E-Learning, Engineering, and Learners of African Descent: A Needs Analysis

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Abstract

The rapid growth and short history of e-Learning technologies and the desire to see these technologies integrated into the learning process have caused a lack of specific guidance and firm foundation of principles on which to base instructional choices. Lessons cultivated in the Learning Sciences about the cultural influences of learning provide a foundation for the development of e-Learning resources. A clear understanding of the cultural impacts on e-Learning resource appropriation is necessary to direct research and to provide designers with clear guidelines for instructional design for distance education. The purpose of this paper is to determine how appropriate e-Learning can be designed to cultivate the learning process and abet the retention of engineering students of African descent.

Introduction

e-Learning

One of the greatest benefits of e-Learning is its ability to overcome the various boundary conditions, such as space and time, in which knowledge can be imparted to a learner. Though many are the opportunities that e-Learning affords, the fact still remains that e-Learning does not change anything about how human beings learn (Nichols, 2003). The true educational potential of e-Learning tools may never be realized until developers see links between established theoretical perspectives on learning and useful applied techniques in e-Learning course design, and until they find ways to improve the dissemination of research for more specified guidance (Bannan-Ritland, Bragg, & Collins, 2004). e-Learning resources that do not address the fundamental principals of e-Learning are doing a disservice to the learners. Nichols (2003) developed several hypotheses as fundamental principles for e-Learning that are worth investigating. These principles include the following:

- e-Learning is a means of implementing education that can be applied within varying education models and educational philosophies.
- e-Learning enables forms of education that fit within the existing paradigms of face-to-face and distance education.
- Whenever possible, the choice of e-Learning tools should reflect rather than determine the pedagogy of a course; however, as a general rule, *how* technology is used is more important than *which* technology is used.
- e-Learning advances primarily through the successful implementation of pedagogical innovation.
- e-Learning can be used in two major ways: the presentation of educational content and the facilitation of educational processes.
- e-Learning tools are best made to operate within a carefully selected and optimally integrated course design model.
- e-Learning tools and techniques should be used only after consideration has been given to online vs. offline trade-offs.
- Effective e-Learning practice considers the ways in which end-users will engage with the learning opportunities provided to them.
- The essential process of education— that is, enabling the learner to achieve planned learning outcomes—does not change when e-Learning is applied.
- Only pedagogical and access advantages will provide a lasting rationale for implementing e-Learning approaches (Nichols, 2003).

Retention and Success in Engineering

The issue of success in engineering among students of African descent may have global and economic impact, and therefore its ramifications cannot be ignored. Although African Americans are entering college and pursuing engineering disciplines at rates higher than ever before, they are dropping out or leaving at rates higher than non-minority students—representing a mere 4.88% of all engineering degree recipients and graduating at a rate 7% lower (Brown, 2004; Sniederman, 2005; Cassell & Slaughter, 2006; Snead-McDaniel 2010). Data was collected by the National Student Clearinghouse (NSC) on engineering graduates from the 2004 Cooperative Institutional Research Program (CIRP) Freshman Survey and enrollment and was compared to completion data for students who completed degrees in the Science, Technology, Engineering, & Mathematics (STEM) disciplines in 2008 and 2009. The results from this comparative analysis indicated White students who started as STEM majors have four and five-year STEM degree completion rates of 24.5% and 33%, respectively, compared to students of African descent who had four and five-year STEM degree completion rates of 13.2%, and 18.4%, respectively; which is lower than all other underrepresented minorities (HERI, 2010). Students of African descent majoring in one of the STEM fields are faced with an uphill battle. There are no statistical differences across racial groups in career interests, aspirations, or ability. Retention decisions are informed by on-going, inter-actional processes among the individual, cultural and peer influences, social dynamics, and environmental factors (Byars-Winston, Estrada, & Howard, 2008). Exploring how e-Learning can be better utilized to ensure their success and to bridge the gap of the traditional education is a worthwhile investigation.

Culture Impacts Learning

The study of culture's effects on learning has its bases in several learning theories. Ausubel's Meaningful Learning Theory depicts meaningful learning as a process of relating potentially meaningful information to what the learner already knows in a non-arbitrary and substantive way (Driscoll, 2000). If a learner has experiences that are unique to his identity, then meaningful learning occurs when he is able to relate new potentially meaningful information. Lave and Wenger's (1990) Situated Learning Theory also explains learning as a function of the activity, context, and culture. Marcus (2000) observes this same trend in user interface designs of different cultures, as various cultures look for different data and visual clues to make decisions. This article will use Lave and Wenger's Situated Learning Theory (1990), Ausubel's Meaningful Learning Theory (1963), and fundamentals established and employed in user interfaces designed for web development to explore the concept of culturally-specific learning.

Ausubel's Meaningful Reception Learning Theory states that the materials to be learned must be potentially meaningful to what the learner already knows and how that knowledge relates to what she is being asked to learn (Driscoll, 2000). Thus as knowledge is acquired in learning new technical information it is assimilated into the learners schema. Novice learners, however, lack domain-specific knowledge and must be provided a framework that can be used for incorporating new information (Mayer, 1981). In examining the current state of knowledge and how it increases the novice's understanding of computers and computer programming, Mayer (1981) establishes that the comprehension of computer science is best achieved when grounded in a previously understood medium. Situated Learning Theory examines knowledge acquisition through active participation in the social, environmental, and cultural merits of a situation (Lave & Wenger, 1990). Through legitimate peripheral participation, learners are afforded knowledge in the communities of practice that they participate in, which serve as tools to shape their understanding of the world around them (Driscoll, 2000). When a learner's instructional knowledge is divorced from her communal configuration developed from within her community of practice, her ability to associate her instruction with her already learned knowledge is hindered. This severed connection is prevalent among the learners of communities of people of African descent. As a result, the advantages of situated learning are not realized in this community of practice.

Learning in the situated learning theory is entrenched throughout the social and substantive matters of a situation (Bryd & Eales, 1997). In the social context of an environment, learning can be manifested through the basic interaction of others, shared information, or even through abstractions from acuity. Lave and Wenger (1990) expressed that learning is not only a result of organized education present in rigorous formats, but also of opportunities to be employed through practice.

If situated learning is defined as a process of engagement in a community of practice (Smith, 2003), a context of learning in an everyday practice that is stretched over—not divided among—mind, body, activity, and culturally organized settings (McLellan, 1996), and a derivative of active cultural participation, then can it serve as a solution to alleviate the disparities in educating African American learners? If identifying the sociocultural setting as the African American community and asserting that knowledge is a lived practice (Driscoll, 1999), then the learning of its participants is impacted and formulated about the activities of this community of practice. Situated learning establishes learning as an occurrence from within a concrete context. Learning is then a tool resulting within a community of practice by which it loses some of its validity if separated from its culture. The situated learning theory, from the perspective of educating African American learners, provides a basis for understanding the disconnect that exists in teaching participants of this particular community of practice.

Situated learning must involve activity, concept and culture. Comprehension of one will not abide with the other two, because they are independent (McLellan, 1996). Therefore, if knowledge can be seen as a dynamic toolkit cultivated through experience (Orellana & Bowman, 2003), tools and cultural skills in these toolkits can be identified with certain characteristics. An understanding of tools is obtained through first accepting the belief system of the culture of the tool and then through use (McLellan, 1996). In the same fashion, the African American community learning tool cannot be understood without the acceptance of the functioning of that tool with respect to the culture.

Learners participate in a number of communities of practice throughout an average life span. Their perspectives and interactions within these communities are impacted by their dominant community of practice. Take, for example the African American community. For many members of the community, their ability to progress from the periphery of a community to the center is framed with respect to the culture of their dominant community of practice. A learner's legitimate peripheral participation, the skills and knowledge he has developed through practice, impacts him to transform the communities of practice that he participates in (McLellan, 1996). The knowledge that is obtained while working within communities of practice reframes the learner's previous knowledge base to encompass the acquired instruction.

Participants of the African American community engage in other communities of practice, as explained by McLellan (1996), with the artifacts created from their historically rooted, dominant community of practice. Through the course of situated learning, learners will encounter situations that are not accounted for which can serve as roadblocks; in this they will draw upon their situated actions (Orey & Nelson, 1994). It is through this framework that they are able to create plausible solutions and move through their situations. In order for the learners to skillfully maneuver, they must understand how to use the artifacts they have acquired. The interaction of understanding and experience forges meaning in an assortment of situations (Orey & Nelson, 1994).

All knowledge is not obtained via situated cognition. Knowledge can be acquired in formal and informal ways; the interaction of the types of knowledge is beneficial when the strengths of both forms of knowledge are used (Bryd & Eales, 1997). Given that full understanding of the attained knowledge has occurred, then knowledge learned through formal means can be applied in situations dealing with informal contexts. Situated learning does play a vital role in the development of learners. Because the nature of learners is to participate in various communities of practice, it is natural that the learner's development in one community of practice can come as a result of her participation in another.

Barron (2004) identifies the different ways technology is used by different demographic groups and how computing is used as a learning tool in more or less affluent schools. Innovational equity is what she calls the shift from concern with physical access to technology to concerns with access to the learning opportunities that will allow for more empowered and generative uses of technology for learning and innovations. Barron (2004, p.6) defines learning ecology as "the accessed set of contexts, comprised of configurations of activities, material resources and relationships, found in co-located physical or virtual spaces that provide opportunities for learning." Thus she has placed the learner as the organizing central node in the system. Barron does not only incorporate the learner's environment as a source of learning but also institutes opportunities for technological fluency development that arise at home and school, through peers, and in community contexts, as well as through utilizing distributed resources such as books and online tutorials. Barron further solidifies that learning is constituted and created by the participation in any one context and shaped by learning histories and beliefs of partners, by mediational tools that are made available from the work of previous generations (computers, systems of symbolic representations, language practices), and by goals and practices of communities and smaller social units, such as families. It is within these social units that the aspects of identity are developed through a sense of belonging to a community, a sense of competence, the development of interest, and the desire to participate in additional learning activities (Barron, 2004).

Learners of African Descent

The numbers for the lack of success for students in engineering is staggering across the board for all minority groups—the issue of success in engineering is not unique to students of African descent. As a result, much of the literature tends to focus on the needs of all non-White minority groups (Banks, 1997). It is problematic or perhaps detrimental to ignore the variations of the diverse members of society, labeling them as fixed entities without cultural influences that can serve as catalysts to shape learning and development in a variety of ways. For example, people of African descent are the only group of people who have been told systematically and consistently that they are inferior and that they are incapable of high academic achievement (Ladson-Billings, 2000). Thus, the possible inferiority complex that can be birthed from generations of belligerent insinuations of belonging to a perceived subculture should not be overlooked. It is imperative, therefore, to understand the specific and unique qualities of the cultural experiences of people of African descent rather than attempt to compress the experiences of all non-White groups into a singular category of "other" without recognizing the particularity of African American experiences and culture (Ladson-Billings, 2000). Widening this perspective offers an insight into "within-group" processes or "outside" factors with respect to interaction with technology (Orellana & Bowman, 2003).

One factor is that learners of African descent do not always begin at the same place as middle-class White students. Additionally, what may be valued in African American culture may differ from what is valued in schools; using the same approach to educate the majority may actually increase the educational disparities in students of the minority (Ladson-Billings, 2000). Even further, as suggested by Chang (2002), attitudinal factors contribute to the discrepancy, and thus, "African American, Native American, and Latinos possess strong cultural values of group and community membership that may be at odds with the perceived levels of individualism and competition associated with the sciences."

Methodology

Using a convenience non-probability sampling approach, this study was conducted to assess the views of students of African descent in STEM disciplines.

For the purpose of this study, the term e-Learning was used as an umbrella term for online learning, distance learning, web-based training, computer based-learning, etc., in which learning and training are facilitated through both computer and communication technology.

Subjects

The results of this research can be used to further the dialogue related to undergraduate and graduate collegiate students of African descent located throughout the United States majoring in one of the STEM disciplines. The sampling frame was derived from the National Society of Black Engineers (NSBE) collegiate membership. This study was done in cooperation with NSBE. NSBE was founded in 1975 to aid with the recruitment and retention of black engineers. NSBE's mission is "to increase the number of culturally responsible black engineers that excel academically, succeed professionally and positively impact the community." NSBE is a student-run organization with members branching across various STEM majors across the country. The sample population will encompass collegiate students, both men and women, over the age of 18, at the undergraduate and graduate levels, and of African decent who are members of NSBE.

Instruments

The survey instrument was designed to measure several possible contributing factors to the success of African Americans in STEM disciplines and the role e-Learning resources have played in their success.[1] The survey instrument was divided into seven sections: demographics, educational background, e-learning, identity, parental influences, technical fluency, and barriers to e-learning.

The demographics section of the instrument was designed to correlate the data-collecting techniques of the U.S. Census Bureau and the Department of Labor, giving a consistent means of measurement. The U.S. Census Bureau demographic categories serve as a model for this study. Questions regarding educational background, parental influences, and technical fluency were taken from the Stanford Survey on Access, Interest and Experience with Information Technology and Greene's (2005) "A Study of Personality and Digital Fluency." These questions were posed to gain a better understanding of the subjects' educational foundation as it pertained to their current field of study and the impact of the subjects' environments on their academics and decisions.

Barriers to e-Learning reflect a subset of questions from the Survey of Student Barriers to e-Learning by Berge and Mulienburg (2005). These questions are designed to determine the underlying constructs that compromise barriers to distance education, online learning, and e-Learning overall (Mulienburg & Berge, 2005). Barriers to e-Learning are partitioned into six factors: (1) technical expertise, (2) infrastructure/support services, (3) social interaction and quality, (4) prerequisite skills, (5) motivation, and (6) time/interruptions (Mulienburg & Berge, 2005). For the purpose of the study, infrastructure/support services, social interaction, motivation and time/interruptions are the only elements that will be analyzed.

Data Collection

Survey instruments were made available one week before the National Society of Black

1 The survey instrument was designed in part with educational psychologist Deborah Kim Emery from the Center for Learning Technologies at SRI International and Stanford University School of Education Professor Brigid Barron.

Engineers Annual conference through e-mail to potential subjects who were currently members of the organization and on its listserve. Subjects were provided an e-mail link that connected them directly to the first page of the survey. Subjects were given two weeks to submit a completed survey instrument for assessment. The survey took approximately 20 minutes to complete. Upon receipt, the data was collected and analyzed.

Analysis

A statistical analysis was performed to assess the results of the completed instruments. Descriptive statistics were collected using statistical software to provide a thorough analysis of the data. All the data received from the case study was then compared and analyzed for any noticeable trends or phenomena originally not accounted for throughout the study and the literature.

Results

Demographics

Approximately 500 of the organization's 15,000 members responded, and 183 fully completed the survey. Of the 183 survey respondents, 9.2% were 17–19 years of age, 37.3% were 20–24, 37.9% were 25–34, 9.8% 35–44, 4.6% 45–54, and 1.3% were 54 or above. Men constituted 53.3%, and 46.6% were women. The citizenship breakdowns of the respondents were 69.9% US citizens and 30.1% non-US citizens. The ethnicity of respondents included 0.5% White or Caucasian, 89.6% Black or African American, 1.1% Asian/Pacific Islanders, 1.1% Hispanics, and 7.7% "other."

Parental Information

Respondents were asked to report demographics information in relation to their parents. On average, 64.1% of respondents' mothers were US citizens, 86.7% Black or African American, and 41.6% ranging in age from 45–54 years of age. The highest level of education completed by mothers was 4.5% elementary school, 7.1% junior high, 31. 6% high school, 9% associate's degree, 23.2% college degree, 14.8% master's degree, and 4.5% Ph.D. or professional degree (i.e., M.D., J.D.); 5.2% didn't know. Also, 18.2% of the mothers had a degree in a STEM field and 4.3% were currently employed in a STEM related field.

On average, 66.7% of respondents' fathers were US citizens, 86.8% Black or African American, and 32% ranging in age from 45–54 years of age. The highest level of education completed by fathers was 4% elementary school, 4% junior high, 28% high school, 12.7% associate's degree, 22% college degree, 9.3% master's degree, and 8.7% Ph.D. or professional degree; 11.3% didn't know. Fathers with degrees in STEM fields constituted 31.3%, and 15.5% were currently employed in a STEM related field.

Educational Background

The majority of all respondents had been exposed to STEM related courses only in school or in the classroom. Sixty-nine-point-five percent of respondents graduated high school with honors in math or science, and 52.4% participated in math or science activities during the summer while in high school. When participants were asked to report their reasons for entering engineering, 41% of the respondents reported they wanted the intellectual challenge, the chance to be innovative and creative, and the satisfaction of solving problems. Thirteen percent reported entering engineering because they were good at math. Twenty percent of respondents' reasons for entering engineering were its impact on their future and its usefulness in the world. Eleven percent reported their selection of engineering being salary related, 8% reported choosing engineering because of parental influence, and 7% of respondents reported other events and reasons for entering engineering.

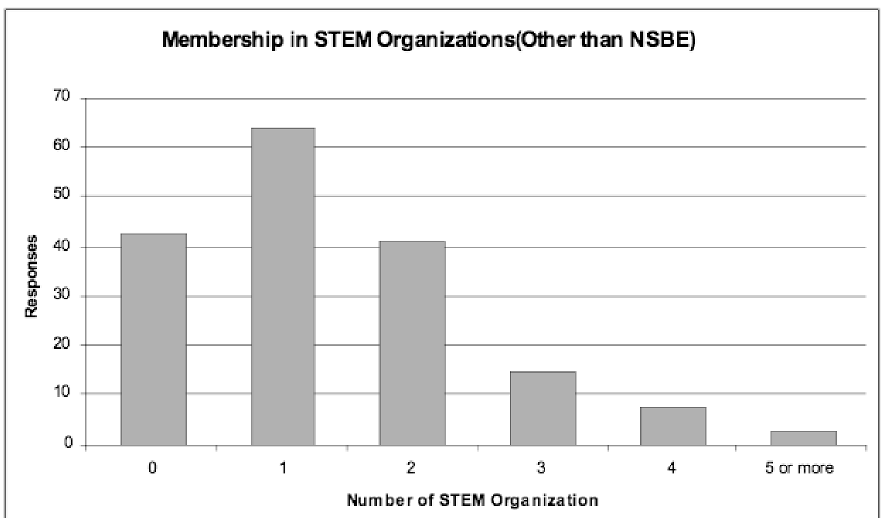

Figure 1: Membership in STEM organization other than NSBE

Social Circle

Respondents were asked to depict their membership in STEM related organizations. Thirty-six-point-six percent of respondents reported being part of at least one other STEM related organization besides NSBE (see Figure 1).

Thirty-five point three percent of respondents reported that only a few of the people within their social circle were in STEM fields (see Figure 2), and 50.6% reported only a few of them were NSBE members.

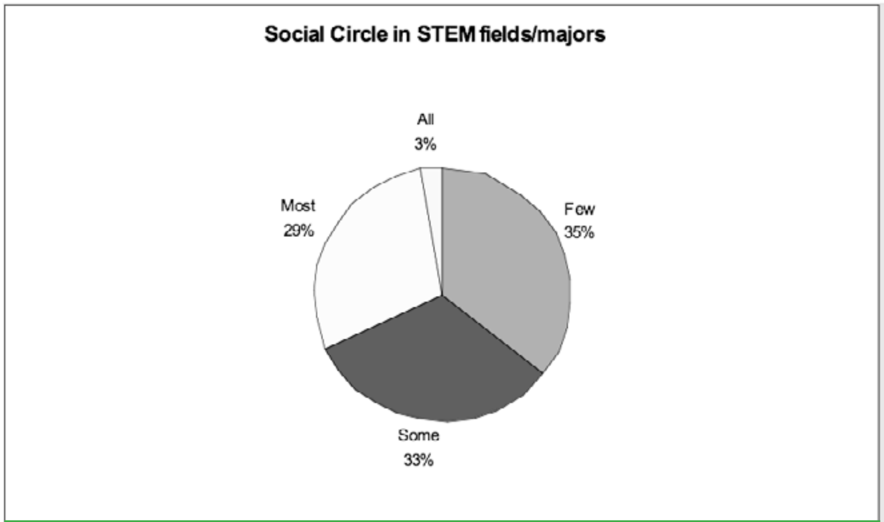

Figure 2: People in Social Circle within STEM fields

e-Learning

Respondents were asked to report how effective the listed e-Learning resources had been in contributing to their knowledge and what kind of content they wanted to see more of in e-Learning resources. Figures 3 and 4 show the results of the responses. In Figure 3, informal learning such as "general web surfing" was rated by the respondents as one of the most effective e-Learning resources that contributed to their knowledge, followed by tutorials, online reading, and books. Figure 4 shows that respondents were primarily interested in e-Learning as it pertained to preparation for and seeking jobs and internships.

Of the respondents, 39.6% had never completed an online education course, 30.8% had completed one, 10.7% had completed two, 6% had completed three, 8.1% had completed four, 6.7% had completed five to seven, 2.7% had completed 8 to 10, 0.7% had completed 11–13, and 4.7% had completed 14 or more. We have

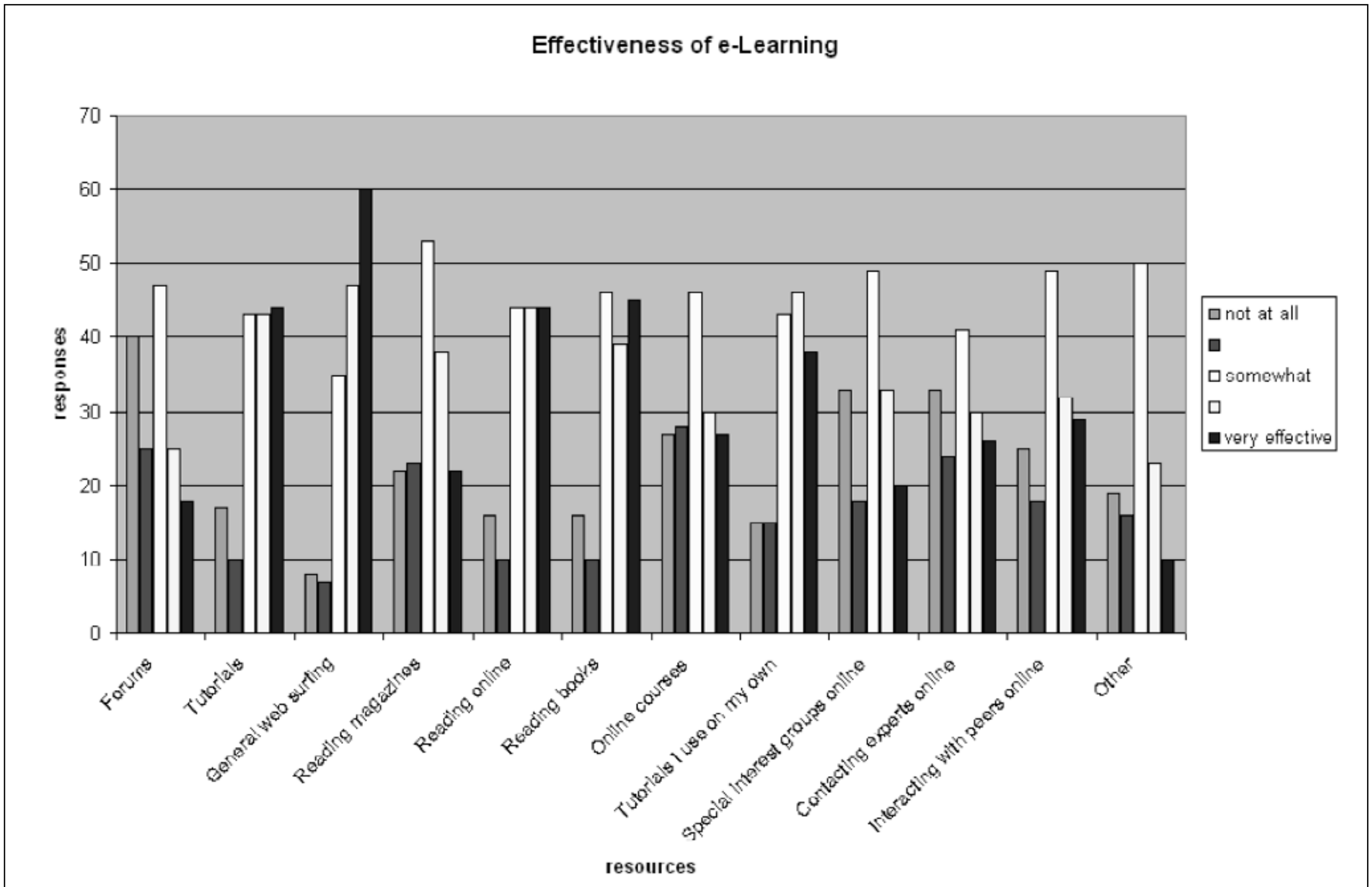

Figure 3: Effectiveness of e-Learning

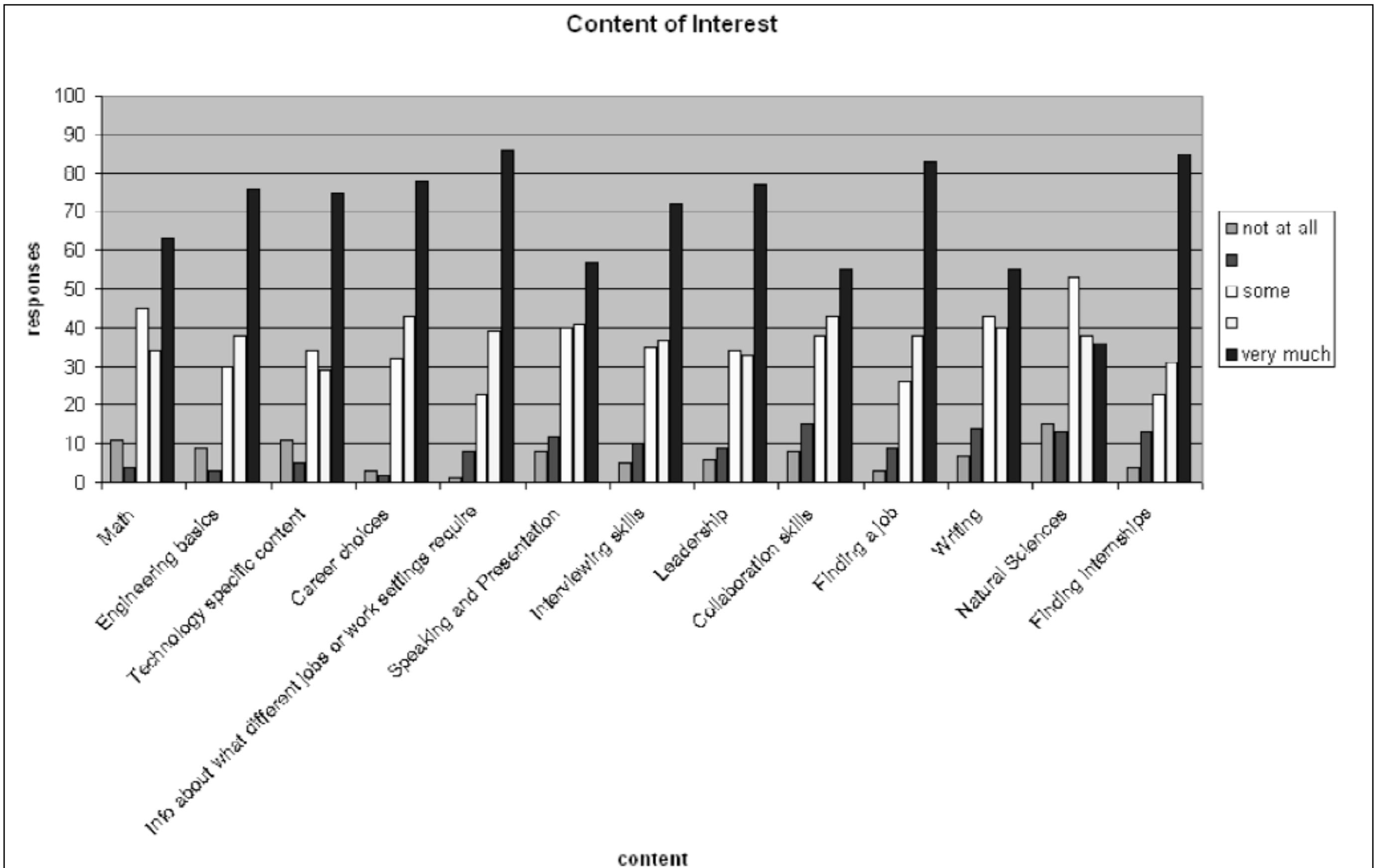

Figure 4: Content of interest in online learning

classified a course as any training or education that the respondent obtains from his or her academic institution or organization via tutorials or web surfing. Respondents were asked not to include courses they have yet to complete.

In their depictions of their participation in online learning, 46% of the respondents agreed with the statement, “I have learned or I am learning online and feel comfortable and confident when I do so.” 37% agreed with the statement, “I use online technologies such as e-mail and the internet for my own personal productivity but not so much for education or training purposes.” Thirteen percent agreed with the statement, “I am learning online but I am unsure of my skills when doing so.” 4% agreed with the statement, “I do not use online learning technology such as e-mail and the internet very much.”

Though 46% of the respondents said they felt comfortable and confident when learning online, 36.3% said they felt that they cannot learn as well online as in the classroom with other learners and the instructor. When respondents were asked to depict the effectiveness of their online learning experience, 24% said they really didn’t see much difference in their learning in an online learning environment compared to being in the classroom. 18% said that, though they had never completed an online class, they predicted they would not learn as well online as they would in the classroom with other learners and the instructor. 12% said that, while they had never completed an online class, they predicted they would not see much difference in their learning in an online environment compared to being in the classroom with other learners and the instructor. 6% said they learn better through online learning compared to learning in the same room as other learners and the instructor.

These results paint a very interesting picture. Respondents showed overwhelming comfort and confidence in their ability to learn using online resources, yet more than half had had little to no participation in formal online learning. Thus, based on the data provided in Figure 3, it can be assumed that respondents’ comfort and confidence in e-Learning is derived from general web surfing. It appears, therefore, that the common perception among respondents is that they were not confident that formal online learning added much value to their learning experience. The question now is, can this be attributed to e-Learning barriers?

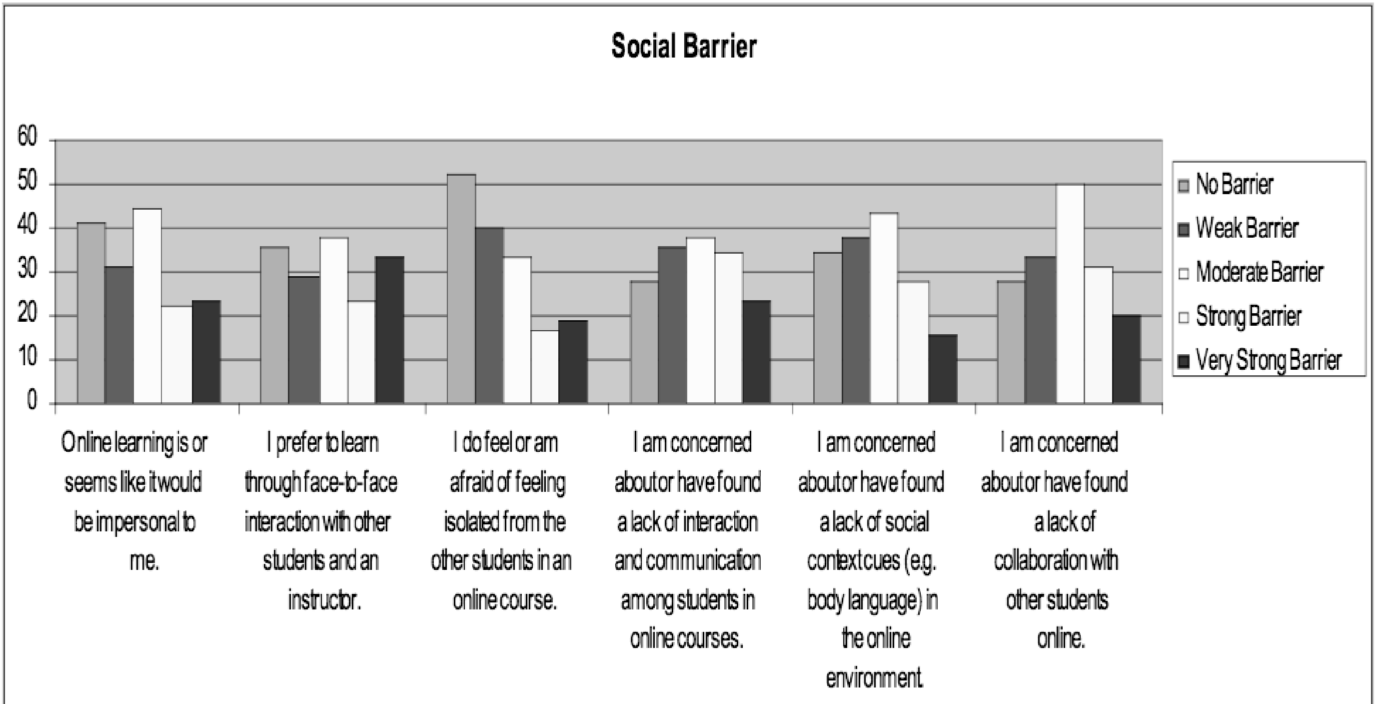

Figure 5: Social barriers

e-Learning Barriers

Respondents were asked to rank the e-Learning barriers that may exist or that they are concerned about. Figures 5 through 8 display the responses for barriers to e-Learning as discussed previously, categorized by Dr. Zane Berge and Lin Mulienburg (2001) as social barriers, infrastructure/support barriers, motivational barriers, and time/interruption barriers.

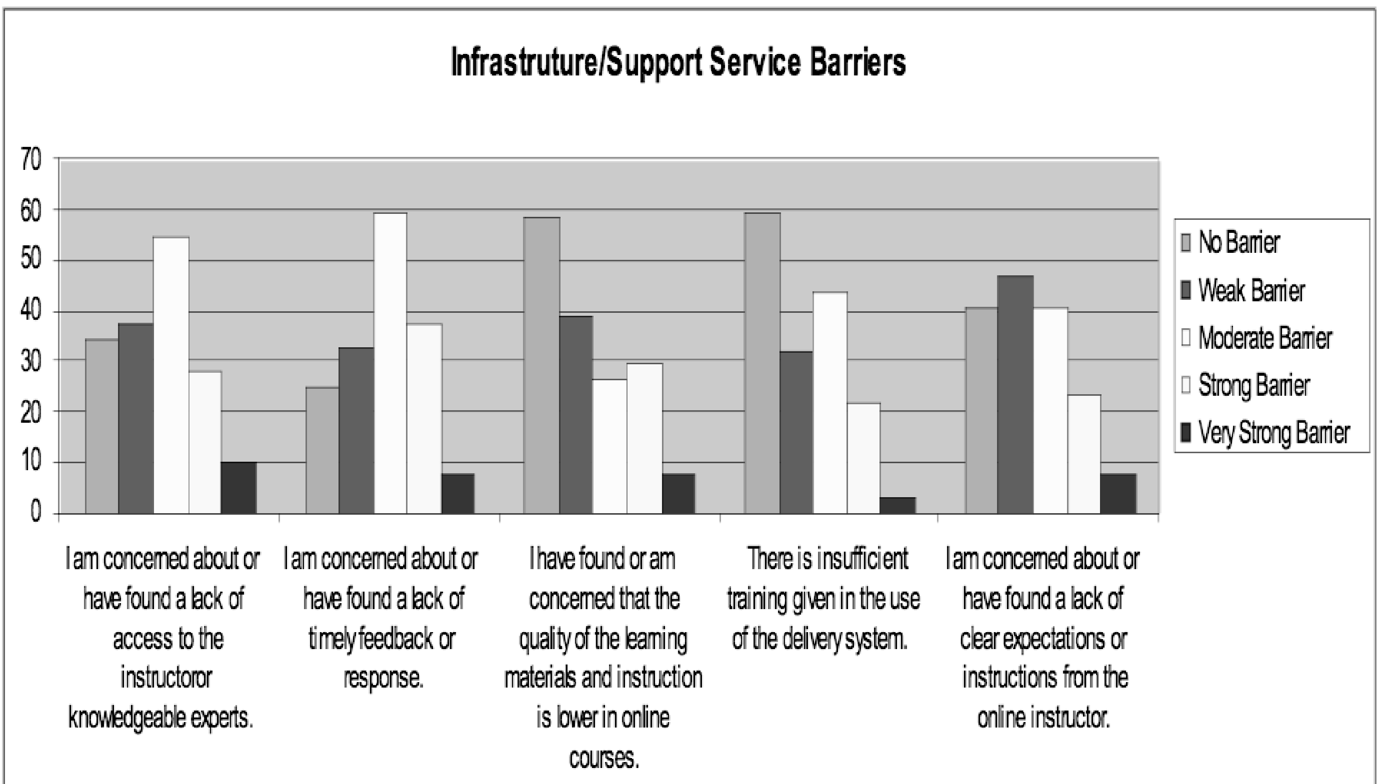

Figure 6: Infrastructure barriers

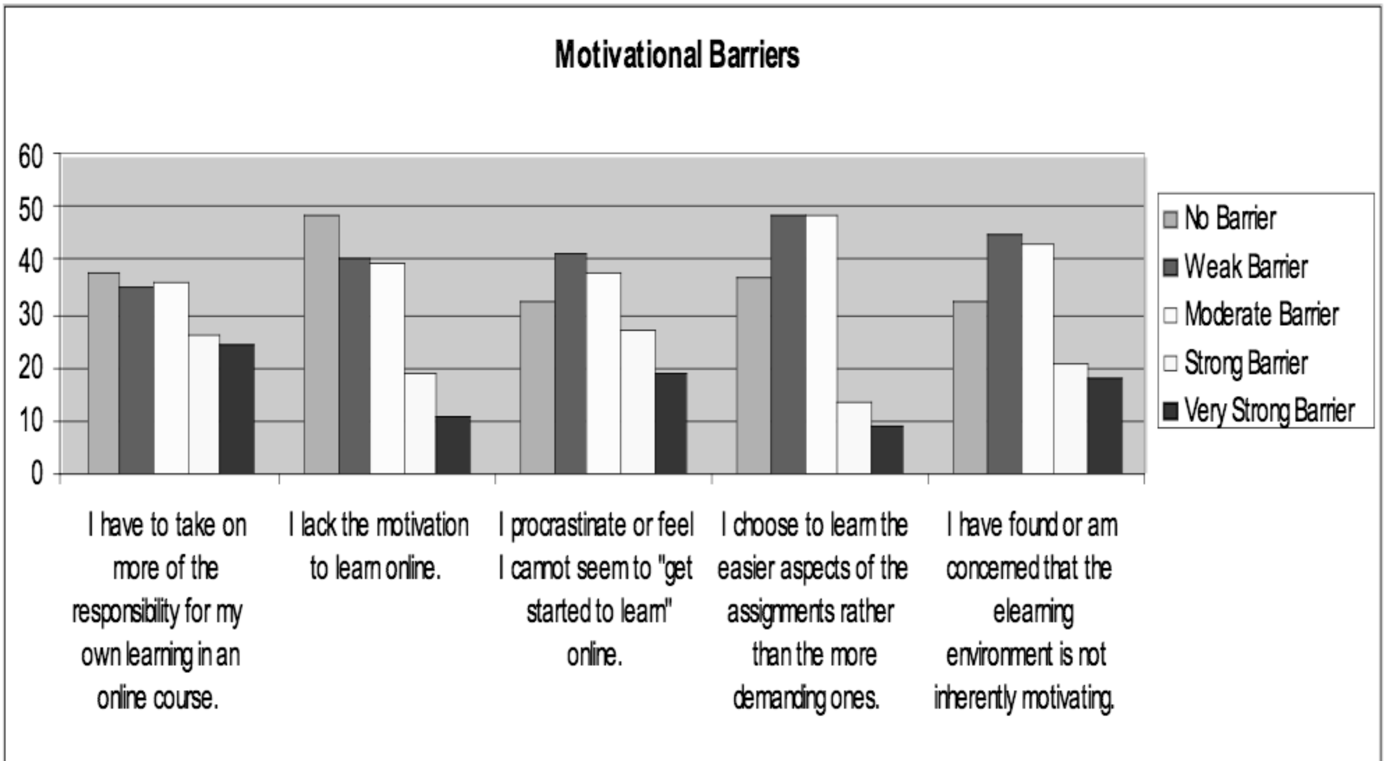

Figure 7: Motivational barriers

Discussion

The demographic, parental, and educational background sections were presented as a means of exploring contributing factors to determine the potential needs of the learner as discussed in the literature.

Aspiring engineers often have had some

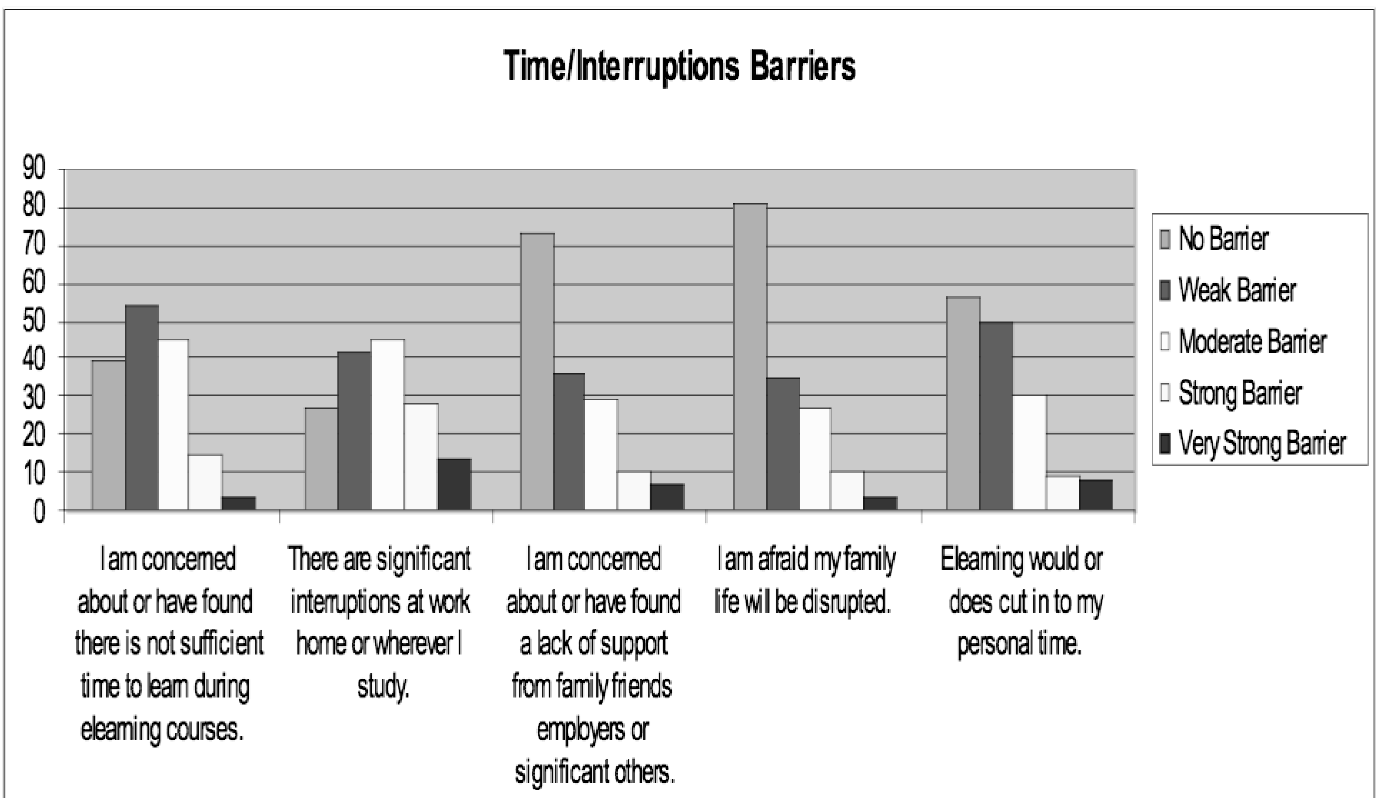

Figure 8: Time/Interruption Barriers

exposure to engineering prior to their pursuit (Foskett & Hemsley-Brown, 2001), and those whose parents are within the STEM disciplines often benefit, as discussed in the literature. For example, exposure provides a means of establishing a mental model for the learner. For a majority of the respondents, neither the mother nor the father held a degrees or occupation in a STEM field. In building competency in preparation for a career in a STEM discipline, the learner profits from formal and informal learning experiences. A mass majority of respondents had received their exposure to the STEM fundamental courses during their high school years in the classroom, rather than through out-of-school learning programs, such as after-school, summer school, or other learning avenues. However, 52% of respondents said they participated in STEM summer programs. 69.5% of the respondents reported graduating high school with honors in math and science, which would have served as a preparation for their studies in a STEM field.

Minority students are often steered into majors with improper guidance (Krist, 1993; Lewis & Collins, 2001), thus leading them to struggle through their studies. In this case, learning aids would not be the answer, but an evaluation of interests, goals, and majors. Respondents reported three major reasons for choosing engineering as their major: 1) the intellectual challenge, 2) the chance to innovate/ be creative, and 3) the satisfaction of solving problems. A large number of respondents additionally suggested they entered into their disciplines because they believed or were told that they were good at mathematics. Though learners' comprehension of math is a necessity to succeeding in the STEM fields, resting on that alone can result in learners who are unmotivated and ill-prepared for what is required to be successful in the STEM disciplines (Anderson-Rowland, 1997). The literature discusses at length informal learning and the learning that occurs within the learner's environment. Family and peer-based playing games were significant pathways for a sense of competency (Barron, 2004). Thus the respondents were tasked with describing their social network.

Figure 2 displays respondents' averages of the number of people within their social circle that are within STEM fields/majors. Students possessing a higher level of social capital have a higher chance of success in engineering education (Brown, Flick, & Williamson, 2005; Galloway, 2008). Eighty-six point three percent of respondents indicated that they had plans for postgraduate study.

Table 1 below depicts the highest barrier averaged among the e-Learning barriers by the respondents. Moderate barriers were found among the infrastructural /support and social barriers. Infrastructural/support barriers found in this study reinforce literature findings regarding the fact that learners of African descent do not always begin at the same place as middle-class White students economically or socially thus additional support is valued. When one considers points made in literature on the ways technology is used by different demographic groups and the social implications associated with the perceived levels of individualism in the STEM disciplines, and when one pairs this phenomena with e-Learning, it becomes clear how e-Learning may not be well received among this community of learners. These findings in reference to support and social barriers, though moderate, parallel with the literature and the hypotheses as to why e-Learning resources have been ineffective in the past.

Respondents indicated tutorials, reading online such as online books, and (most significantly) general web surfing as being the most effective e-Learning resources. When given the chance to compare online learning to traditional learning trajectory, the learners, overall, felt that

Barriers	Average
Infrastructural/Support	Moderate Barrier
Social	Moderate Barrier
Motivation	Weak/Moderate Barrier
Time/Interruptions	No Barrier

Table 1: Highest e-Learning Barriers

they could not learn as well in an online learning environment as they could in a classroom with instructors and other students. Figure 4 displays the type of content that respondents are interested in seeing more of, which ranked high in employment related areas and engineering fundamentals. When analyzed alongside the literature, it can be concluded that designing tools that are culturally appropriate will provide a successful medium for learners of African descent to supplement their learning experience as engineering students, where traditional methods have fallen short.

Conclusion

One of the areas of improvement for e-Learning resources is the notion of culture. The data collected presents a case for the continued exploration of culture, as well as for finding ways to eliminate e-Learning barriers. Respondents identified barriers in social support. Thus, Chang's (2002) assertion of the strong cultural values of group learners of African descent and community membership is not addressed in the current e-Learning resources, and may lead to greater disparities.

This study has explored the connection between cultural identity, learning styles, retention of engineering students, and e-Learning as a method of understanding what features can be utilized in an e-Learning environment to make it more appropriate for students of African descent. A good start would be incorporating features that, according to Barron (2004), place the learner as the organizing central node in the system. Such features involve activity, concept, and culture so that in the social context of an environment, learning can be manifested through basic interaction with others, through shared information, or even through abstractions from acuity.

From here we can affirm that designing tools that are culturally appropriate may provide a successful medium for learners of African descent to supplement their learning experience as engineering students where traditional methods have fallen short. An example of pulling together such features can be seen in Mayer (1981) and Eglash (1999). Eglash (1999) has designed culturally situated design tools which teach various mathematical concepts that investigate fractals in African architecture, traditional hairstyling, textiles, sculpture, painting, carving, metalwork, religion, games, quantitative techniques, and symbolic systems. Such a method not only situates the learning but also debunks the negative theories depicting the inferiority of people of African descent, thereby elevating the learner by explaining science, technology, engineering and mathematics that are already part of their identity.

Learning, in part, can be viewed as acquiring tools that are used actively and are to be understood within one's given culture. In an effort to meet the needs of learners of African descent, often the first inclination is to turn to images and beliefs of acceptable mediums perpetuated by pop culture to convey information and knowledge to this particular demographic group. This research proposes using African ethos as presented by Boykin (1986) as a means of establishing a foundation of Black identity descriptors for building e-Learning resources, rather than using racial stereotypes that have been repetitively misconstrued as Black identity signals.

Instructional strategies emphasize a need to teach in the context of the to-be-learned culture to produce useful knowledge. Perhaps, if these instructional strategies are employed, the learner will gain a personalized sense of situation that guides her determination, allowing her to integrate and synthesize actively across disciplines (McLellan, 1996). These strategies must first hone in on realistic complex scenarios in which the learner is challenged to discover, as opposed to the cookie-cutter problems of no real-world relevance presented within schooling. Thus the learner is placed in a pragmatic simulation, having the chance to think and operate as an expert in her given situation. It is recognized that experts do not operate on an island; in the same fashion, these instructional strategies must be equipped with content and methodologies that foster cooperative activity, exploring the learner's zone of proximal development (McLellan, 1996).

This study was designed to explore how e-Learning resources can be used to aid in the retention of students of African descent in STEM disciplines. They are in need of a foundation that is based on an assessment of the elements of culture and identity and that uses those elements in incorporating learning psychology and ecologies to build strong instructional strategies.

References

Anderson-Rowland, M. (1997). Retention: Are students good predictors? Paper presented at the 1997 ASEE/IEEE Frontiers in Education Conference, Pittsburgh, PA. Retrieved April 1, 2006, from Frontiers in Engineering Conference http://fie.engrng.pitt.edu/fie97/papers/1182.pdf

Ausubel, D. (1963). The psychology of meaningful verbal learning. New York: Grune & Stratton.

Bannan-Ritland, B., Bragg III, W., & Collins, M. (n.d.). Web conferencing: Linking theory, educational constructs, and instructional strategies. Project Science Space, George Mason University. Retrieved March 18, 2003 from the World Wide Web: http://www.virtual.gmu.edu/EDIT611/BannanWBC.pdf

Barron, B. (2004). Learning ecologies for technological fluency: Gender and experience differences. *Journal of Educational Computing Research, 31*(1), 1–36.

Berge, Z. L. (2002). Active, interactive, and reflective Elearning. *The Quarterly Review of Distance Education, 3*(2), 181–190.

Brown, S., Flick, L., & Williamson, K. (2005). Social capital in engineering education. *Proceedings of 35th ASEE/IEEE Frontiers in Education Conference*, October 19–22, S3D-10–S3D-16.

Brown, R. A., Morning, C. & Watkins, C. (2004). Implications of African American engineering student perceptions of campus climate factors. *Proceedings of 34th ASEE/IEEE Frontiers in Education Conference*, October 20–23, S1G-20–S1G-28.

Boykin, A.W. (1986). The triple quandary and the schooling of African American children. In Neisser, U. (Eds), *The School Achievement of Minority Children*, 57–92. Hillsdale, NJ: Psychology Press.

Byars-Winston, A., Estrada, Y., & Howard, C. (2008). Increasing STEM retention for underrepresented students: Factors that matter. The Center on Education and Work. Sloan Project for Diversity in STEM Retention: Research Brief. Retrieved from http://www.cew.wisc.edu/docs/news/Research%20Brief%20%20Feb%20 2008.pdf

Byrd, L. M. & Eales, R. T. J. (1997). *Virtually deschooling society: Authentic collaborative learning via the Internet* (REC 9554206). Arlington, VA: National Science Foundation. (ERIC Document Reproduction Service No. ED 429 532)

Cassell, G. & Slaughter, B. J. (2006). The challenge of the new demographics of higher education: Increasing women and minority participation in the STEM disciplines. BHEF 2006 Issue Brief. Winter 2006. Retrieved April 1, 2006 from: http://www.bhef.com/publications/documents/brief2_w06.pdf

Chang, J.C. (2002). Women and minorities in the Science, Mathematics and Engineering pipeline. ERIC digest: ERIC Clearinghouse for Community Colleges, Los Angeles, CA. http://purl.access.gpo.gov/GPO/LPS43175

Driscoll, M. P. (2000). *Psychology of learning for instruction*. Needham Heights, MA: Allyn & Bacon. (Original work published 1994)

Eglash, R. (1999). *African fractals: Modern computing and indigenous design*. New Brunswick, NJ: Rutgers University Press.

Foskett, N. & Hemsley-Brown, J. (2001). *Choosing futures: Young people's decision-making in education, training, and careers markets*. London: Routledge/Falmer.

Galloway, R. (2008). Support resources utilized by minority students majoring in science, technology, engineering, and mathematics disciplines. Dissertation Abstracts International, DAI-A 69/07, Jan 2009, 139 (UMI No.3322301) (URN etd-04072008-093433).

Green, R. M. (2005). Predictors of digital fluency. Dissertation Abstracts International Section A: Humanities and Social Sciences.

Higher Education Research Institute. (2010). Degrees of success: Bachelor's degree completion rates among initial STEM majors. HERI/CIRP Research Brief, January.

Krist, P. S. (1993). Educational and career choices in math and science for high ability African American women. Unpublished doctoral dissertation, University of North Carolina, Chapel Hill.

Ladson-Billings, G. (2000). Fighting for our lives: Preparing to tech African American students. *Journal of Teacher Education, (51)*3, 206–214.

Lave, J., & Wenger, E. (1990). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Lewis, B. F. & Collins, A. (2001). Interpretive investigation of the science-related career decisions of three African-American college students. *Journal of Research in Science Teaching, 38*: 599–621. doi: 10.1002/tea.1020

Marcus, A. & Gould, W.E. (2000). Crosscurrents: Cultural dimensions and global Web user-interface design. *Interactions (7)*4: 32–46.

Mayer, R. (1981). The psychology of how novices learn computer programming. *Computing Surveys (13)*1: 121–141.

McLellan, H. (1996). *Situated learning perspectives*. Englewood Cliffs, NJ: Educational Technology Publications.

Muilenburg, L.Y. & Berge, Z.L. (2005). Student barriers to online learning: A factor analytic study. *The American Journal of Distance Education. 26*(1): 29–48.

Nelson, W. A. & Orey, M. A. (1994). *Situated learning and the limits of applying the results of these data to the theories of cognitive apprenticeships* (Report No. 016 756). Nashville, TN: National Convention of the Association for Educational Communication and Technology. (ERIC Document Reproduction Service No. ED 373 746)

Nichols, M. (2003). A theory for eLearning. *Educational Technology & Society 6*(2): 1–10, Available at http://ifets.ieee.org/periodical/6-2/1.html

Orellana, F. M. & Bowman, P. (2003). Cultural diversity research on learning and development: conceptual, methodological and strategic considerations. *Educational Researcher (32)* 5: 26–32.

Smith, M. K. (2003). Communities of practice. *The encyclopedia of informal education,* www.infed.org/biblio/communities_of_pratice.htm. Last updated: 14 February 2004

Snead-McDaniel, K. (2010) Exploration of the lived experience of undergraduate science, technology, engineering and mathematics minority students. Dissertation Abstracts International, DAI-A 72/01, Jul 2011, 139 AAT. (UMI No.3436670)

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