teaching also increases. The third research question investigated if there were interactions between age and year of study on how the preservice teachers perceived the usefulness of technology for language teaching. ANOVA was conducted to investigate if there were interactions between these variables. Prior to conducting the main analysis, Levine's test was performed to check for violations of the assumptions of homogeneity of variances, F (5, 129) = 0. 560, p = 0.73. Since Levine's test was insignificant, ANOVA was conducted with no concern for any violations. The results for research question three showed an interaction in year three (see Figure 1). However, the interaction was not significant, F (1,129) = 1.44, p = 0.23.

As shown by Figure 1, preservice teachers between 30-39 years in both first and second year had better perceptions of using technology in the ESL classroom compared to their counterparts whose ages were between 20-29 years. However, in third year, the reverse was true. That is, the third-year preservice teachers between 30-39 years fell below their counterparts of ages between 20-29 years. This sharp decline is indeed a cause for concern.

Table 4. *Correlation*

Paired Items	*N*	*Correlation*	*Sig.*
Usefulness of technology versus its use for language teaching	135	.412	.000**

Note: * = significant at alpha <.05; ** = significant at alpha < .001

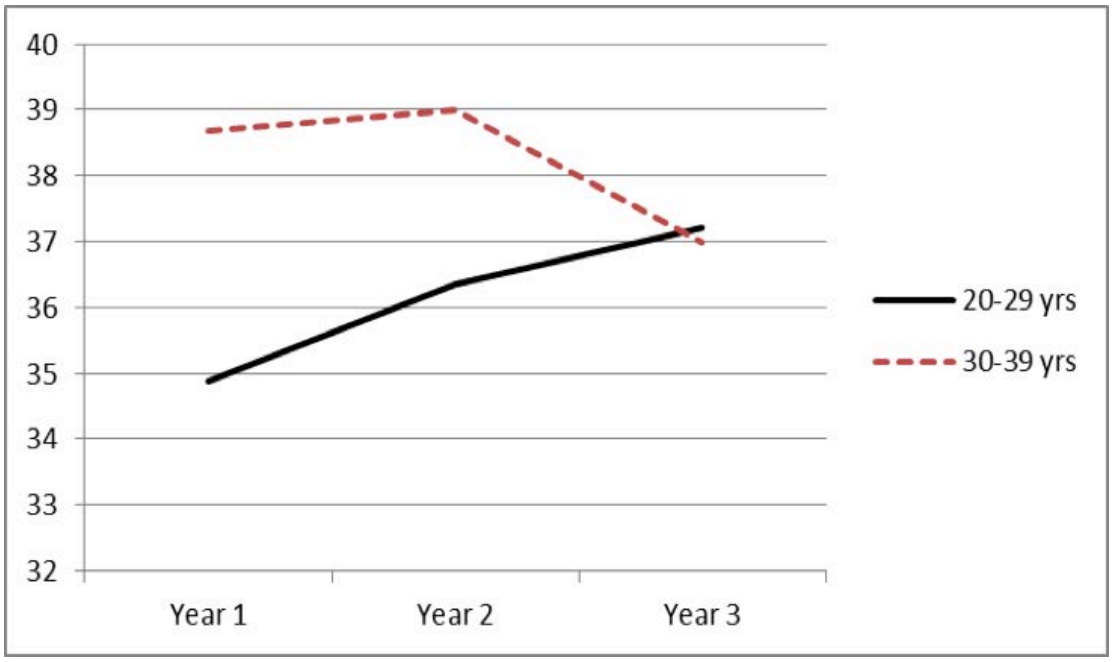

Figure 1. *Interaction between Year of Study and Age*

QUALITATIVE RESULTS

The last research question investigated if the preservice teachers were likely to use technology to teach English in their schools, and why? This question came as a result of the quantitative data analysis, which showed that preservice teachers were less likely to use technology in language teaching. Therefore, follow-up interviews were conducted with 23 participants, who had taken part in the quantitative data collection. Data emanating from the qualitative question were analyzed using the constant comparative method. The overarching theme that emerged from the interviews was that participants were less likely to use technology to support language teaching, and the reasons they gave revolved around the following thematic categories: class size, practice time, Internet speed, and power outage.

Class Size

Most of the participants noted that the ICT classes were large. For example, there were over 40 students in each ICT class, and there was only one instructor who helped them each time they encountered technical problems. Also, some participants highlighted that technical problems took a toll during their material learning time. As a result, they were not confident that they could use technology to teach. They emphasized that since most of them did not have background knowledge of using computers, they needed support from time to time during the ICT lessons. But because of the large number of students, they waited for a long time to get technical support from the instructor. In relation to the size of the classes, one participant stated:

> The classes are big, big, I mean big because now more students are admitted at STC. If I have a problem at my workstation, sometimes I wait for more than 3 minutes before the instructor can reach my workstation. Sometimes, as soon as he leaves, I encounter other problems, and it takes time for him to come back to me, and I understand, he has to help other students too.

Moreover, the participants also noted that each workstation, for instance, had about six students and most of them encountered technical problems. So, if they cannot help each other (peer support) to solve the problems, they all wait for the instructor to attend to them.

Practice Time

Another reason the participants gave for being less likely to integrate technology into their teaching was that they don't have enough practice time, apart from class time. As a result, they do not get an opportunity to reinforce previously learned materials. For instance, during the day when the computer laboratory is open, they are in other classes. In the evening when they get time for practice, the computer laboratory is closed, and when they go to class the next day, they usually start a new topic. So, they do not get enough time for individual practice. When one participant was asked what major changes he would like to see concerning practice time, he said:

> I wish the computer laboratory could be open in the evenings and weekends because most of us live on campus. So, we can use the evenings and weekends for practice. This time may also be con venient for typing our assignments, other than writing them.

Internet Speed

Another setback the participants mentioned was access to the Internet, which was sometimes very slow. They emphasized that the Internet was sometimes very slow even after connection. As a result, they wait for a long period of time to access web pages. They also noted that some of the computers in the ICT laboratory were not connected to the Internet, and it was difficult to learn how to use the Internet resources without a connection. One participant when asked if he was ready to use technology in teaching said:

> I don't think I am ready to use technology in my teaching. I don't want to embarrass myself in front of my students because students who come from privileged families know more about computers and how to use the Internet, than I think I do. Here (meaning at the college) we do very little on the Internet because it is slow. So, I think I will be embarrassed to be taught by my students how to search materials on the Internet.

Power Outages

The last reason participants cited was power outages, especially in summer. They said sometimes thunder and lightning cause severe power outages, and once there is power outage, they cannot use computers. They noted that, sometimes, the power outage can last for several hours before it is fixed, especially if it is not only a problem of STC but of the entire neighborhood. During the absence of power, they do not engage in any technology related activities in class, apart from a regular lecture. As a result, they miss a lot of material during the times when there is no power, especially in summer.

DISCUSSION AND CONCLUSION

Essentially, both quantitative and qualitative findings of this study revealed complementary results about preservice teachers' perceptions of technology and using technology to support language teaching. In fact, the qualitative portion illuminated the *why* question that arose from the quantitative analysis. For instance, the mean for preservice teachers' potential to use technology for language teaching was lower than that of their perceptions of its usefulness, suggesting preservice teachers were less likely to use technology to support language teaching. The reasons preservice teachers gave during the interviews when triangulated with the quantitative results complemented each other. Therefore, the challenges preservice teachers encountered were related to the low ratings on their potential use of technology in the language classrooms.

Overall, the results can be explained in terms of preservice teachers' low efficacy in using technology to teach ESL in comparison with the perceptions of its usefulness. The disparity between their perceptions of the usefulness of technology, together with the compromised intention to use it for language teaching is an epitome of a disconnection between the ICT program and its intended objective. As revealed by the qualitative section, the disparity is mainly caused by lack of confidence in using technology, arising from myriad challenges orchestrated by class size, practice time, Internet, and power outages that preservice teachers encounter, leading to low efficacy. For instance, the large number of students in the ICT classes tends to slow the frequency of technical support students receive, and this, in turn, lowers their confidence levels associated with using technology to support teaching. There is no doubt that teachers need a lot of technical support in technology (Selami, 2013), and that support builds teachers' confidence in merging technology with their teaching practices (Redmond, Albion, & Maroulis, 2005).

Also, it is worth noting that in this study each of the groups (i.e., year 1 through year 3) reflected a different perception pattern with regard to integrating technology with language teaching. The decline by the third-year group between 30-39 years to use technology for teaching has a direct impact on the main objectives of the ICT program, which is to prepare preservice teachers to integrate technology with their teaching. The third-year students between ages 30-39, as they were in their final year, must have developed a positive cognition of technology that translated to its potential integration with instruction. However, this was not the case in this study; instead, the group showed a decline. The cause of this decline may be attributed to the challenges the preservice teachers cited in the qualitative section of this study, such as large classes, lack of practice, slow Internet, and power outages.

Overall, the challenges preservice teachers encounter in developing countries on issues of technology compromise the adoption and integration of the same to the classrooms. As revealed by this study and, also, as observed by Jaffer, Ng'ambi, and Czerniewicz (2007), one of the challenges facing technology in Africa, including Swaziland, is having a large number of students in the classrooms, which makes it practically difficult for ICT instructors to support students in a timely manner. And if students do not get support quickly, they lose focus and interest in technology. However, besides the challenges facing the adoption of technology in Swaziland such as class size, practice time, Internet, and power outages, the importance of integrating technology with instruction in ESL cannot be underrated; thus, solving these challenges is crucial for education to thrive in Swaziland, including other similar ESL contexts. If these challenges are not mitigated, they continue to thwart all concerted efforts to integrate technology with instruction. Also, these challenges compromise the teacher's positions in executing their educational mandate, including the use of current educational metaphors. Teachers

are crucial in effecting educational changes (Ertmer & Ottenbreit-Leftwich, 2010), and it is through effecting current educational metaphors that a 21st century ESL teacher can be validated.

As noted by Armstrong and Yetter-Vassot (1994); Blake (2000); Brett (1997), and Pusack and Otto (1990) learners benefit a lot when technology is incorporated into the classrooms. Therefore, beyond all these challenges, teachers have the responsibility to pave ways for new innovations in education, including integrating technology into the classrooms (Kim, 2002) in order to expose learners to a variety of materials that support learning (Montelongo & Herter, 2010). Thus, if these challenges are not mitigated, the attempt to improve education, especially teaching English as a second language using technology is threatened at its core, not only in Swaziland, but also in other ESL contexts with challenges similar to that faced by Swaziland.

CONCLUSION

The study examined the impact and cognition of technology on preservice teachers of English in Swaziland, where English is taught as a second language (ESL). The lens through which this study examined the phenomena was the diffusion of innovations theory and the grounded theory. The results of this study revealed myriad challenges facing the adoption and integration of technology to support language instruction in Swaziland. These challenges can be mirrored in other ESL contexts. Therefore, this study serves as a springboard for more research on ways to improve the adoption and integration of technology to support instruction in ESL.

Also, this study can be used to inform policy makers and curriculum designers on critical issues revolving around the adoption of technology to support instruction in ESL. However, more empirical research must be conducted on a large scale, covering more teacher education institutions. For instance, this study did not collect data from a large sample size; therefore, expanding data collection to a large sample can unearth more challenges that this study did not establish, regarding the adoption and integration of technology with instruction in Swaziland.

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Characteristics of Today's Applied Engineering College-Level Educator

By Jeffrey M. Ulmer, Douglas Koch, and Troy Ollison

ABSTRACT

Higher education is constantly changing and evolving. Many contend that the recent changes have not always been positive and that current changes have greatly affected applied engineering programs. The purpose of this article is to investigate and collect information regarding current issues and the current state of educators in postsecondary, applied engineering/technology programs. It is a broad overarching approach with the intent of identifying the current state, potential research needs, and concerns within the discipline. Two hundred and twelve faculty members within the United States responded to a national survey to help fellow faculty determine the current and evolving characteristics of today's applied engineering college-level educator. Previous literature and data identifies changes related to financial challenges, salaries, technological advancement, professional experience, course load and class size, globalization, and lack of advancement opportunities. The survey sought to determine the current status of the field in those areas and found that the mean salary of $73,567 for the respondents was above the mean national higher education salaries but had a high standard deviation. Of the faculty, 74% are teaching in the classroom followed by 13% hybrid, and 13% online. The mean number of years of service outside of academia was 12.34. Regarding positional status and opportunities for advancement, the respondents were 21% contract only, 19% tenure track, and 60% tenured faculty. The data collected points out some areas that have potentially changed over time and areas that need further investigation. Long-term data is needed to establish a change in trends.

Keywords: Higher Education, Professional Development, Technology, Applied Engineering

INTRODUCTION

Most industries and businesses are in a constant state of change. As economies change, technologies evolve, and labor forces fluctuate, industries have to adapt and change as well. Higher education is no different. Some might argue that education, particularly postsecondary education, is somewhat slow and reluctant to change but it does change nonetheless.

This purpose of this article is to investigate and collect information regarding current issues and the current state of educators in postsecondary applied engineering/technology programs. It is a broad overarching approach with the intent of identifying the current state, potential research needs, and concerns within the discipline.

Review of previous literature and studies reveal that there are several aspects of applied engineering programs that are changing and are of concern to many of the current educators. A couple of the changes or concerns often pointed out include a potential shortage of well-prepared faculty and concerns of salary compression or low salaries. According to the Bureau of Labor Statistics (2010), postsecondary teacher growth is projected at 17% from 2010 to 2020, and in 2010 the faculty earned a median salary of $62,050 per year. Additional concerns include the ever- changing population of students and their skills and abilities they bring with them out of high school. Applied engineering college-level educators are being called upon to deliver remedial, introductory, intermediate, and advanced technical content to students in traditional classroom, hybrid/blended, and 100% online delivery methodologies. Many faculty members are not only teaching typical lecture courses but also being tasked with running student laboratories, advising students, participating in professional associations, serving on governance committees, having responsibility for finance, and keeping technical education for themselves, and their students, at a high level of competency (Chikasanda, Otrel-Cass, & Jones, 2010). The culmination of these factors may result in possible reasons for some educators to leave teaching. Steinke and Putnam (2011) pointed out that applied engineering educators leave the teaching profession due to "low salaries, lack of career advancement, or administrative support, student and peer issues, and other school

and environment-related concerns" (p. 41). This paper is a culmination of efforts after a broad literature review-based survey was administered online to educators in the United States with the purpose of obtaining the current and evolving characteristics of today's applied engineering college-level educator.

CURRENT CHALLENGES FACING EDUCATORS

There are many challenges facing university faculty given the current systems and methodologies employed by higher education institutions. Some contend that certain changes within higher education are detrimental. Wheeler (2004) provided seven fundamental reasons for the decline of the traditional university system and the faculty in the system. They include "technological innovation, adverse economic climate, mounting commercial competition, demands for greater flexibility, subject proliferation, erosion of academic staff base and globalization" (p. 12). Wheeler also stated that the survival of universities is dependent upon retaining talented and innovative staff through job security, job satisfaction, and optimal rewards without using the typical disdain often given to faculty who support the academic system.

University faculty members are very resilient and have been forced to adapt to changes. Today's educators possess passion for their jobs and often focus on where they can make a difference (McClellan, 2012). In the midst of change, educators typically go with the flow and adapt to their educational reality (Osborn, 2012). With changing technologies and evolving delivery methods, faculty members have received the "do more for less" mentality from many higher education institutions. Privateer (1999) pointed out these concerns several years ago stating, "factoring in the growing tendency of federal officials, governors, legislators, governing boards, and college and university administrators to envision instructional technologies as a panacea able to maintain the status quo while dramatically cutting delivery costs" (p. 66).

Financial Challenges

According to Kelderman (2012), state appropriations for colleges declined 7.6% from 2011-2012. Program and departmental budgets are being stretched further as costs of operations are ever increasing. Numerous academic institutions are facing financial challenges and focusing on increasing enrollments to offset budget and appropriation deficits. Donoghue (2011) related that many colleges and universities are increasing the number of students in each class and the number of classes taught each semester by each educator. This translates into more generated revenues. Many administrators in higher education feel that the current state of academia can be remedied through higher levels of recruitment and retention of faculty (Field, 2011). Miller (2011) supported this idea by stating that marketing is a key to program success and survival. Currently, higher education faculty recruit and retain students through face-to-face meetings, web-based technologies, and social networks (Doggett & Lightner, 2010). Sevier (1996) stated years ago that higher education administrators begin with vision, define marketing broadly, create an institutional image, and understand student decision-making to set the stage for a increasing student enrollment and keeping retention higher.

Salaries

Salaries are often mentioned regarding concerns for retaining and attracting qualified faculty. Whereas postsecondary teachers earned a 2010 median salary of $62,050 per year with no requirement of related occupational experience, faculty in the more specialized area of career and technical education (technology and applied engineering teachers) earned a median salary of $53,920 per year with 1 to 5 years of related occupational experience (Bureau of Labor Statistics, 2012; Occupational Outlook Handbook, 2012). This disparity in salaries is a reality, and no literature could be found to explain the differences. The lower salary is exasperated by the fact that non-faculty feel that college educators do not earn the salary they currently are paid because faculty typically work less than one-half the time of those outside of academia (June, 2012). Furthermore, many institutions are on a faculty-hiring freeze, and faculty pay dropped 1.8% during a 2011-2012 academic year undergoing a 3% inflation rate as reported by the American Association of University Professors (June, 2012; Osborn, 2012).

Technological Advancement

Technologies have evolved to help educators maintain levels of competency and give students the tools they need for their studies. As these technologies have evolved, educators still face challenges in providing students with basic skill competencies all while increasing the number of postsecondary students in their programs, aligning curriculum with employers' skill needs, creating better education delivery modalities, and still attempting to provide students with an educational experience that adds to a student's skill sets (Jones, 2013).

One of Wheeler's (2004) reasons for the decline of the traditional university system was ironically technological innovation. One would think that technological innovation would be an asset that higher education relies on and benefits from; to some degree that is the case. Lack of technological innovation and competency can be a detriment. Grumwald (2010) summarized that effective teachers use technology to enhance student learning. The understanding of technology is a must for technologists and applied engineering college-level educators (Devine, 2006). Educators need to be ready to handle diversity, incorporate technology for faculty and student breadth-of-knowledge, use multimedia formats to aid critical thinking, and teach students entrepreneurial skills (Donlevy, 2005; Kenney, McGee, & Bhatnagar, 2012).

In the new reality of online education, an educator is someone who "reaches across time and distance through online courses and virtual universities" (Wolcott, 1997, p. 3). Key student program awareness tools and education technologies available for education institutions include: "virtual campus tours, online enrollment and admission, specialist keynote lectures via webcasting, individualized course delivery and live links to special events" (Wheeler, 2004, p. 11). Gumbo, Makgato, and Muller (2012) took the competency of educators seriously by suggesting that educators should be profiled to ascertain if their level of technology understanding is satisfactory, and if not, apply appropriate remedial training to prepare them for educating today's students.

Technical innovation also encompasses specific technologies within the field(s). According to a Society of Manufacturing Engineers (SME) survey with 261 respondents, conducted by Callahan, Jones, and Smith (2008), students should be prepared in areas of "lean process improvement tools, CAD/CAM, flexible manufacturing, integrated manufacturing systems, six sigma and automation" (p. 5). Therefore applied engineering educators should possess these same skills. Other areas of preparation for students, and educators, include: "sensor technology, advanced inspection techniques, automated material handling, expert systems, artificial intelligence, simulation, laser applications, design of experiments (DOE) and composite materials" (Callahan, Jones & Smith, 2008, p. 6).

Professional Experience

Garrison (2005) contended that an increasing number of universities strive to higher faculty members with industry or government experience. A quick search of job postings for applied engineering related positions will show many requiring or preferring recent industry experience. Applied engineering college-level educators often enter teaching straight out of the industrial trenches. Garrison found that the predominant reason for individuals to switch from industry to academia was "the desire to teach." These late-entries of "new" faculty, who have professional experience, often benefit the students due to their experience in applied engineering and technology. In 2010, Nickolich, Feldhaus, Cotton, Barrett, and Smallwood commented that midcareer professionals bring other attributes and stated:

> In addition to their presumed subject matter backgrounds in high-demand disciplines, midcareer professionals who are currently a part of, or choose to enter teaching, can bring new maturity and experience to the nation's talent base of educators and help connect teaching and learning to expanded applications in the world of work (p. 44).

One of the challenges of requiring work experience prior for faculty positions is that it reduces an already small pool of candidates. In some professions, advanced degrees are not often sought and may not always benefit someone in an industrial setting. An individual may have excellent work experience but may lack the

required education or terminal degree required for many jobs in higher education.

Course Loads and Class Sizes

Donoghue (2011) stated that many universities are trying to offset financial deficits by increasing sections of course offerings and increasing the numbers of students enrolled in those sections. Faculty at one time were given release time to pursue scholarship, continuing education, and to offset large class sizes. Now they are often being required to increase their activities on committees, recruitment, and participation with accreditation activities or other duties. Wilson (2011) mentioned several examples in which release time and reduced teaching loads have been removed from faculty. She believes that release time and "deals" for teaching relief are not as common. She stated that, "the pendulum on granting special deals in exchange for service is swinging back, specifically at public research universities." Many universities are going to standard teaching loads and with the increased enrollments at many schools; class sizes are increasing as well.

According to Barwick (2007), when faculty members discuss workload, class size "arises repeatedly." Increasing the number of sections offered and the class size have many ramifications for faculty, departments, budgets, and the students. Faculty do not typically contend that student learning increases as class size increases. Many faculty are now teaching additional courses or sections to accommodate the increased need. As the number of students increases in classes, so do the costs associated with the classes. A typical lecture-based course will typically entail only an increase in workload for the faculty teaching the course, but many of the applied engineering and technology-based courses have lab and hands-on components. This creates increased needs for equipment and materials or could potentially pose a safety concern if numbers are too large.

Globalization

Wheeler (2004) also mentioned globalization as a cause for decline. Globalization is affecting how students should be educated (Ayokanmbi, 2011). Therefore technology educators should align course content with the needs of industry (Hogan, 2009; Jones, Smith, & Callahan, 2010). Demographic changes, technology advances, and globalization are claimed to be the game changers in the 21st century (Donlevy, 2005; Karoly & Panis, 2004). In fact, many educators are being encouraged to insist that their applied engineering students acquire global perspectives through exposure to cultures in other countries and to be prepared for mobile careers (Ayokanmbi, 2011).

Lack of Advancement Opportunities

Lack of opportunities for advancement or clearly outlined paths for advancement also seem to be a concern for faculty. Today's educator may or may not be tenured or in a tenure-track position. This all varies greatly with the type of institution and the mission of the institution. Although tenure-track faculty are usually assigned mentors to nurture scholarship and offer academic-pertinent advice toward tenure consideration, tenured faculty still require additional professionally applied training and education (Chronicle, 2012). According to "Midcareer Mentoring, Part 1," published in *The Chronicle of Higher Education* in 2012, professors have questions and concerns about post tenure. The top questions asked include:

1. How would I pursue employment at other institutions?
2. Can a counteroffer at my institution help improve my career?
3. How much service is required at my institution?
4. Should I choose a position in administration?

These top questions may hint at tenured faculty members' concerns and desires to seek additional employment, address low salaries, and continue professional growth.

Obtaining tenure and progression through the ranks (instructor-to-assistant professor, assistant professor-to-associate professor, and associate-to-full professor) requires a well-documented dossier and supporting materials in the area of teaching, scholarship, and service in many higher education institutions (Kelly, 2008).

According to the American Association of University Professors (1993), "we believe that all faculty members—regardless of institution and regardless of workload—should involve themselves as fully as possible in creative and

self-renewing scholarly activities" (p. 198). Service in academia possesses a broad base of definitions ranging from service on committees to public service for organizations outside an educational institution (University of Wisconsin - Stout, 2010).

PURPOSE OF THE STUDY

The purpose of this study was three-fold for applied engineering college-level educators: 1.) conduct a broad literature review on employment conditions affecting faculty, 2.) administer a career-status-update survey to faculty in the United States, and 3.) report summarized survey results on the current and evolving characteristics in order to identify future, more in-depth research needs.

METHODOLOGY

A 23-question online survey was developed for distribution to faculty through the Association of Technology, Management, and Applied Engineering (ATMAE) and Texas A&M Engineering Technology (tamu.edu) Listservs at United States community colleges and universities that include Engineering Technology, Industrial Technology, or Technology programs. Information was obtained from faculty through an introductory listserv email and enclosed web link to the survey. The survey was posted in March of 2013. See Appendix A for the content of the online survey. Survey responses were kept confidential for this study.
Summarized survey data using Microsoft Excel and Minitab 16 were used to categorize:

- State of employment
- Positional status
- Faculty rank
- Length of time in current rank
- Length of time in a nonacademic position (before or after academia)
- Primary academic program for employment
- Number of students taught
- Academic salary
- Nonacademic salary
- Accreditation agencies supporting the program
- Degree levels obtainable for students
- Institutional offering of market pay
- Level of academic freedom
- Benefits cost of coverage
- Effective use of faculty talents
- Manageability of teaching requirements credit hours taught per semester
- Percent of share for class type (face-to-face, hybrid, online)
- Ease in getting resources for teaching and labs
- Level of expectations for research (scholarship)
- Unique ways in which the institution supports faculty beyond base contract salary
- Expectations for promotion and tenure and general comments related to the college/university
- Satisfaction level at your institution

Study limitations could exist due to information provided by survey respondents. For instance, faculty may not possess a comprehensive understanding of the actual reasons for the way in which their institution is managing academic affairs. Furthermore, low salaries or benefits could be to the result of poor faculty performance or discord present between the faculty member and the immediate chair or supervisor. Another potential limitation was the use of a researcher-developed instrument with limited validity and reliability.

SURVEY RESULTS

State Representation for Study

Two hundred and forty four people from 39 states (see Figure 1) provided survey data, although this number was reduced to 212 survey respondents after removing individuals who did not provide one of the following responses: 1.) The primary applied engineering-related program, 2.) State worked in, 3.) Faculty rank, 4.) Positional status, or 5.) Average academic salary. This action was taken because these five questions were the baseline for extraction of information for summarization for faculty.

Positional Status

Primary positional status for survey faculty

consisted of contract only (21%), tenure track (19%), and tenured (60%).

Faculty Rank

The dispersion of faculty rank was: Coordinator (1%), Director (1%), Adjunct (2%), Lecturer (2%), Instructor (13%), Assistant Professor (16%), Associate Professor (36%) and Full Professor (29%).

Length of Time in Current Rank

The mean years of service for the respondents were 10 years. The range was from 1 year to 40 years, with a surprising number of respondents with less than 10 years of service (see Figure 2).

Length of Time in a Nonacademic Position

The respondents had varying lengths of service in nonacademic positions with a range of 0-50 years and a mean of 12.34 years (see Figure 3).

Primary Programs and Degree Levels

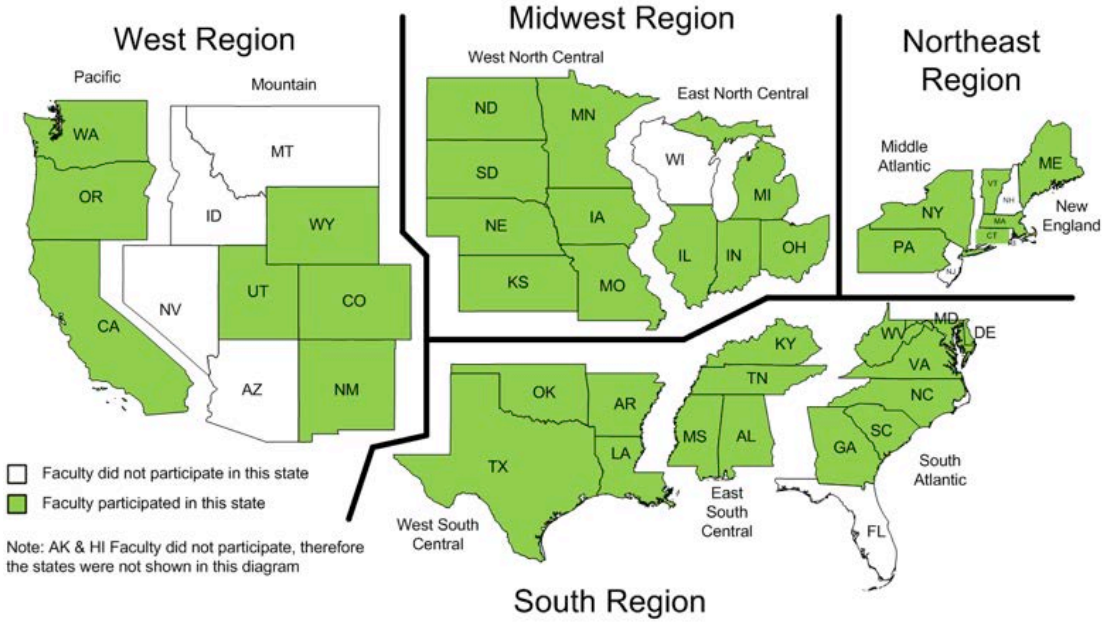

Figure 1. Survey participation by region, subregion, and state

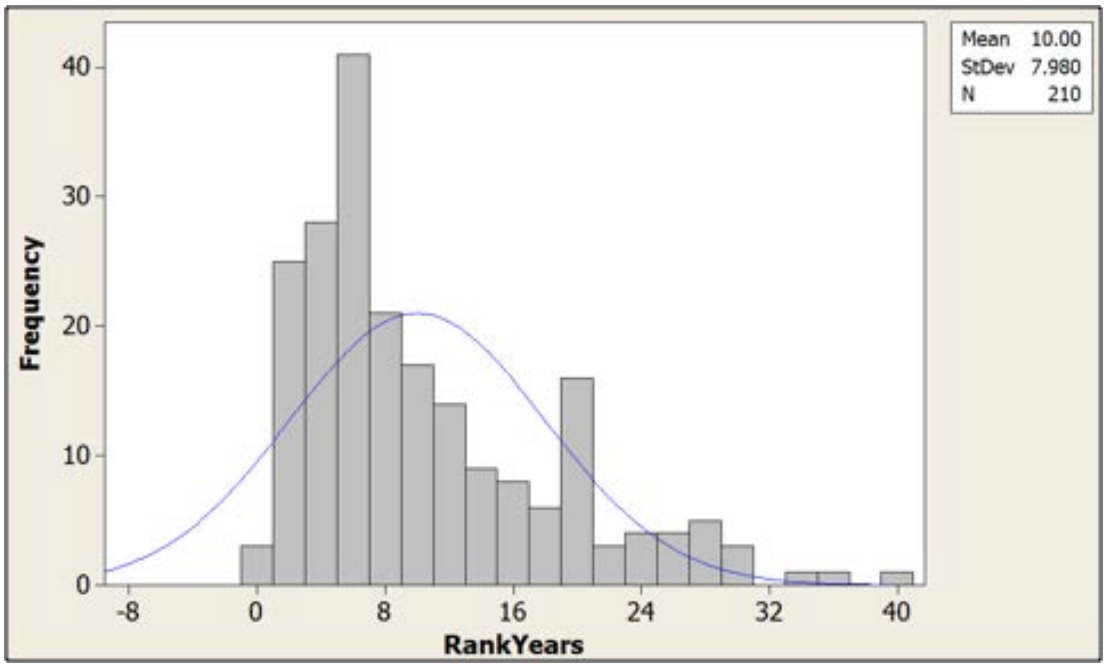

Figure 2. Faculty length of time in current rank

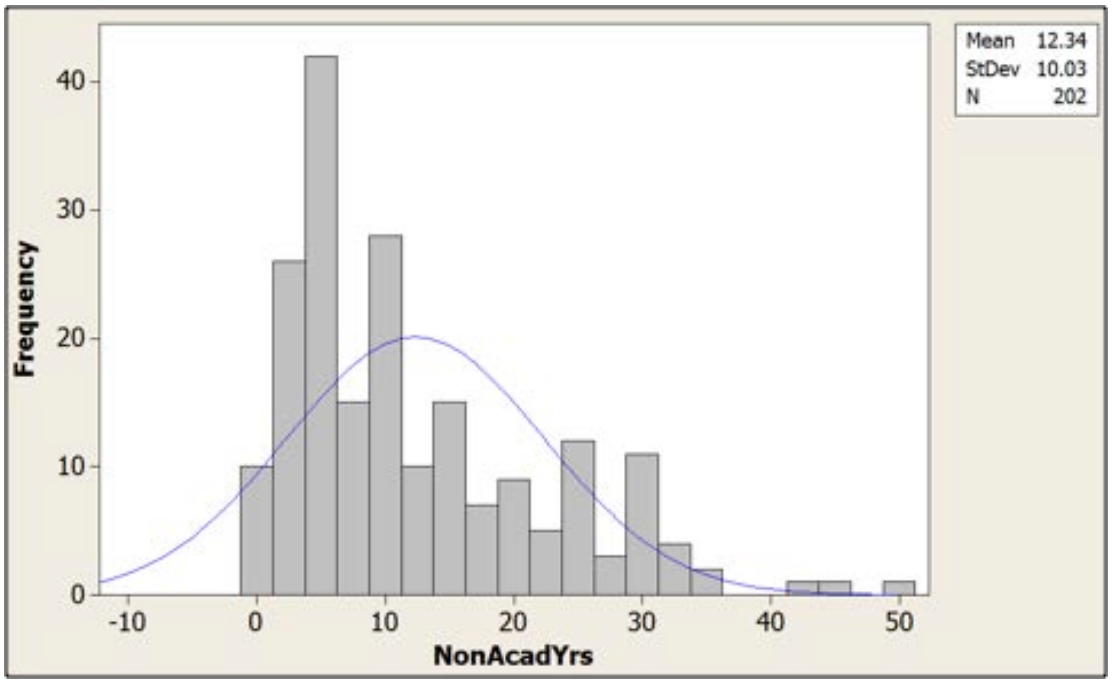

Figure 3. Faculty length of time in a nonacademic position

Faculty teach in the following programs (with greater than 5 responses for each item): Construction Technology or Management (12), Design & Drafting Technology (or CADD) (12), Electronics Technology (33), Engineering Technology (76), Industrial Technology (15), Manufacturing Technology (13), Technology (7) and Technology Management (12). Degree levels taught as reported by greater than 10 survey respondents consisted of the following: Undergraduate (Associate—2 Year) (69 respondents), Undergraduate (Bachelor—4 Year) (94) and Graduate (Masters) (35).

Faculty Credit Load by Semester and Students per Semester

The number of credit hour load and students taught by a faculty member in a semester is provided in Figure 4. The mean credit hours taught per semester is 12.27 with an average of 63.86 students taught per semester.

Faculty Salary and Contract Length

Faculty salary mean was $73,567 with a standard deviation of $24,890 (see Figure 5). The vast majority of the faculty members are on a 9-month contract.

Administration Position and Pay

Survey respondents (number provided after title) who were both a faculty member and an administrator had the following primary positional titles: Chair (18), Coordinator (32), Department Head (3), Director (2), and Program Director (4). Seventy-one individuals responded to this question and provided the following stipend yearly amounts (values were only listed for greater than 3 responses): $0 (26 respondents), $3,000 (9) and $6,000 (4). Stipend range: $0 to $75,000 per year. Other means of support consisted of release time, teaching of summer courses, grant work, and online course development.

Market Pay

Yearly competitive (market pay) is not acknowledged or utilized at 50% of faculty institutions (83 respondents). The remaining 50% of respondents reported the following professional organizations for benchmarking: AAUP, ABET, ACCE, ASEE, ATMAE and CUPA-HR.

Accreditation Body

The primary accreditation body supporting a faculty member's primary program were (number of responses in parentheses): Accrediting Board for Engineering & Technology (ABET-EAC) (9); Accrediting Board for Engineering & Technology (ABET-

TAC) (94); American Council for Construction Education (ACCE); and the Association of Technology, Management, and Applied Engineering (ATMAE) (45).

Academic Freedom, Benefits Cost of Coverage, Talent Usage, and Teaching Manageability

Academic freedom scored a mean of 3.79 on a scale of 1 to 5, with 5 being the highest. Benefits cost of coverage scored a mean of 3.57. Similarly, faculty talent usage scored a mean of 3.52. Teaching assignment manageability scored 6.16 on a scale of 1 to 10, with 10 being the highest.

Teaching Method

Faculty taught by face-to-face (74%), hybrid (13%), and online (13%).

Resources and Support, and Research (Scholarship) Expectations

Resources and support provided for faculty rated 6.33 on a scale of 1 to 10, with 10 being the highest. Research (scholarship) expectations by educational institutions scored 2.87 on a scale of

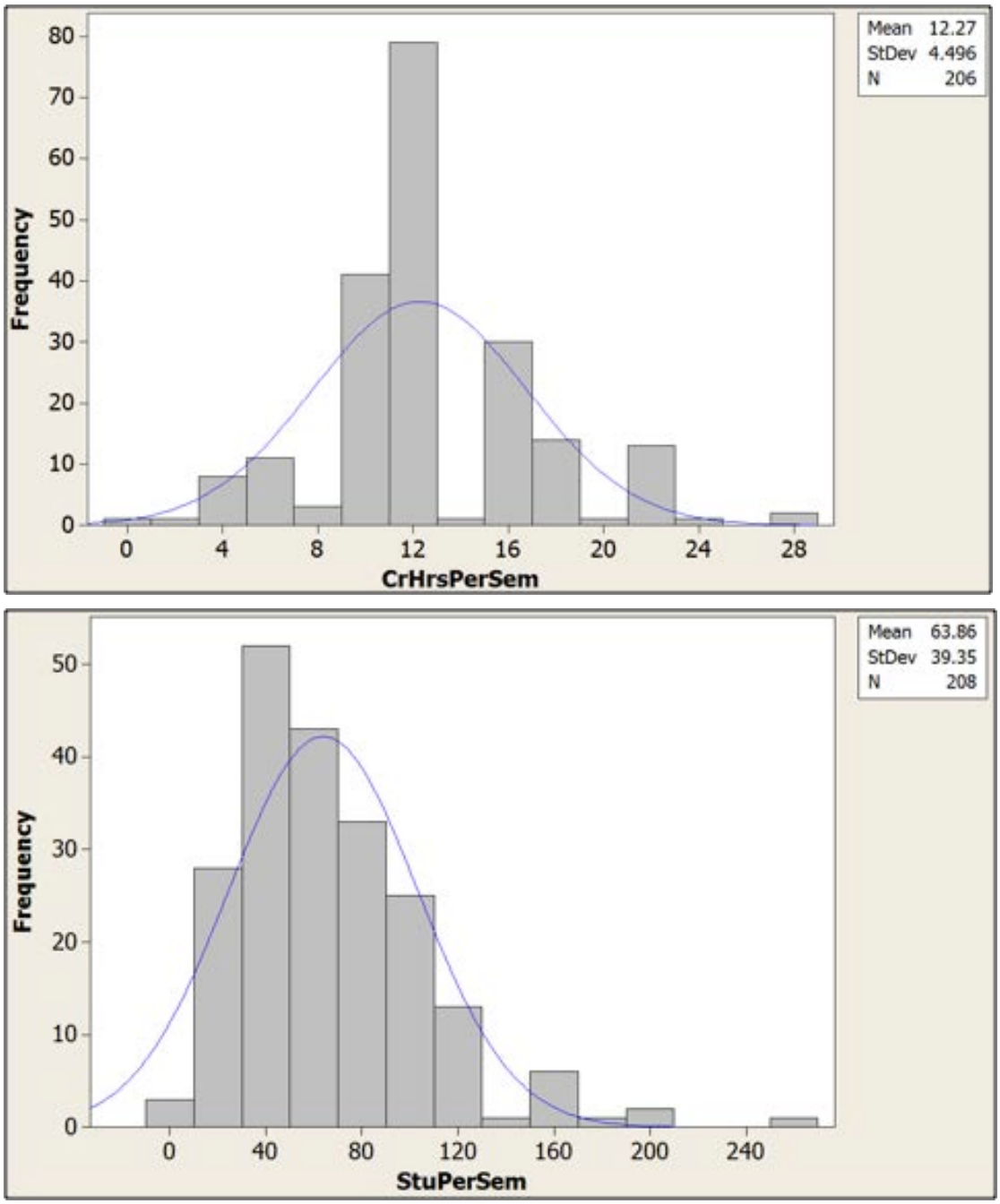

Figure 4. Number of students taught per semester by faculty

1 to 5, with 5 being the highest, by faculty.

Promotion and Tenure Expectations

The survey allowed for open-ended responses regarding the respondent's university tenure and promotion procedures or expectations. A summary of faculty anecdotal information on their promotion and tenure is provided below:

- Two publications required per year
- Five years teaching and 15 hours of Master's credit to apply for assistant professor
- A joke. No new faculty mentoring. No feedback from administration on how well we are doing
- Absolutely ridiculous and highly arbitrary— even though there are written requirements
- Based strictly on education and years of service

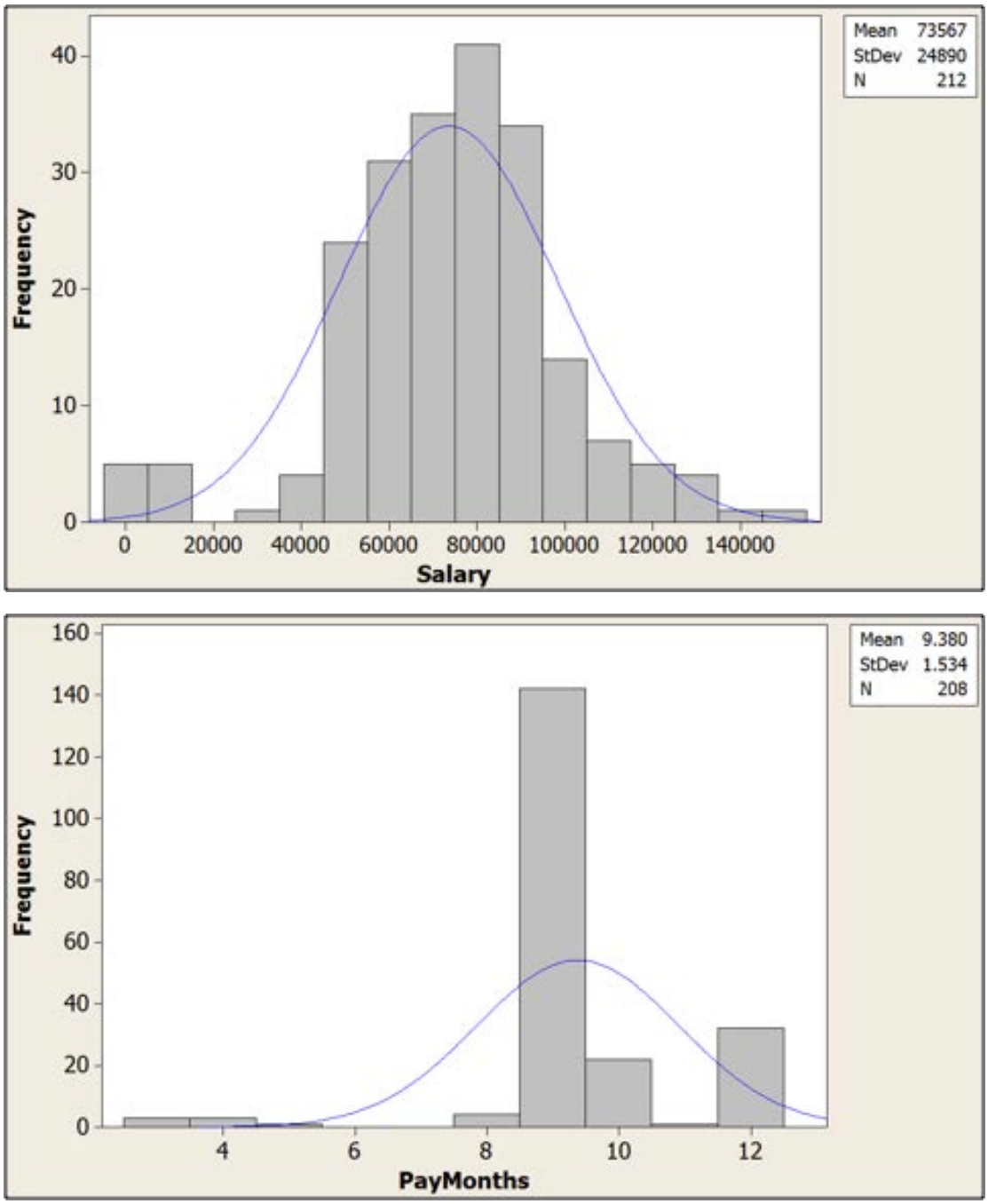

Figure 5. Faculty salary and contract length

- Does not hire full time but depends on adjuncts
- Expect too much scholarly activity given the teaching loads
- I will get tenure this year—the target is moving
- It is a fair system
- One is completely at the mercy of the academic politics

CONCLUSION AND DISCUSSION

The literature tended to focus on the areas of financial challenges, salaries, technological advancement, professional experience, course load and class size, globalization, and lack of advancement opportunities as some of the growing concerns in higher education. When examining and attempting to draw conclusions, additional longitudinal data will be needed to establish trends. The data collected from this initial study yields a current snapshot into the current standings. The researchers felt the response rate was appropriate and representative of the population. United States faculty representation by state was well represented with 39 out of 50 states responding (78%), which included 212 respondents.

From the standpoint of salaries, additional data will have to be examined to see trends, but the mean salaries reported were above the national higher education mean. The mean of $73,567 for faculty salary fits well within the normal distribution but the standard deviation of $24,890 is very wide—possibly due to positional status, rank, length of time at current rank, institution, location within the United States, and market pay. Faculty contracts are primarily 9 months; 12 months for a chair or administrator.

Technological changes have transformed education greatly. Online delivery of courses and materials was one of the areas most affected or actually created by technological advancement. Although online education is growing in the United States as shared by other scholarly articles, the evidence of 74% of faculty teaching in the classroom followed by 13% hybrid, and 13% online, seems to be a relatively small percentage, and further study is needed to see if it is increasing within applied engineering.

The vast majority of the respondents had some work experience outside of academia with a mean of 12.34 years. This could support the notion that applied engineering programs tend to hire individuals with professional experience. More information is needed to determine if this is a requirement and benefit within the field or it is typical that individuals pursue higher education positions after working in industry.

Course load and class size should be further examined, and additional information such as type of institution and its mission to draw usable conclusions. This information will also have to be examined longitudinally to determine changes and trends by institution type. The distribution of faculty credit hours per semester is not normally distributed. The mean of 12.27 credit hours is both the mean and the highest point in the curve. The right skew of the distribution for students taught per semester underscores the tide towards a larger number of students for each faculty member per semester.

The lack of advancement opportunities of faculty is a concern for many as a large percentage of positions are contract only with no opportunities for advancement. Positional status for faculty is interesting with 21% as contract only, 19% as tenure track, and tenured faculty at 60%. Per faculty responses in question 23, more colleges and universities are hiring more contract-only faculty. Also, it appears that faculty members have spent a lot of time in their current rank with a mean of 10 years. Promotion and tenure is a typical process of advancement and generated the most disparate and heated anecdotal responses by faculty. Some individuals were content with the P&T policy in force at their institution, whereas others were very upset on how promotions and tenure was discriminately given to "special" faculty.

Additional information was collected in other areas that may hint at satisfaction or provide more insight into changes within the field. Academic freedom, benefits cost of coverage, talent usage, teaching manageability, resources and support, and research (scholarship) expectations all scored from mid-level to approximately 80% of acceptability by faculty. Overall, it appears faculty were not overwhelmed by the working environment of their educational institutions; they were not too upset about it either.

FUTURE RESEARCH

The authors intend to conduct a statistical study on positional status; academic rank; length of time at current rank; length of time in a nonacademic position; and academic salary and market pay by state, region, and subregion. Through a descriptive and inductive analysis of raw data from this current study, it is hoped that an in-depth picture of exceptional career attributes can be extracted to help develop a "Faculty Body of Knowledge" in a future study. This study, as well as any planned future studies, is significant to college-level faculty and administrators in several ways. For administrators, being aware of current trends in higher education can be a powerful tool to manage and motivate faculty. From the faculty's point of view, this data can serve not only as negotiation leverage for compensation, load, and release issues, but it can also give faculty a sense of community by letting them know that their problems and concerns are not isolated and that they are potentially in the same situation as thousands of other faculty around the United States.

Trend data has to be established to determine change in the areas being investigated, and there are many areas in that warrant further investigation and refinement. These areas include: 1.) Additional analysis of administration faculty in terms of stipends and institutional expectations, 2.) Academic freedom in comparison to academic rank and other potential significant factors, 3.) Correlation between an institution's use of academic talents to manageability of teaching assignments, and 4.) Further analysis of teaching mode of delivery (face-to-face, hybrid, online), faculty resources availability, expectations for research (scholarship), unique ways to compensate faculty, and institutional expectations for promotion and tenure.

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