Culture Based Computing For Adult Learners (C-CAL)

by

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Abstract

This dissertation presents the design, implementation, and evaluation of the novel Cultural based Computing for Adult Learners (C-CAL) system, a self-directed online learning application utilizing culture to support adult learners in grasping computing concepts. C-CAL contains four major components – Culture Inquiry Form, Cultural Data Mining, Links for Learning, and Learning Modules – seeking to enhance the learning experience of non-traditional adult learners.

Through a series of experiments, the C-CAL system has been found to be a viable alternative to introducing computing concepts to adult learners. As a result, using the general technology acceptance model (TAM), there was no statistical difference between the C-CAL system and traditional, non-culturally engaging methods currently used in regards to perceived ease of use and perceived usefulness. Thus indicating the C-CAL system performed just as well as traditional methods. However, C-CAL was consistently rated higher than the control on along all measures. Thus indicating the C-CAL system is a feasible system to utilize, whose benefits can manifest itself in the array of adult learners returning to education. This dissertation work demonstrates a deepening effort in applying culture norms and understanding to the design of computing technology, which will allow for more empowered uses of technology for learning and innovations among adult learners.

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Chapter 1

Introduction

"The engine of our national economy, upon which our safety and security, our wellbeing, our quality of life, and our global competitiveness, indeed, our national preeminence depends, is powered by the technological and scientific discoveries and innovations" (Jackson, 2004).

1.1 Motivation

There is a rapid societal shift from a need for laborers to one for knowledge workers and a wide-ranging effort to strengthen scientific competitiveness (Gilbert & Eugene, 2007). There is now a need for digital fluency among those who were once common laborers. Digital fluency, as defined by the National Research Council, is the ability to reformulate knowledge, to express oneself creatively; and appropriately, to synthesize new knowledge, and to produce and generate information rather than just comprehend it (NRC, 1999).

Without supporting common laborers, ages 18-50, who are not usually targeted for computational learning resources outside of academic or job space, in developing digital fluency, the competitive edge will be lost and a rather large segment of our population will continue to be marginalized. The question becomes, "How can our society be supported in gaining digital fluency?" A first step towards answering this question came after the term "digital divide," was coined during the mid 1990s. During this time, access to computational resources was thought to be the solution. There was little success, however, in integrating technology into the lives of learners (Wolverton, 2010). Since then, education, rather than access alone, has become the push for supporting participation in the information society.

As with all other educational concepts, there are numerous challenges that can hinder efforts to educate adult learners about computing. The obstacle most relevant to the current body of work is that of culture. Hughes postulated that all inventions are fashioned by individuals with a very specific educational and cultural background such that each part of an invention's complex story involves processes that are highly contingent and highly intertwined with social, economic, and political relationships (Hughes, 1993). In other words, technology systems are imbued with the culture of the inventors. This idea can be extended to computing education. Computing education is socially produced, and social production is culturally informed. Thus, the culture of the producers of these educational practices shapes the ways in which they are realized (Castells, 2001). As a result, efforts towards computing education can be hindered for learners with limited or no participation in the producers' culture that is inherently built upon in the computing education practices.

Conceptual understanding of computing differs between cultural groups with respect to logic, perceptions of time and space, society, values, problem-solving methods, or even determining which problems are considered legitimate (Tedre et al., 2003). Therefore, some learners must first come to understand this new culture prior to engaging in the learning experience, some will adapt regardless of the situation, some learners will adapt with difficulty, and some learners will not adapt at all. It is imperative that the cultural barriers to learning are addressed in order to support the development of digital fluency in adult learners.

1.2 Development of the Culture Construction

Culture has been presented as both a challenge to learning, and although culture has made its way to the forefront of conversation, constantly being acknowledged as important, it still manages to elude specificity. In every context of its use, culture takes on a different meaning or representation, fulfilling a different purpose or function. As culture influences action by shaping a repertoire or "toolkit" of habits, skills, and styles from which people construct "strategies of action" (Swidler, 1986), it creates culture identities, which are understood within and between the culture participants. These toolkits depict the wealth of knowledge shared and understood within the culture. They also provide an alternative lens of understanding and interpreting data not already associated with one's mental schema.

Unfortunately, current methods of culture identification are limited and do not encompass this kind of multifaceted view of the learner. In previous research (Jensen, 1969; Betancourt & Lopez, 1993; Nasir & Hand, 2006), a participant's culture was often defined by his gender and/or ethnic culture of participation, or the practices he partakes, in hopes that one would characterize the other. For example, an African American male that participates in the music culture of hip-hop, would then be identified by one of the above cultures (being African American or hip-hop) regardless of his depth of participation or identification with those cultures.

Though often used interchangeably, despite their vast differences, culture is not race but is informed by racial and ethnic categories (Nasir and Hand, 2006). Race is pervasive and unchangeable yet culture is produced in cultural settings between people created in moments of culture activity in the context of institutions. The merging of the two constructs, the perspective of race as culture, which asserts that the characteristics and adaption of all people from a racial group are viewed as being homogenous (Nasir and Hand, 2006) is therefore unfounded.

The term culture will be used as one of the fundamental underpinnings of this body of work, and the foundation for the system design efforts. The use of culture throughout this research is theoretically based in sociocultural theory. As described by Nasir & Hand (2006), sociocultural perspective on culture as produced and reproduced in moments as people do in life, examine the roles of social and cultural processes as mediators of human activity and thought. The authors also present the four core aspects of sociocultural theory that form the foundation of the definition of and use of culture:

1. Development at multiple levels of analysis
2. Cultural practices as a unit of analysis
3. Learning as a shift in social relations
4. The meditation of artifacts and tools

In understanding this perspective of sociocultural theory, culture is grounded as being a system of meaning carried across generations, and constantly recreated in local context as one participates and reconstructs cultural practices. This perspective of the culture construct encompasses a dynamic view of culture as a holistic body that is constantly changing and one within which its participants interact. Building upon this dynamic characterization of culture, in this research *culture is defined as "who you are" and "what you do."* Who you are" are things about about a person that are not easily changed, i.e. gender, ethnicity, age, height, weight, etc."What you do" are things a person regularly practice and/or have meaning in their life, i.e. religion, political affiliation, music, sports, hobbies, etc.

1.3 Research Challenges

Adult learners have been chosen since audiences aged 18-50 are normally not targeted for computational learning resources unless they have received higher education or some other job training (Seals et al., 2008). Adults in this age group that are not privy to higher education, or employment where such training is available can quickly become disenfranchised since they lack the computing knowledge that drives our society. There are certain challenges, however, to the development of a system to support these adults in understanding computing concepts such as barriers to learning with computational artifacts.

Because computational artifacts are culturally mediated, they are inherently designed with the cultural prospective and understanding of their designers and builders (Eugene & Gilbert, 2008). This can prove problematic if the learner is not a participant in the designer's culture. Before the learner can engage in learning, s/he must first come to understand the culture that the artifact is situated in, and then begin the learning process. All learners participate in a range of cultures and culture practices, derived from their life experiences in communities, industries, hobbies etc. Every artifact or practice that draws from a culture has rules of engagement. Delpit (2005) explains, that learner decides when and how to draw from their knowledge and experiences from within these various cultures but are lost without that choice. This creates an unnecessary barrier, making it difficult for new learners to engage. A learner's inability to connect to the culture that the artifact is situated in can create disjoint learning, making it difficult for a learner to connect this learning experience to their current mental model. This in turn produces a rote learner or a learner that learns without understanding of the reasoning or the relationships involved (Mayer, 1995), versus an adaptive learner or a learner with flexible knowledge that allows them to invent ways to solve familiar problems and innovative skills to identify new problems (Brophy et al., 2004), because the learner does not embody a full understanding of the learned material. Though problematic with all learners, this can be detrimental to adult learners that often affiliate new learning as a challenge for the young to engage in, thus are apprehensive. Concern for the challenge that awaits, matched with barriers of learning computational artifacts that stems from an unfamiliar culture background these learners can find themselves at a disadvantage from the very beginning.

1.4 Research Question

In order to understand how culture participation can be captured, collected, and used to generate instruction through a computer-based system, the following research question will guide this research:

Is culture based learning a feasible option to introduce adults to computing and does culture based learning enhance the learning experience for adult learners when being introduced to computing concepts?

The exploration of this question gives rise to two sub-questions:

1. Can culture of participation be identified and captured?
2. Can culture data mining be used to create culture based learning modules?

1.5 Contributions of the Dissertation

The Cultural based Computing for Adult Learners (C-CAL) system in all its components fills a void in making the following contributions to the field of Human Centered Computing and Computer Science Education: a practical tool for identifying culture of participation for a group, modeling a process for the use of culture as a design construct and introduces a new system for increasing digital fluency for among Adult learners.

1.6 Organization of Dissertation

Chapter 2 gives an overview of the areas of research that pertain to the development of C-CAL. The research presented here is addressed in three parts: Learning Consideration, Scaffolding Learning and Technology Design Considerations. In learning consideration, a brief history of the plight of adult learners is discussed followed by a snapshot of the current issues with adult learners and computing. Next, the theoretical basis established that supports culture and learning in Scaffolding Learning. Finally, chapter 2 presents Technology Design considerations such as culturally relevant design, e-Learning cultural data mining and user interface design.

Chapter 3 will discuss the system design in terms of system architecture. Here a thorough picture of the steps taken to design the C-CAL system. C-CAL is composed of four components all of which were designed and developed for this system. The first component is the Culture Inquiry Form, followed by the Culture Data Mining and then the Culture Dyads and finally the Learning Modules. The detailed design of the first three of the components will be discussed in chapter 3, including the design decisions made, the various factors used to influence those decisions, and final design that resulted.

Chapter 4 will continue from chapter 3 with the implementation of the design strategies of chapter 3. The implementation of the C-CAL system is the materialization of the fourth and final component, the Learning Modules. Chapter 4 will demonstrate the transition of moving from the design realm to creating a user-friendly learning application.

Chapter 5 presents the experiments, results, and analysis conducted on the C-CAL system in part and as a whole. Throughout the design and development of the C-CAL system the components were vigorously analyzed and or tested. At the end, an experiment was conducted on the C-CAL system in its entirety. Finally, Chapter 6 discusses the conclusions of the study, including limitations; summarizes main contributions that this work made; and points to some areas for future work.

Chapter 2

Literature Review: Design Considerations

This chapter details the literature that informs an understanding of design considerations for Culture-based Computing for Adult Learners (C-CAL), a computer-based learner assistant, utilizing adult learners' culture-based knowledge to teach them computing concepts. These considerations are discussed two domains: learning and technology. Learning considerations include those related to reaching adult learners, teaching computing, and scaffolding learning through culture. Culturally relevant design and user interface design are considerations that inform the technological design of C-CAL.

2.1 Learning Consideration

2.1.1 Reaching Adult Learners

One of the greatest challenges of education is the quest to understand if the learner is gaining insight into their own interpretation and framing the learning experience in the context of their learning. Beginning in the 1920s, the exploration of adults and learning was rooted in behavioral psychology and focused on the question *can adults learn*? By the 1950s, there was a shift away from this more behavioral view, to a more cognitive view of learning. At this time, however, adults were not differentiated from children. Researchers in this time period found that gaps in adult knowledge were actually functions of non-cognitive factors such as level of education training, health and speed of response (Merriam, 2001).

These discoveries, helped researchers put to the rest the question of whether adults could learn and led to the development of an understanding of how adult learning differs from the way children learn. By the late 1960's two theories of adult learners began to gain popularity, that still serve as the foundation to adult education today: 1) andragogy, defined as the art and science of helping adults learn, and 2) the theory of self-directed learning, centered on learners becoming increasingly self-directed as they mature. Merriam points out that by the 1970's and 1980's both theories had gained criticism for not considering the social impediments of adult learners and ignoring social-historical context. This social-historical context is addressed by Guy (1999) who asserts that every aspect of adult life shaped by culture and education has served as a vehicle for defining the culture values that people hold or that they view as central to being successful in their society. As a result, "the nature of the fit between learners' *cultural backgrounds* [emphasis added] and their educational experience is of central concern because of cultures' importance in establishing criteria for success or failure" (Guy, 1999, p. 13).

In order to better understand the social impediments and social-historical context of adult learners, over time, distinctions are made among the different categories of adult learners, such as age and motivation, all of which factors into their learning needs.

There are three generations of adult participations, the older age group of 45-50 years or more, the main and middle group from 25-30 up to 45 to 50 years, and the young adults from 18 to 25-30 years (Illeris, 2003). The older generation's attitudes towards education are depicted by their identity as "wage earner consciousness." The middle generation is also a carrier of the wage earner identity, but developed with it the material and collective value orientation toward more immaterial and individualistic attitudes. The young generation's central identity is influenced by the culture liberation. These distinctions can provide insight regarding the possibility of defense strategies to learning that challenges their identity and personal way of thinking, reacting, and behaving.

In current research, the concept of the identity of adult learners within education has expanded to encompass non-traditional students, students other than young adults matriculating from high school into college, within informal learning environments, learning outside of the classroom. The term adult learners has evolved from adults that participated in learning as a voluntary activity, to adults that are there directly through necessity or persuasion either by employers/authorities, or indirectly, to avoid social and economic marginalization. All of which do not capture the various types of adult learners or identify a centralized motivating factor. Motivations are rarely straightforwardly, positive or negative, but seem to be a mixture of social, personal and/or technical elements with a focus on the concrete skills that the adults expect to gain (Illeris, 2003). Furthermore, researchers still agree that adult learners differ in motivation, limitations, and method of engaging in the learning process. If this is true, how are these adult learners reached?

2.1.2 Role of Computing

With the massive return of adults to education, a buzz around the role of computing education has also begun to arise. Many of these returning adult learners, are finding their newfound educational or career interests fully entrenched with some form of computing education. In the last two decades, society has made an enormous investment in technology-based infrastructures for continued education, which has resulted in technology-based education and technology-assisted education becoming high priority for almost all forms of education

(Nasseh, 1999). In addition, most jobs today require employees to have the capacity to access, organize, and evaluate information using technology, "whether the person works on a construction site, drives an 18-wheeler, or processes payroll at the local convenience store, technological skills can mean the difference between having a job and seeking one, especially for older workers" (Cordes, 2009, pg 1). This need has adult learners storming learning centers around the world to improve their skills and knowledge bases (Nasseh, 1999; AE Listserve, 2008, Massy, 2005).

Meeting the needs of the influx of adult learners requires distributed learning environments, and the ability to support new technologies and devices (Cordes, 2009). Although these adult learners are returning to education, many will not be in classrooms and are armed only with the limited technical knowledge they obtained from workplace or personal life. There will most likely be an inverse relationship between their age and socioeconomic status versus their technological experience and resources. Thus, the older adults are, the less technological experience they are likely to possess. In addition, if these adult learners are of a lower socioeconomic status, there will be higher disparities in terms of available resources. Cordes (2009) asserts, factors such as formal computer training, practical experience, and the confidence gained from extensive use over time, that is often seen in younger learners that have grown up digitally, will play a critical role in their effectiveness in performing the needed learning tasks.

These factors reflect much of the call to action that has been a stir in the computing education community for the last several years. All of which begs the question, *how do we meet their needs*? In 1999, the National Research Council organized by the National Academy of Sciences produced "Being Fluent with Information Technology" to set the standard for what everyone should know about information technology in order to use it effectively now and in the future (National Research Council, 1999). In the report, they explained that computer literacy is too modest of a goal in the presence of rapid change because it lacks the necessary "staying power." The committee called for learners to have fluency with information technology (FITness), which entails the ability to reformulate knowledge, to express oneself creatively; and appropriately, to synthesize new knowledge, and to produce and generate information rather than just comprehend it. Further, fluency was defined as having three interrelated dimensions—intellectual capabilities, conceptual knowledge, and an appropriate skill set. Thus, the committee established the need to have "an adequate level of 'FITness' that provides an individual with the foundational knowledge and understanding that enables him or her to advance along a continuum, becoming more and more adept at applying information technology for a range of purposes and having a deeper understanding of technological opportunities for doing so"(National Research Council, 1999, pg 14).

Over the years "FITness" has had a range of interpretations of what its practical components should contain. A long-standing question that has evolved from this, is what exactly is this *need to know* knowledge? For example, is the goal to provide all adult learners an introduction to computer science education (often entailing some form of programming); or is the goal to effectively provide knowledge equivalent to that obtained through an information system-training program (focusing on the processes and management of information)? Efforts made to address the "need" question often align themselves, knowingly or unknowingly, to one or the other side of this debate.

One growing concept, energized by Jeanette Wing in 2006, is that of computational thinking, a fundamental skill she claims is as rudimentary as reading, writing and arithmetic (Wing, 2006). Computational thinking involves solving problems, designing systems, and understanding human behavior by drawing on the concepts fundamental to computer science. It encompasses six main characteristics: 1) Conceptualizing (thinking at multiple levels of abstraction); 2) a fundamental skill as oppose to a rote skill; 3) a model of human thinking; 4) a way of complementing and combining mathematical and engineering thinking; 5) based on ideas not artifacts and 6) it is for everyone everywhere.

Further, Guzdial asserts the need for the computing profession to explicitly teach an expanded view of the ways of thinking about computing and making computational thinking easily accessible to a broader audience (Guzdial, 2008). He discusses Miller and Pane's study of how people specify processes in natural language that suggests that object-oriented thinking, in regards to a novice task description, is not natural for students. Thus, there is a need to teach students computing in a way that makes sense to them (Guzdial, 2008).

Though often seen as a "noble goal," computational thinking has been met with some debate as to the role of programming languages in this process. One perspective on this debate, is that programming is to computer science what proof of construction is to mathematics, and what literary analysis is to English (Lu and Fletcher 2009). In other words, the introductory level should focus on vocabularies and symbols that can be used to annotate and describe computation and abstraction, suggest information and execution, and provide notation around which mental models of processes can be built. In another view, there is a call to move away from object-oriented languages all together with beginners, and to a more simplified languages until proficiency in design has been reached (Davies 2008). Yet and still other debates have focused on the optimal choice for the more common languages in use today (McIver, 2002).

A more recent argument gaining support focuses on "how" computing is introduced. In understanding that the mental and material worlds are mainly connected through our acting, perceiving, thinking and feeling; that is, through our activities, there must be a shift in focus on how to build that bridge between the mental and the material (Siefkes, 1997). Thus, the debates on whether to focus on computing technology instructions, on computer science, on information science or even what programming language is optimal, becomes secondary to connecting with the target audience. Siefkes suggests a shift of focus to how to better connect one's mental model to the new material.

Mechanical metaphors of thinking and learning such as:

> "Our mind is a container where knowledge is stored in various compartments; theories and curricula are buildings with foundations and supporting pillars; learning is putting "stuff" into right places; teaching thus is making this stuff handy." (Siekes, pg40, 1997)

no longer suffice, according to Siekes (1997). In an effort to engage adult learners in digital learning with a goal of obtaining FITness, their learning is distinguished from children by acknowledging that a cognitive change is requested in how they view their world. Siekes explains that if change is to last, it must affect and be connected to the people involved and spread to wider domains. He continues by establishing that our environments represent our activities, and that these activities are supported and dictated by our knowledge and valuation, which are formed by them simultaneously. Thus, Siekes concludes, knowledge and valuations are linked by perception, action and communication that are through our mental, physical and social activities. If matters such as logical thinking and problem solving are emphasized, and then resolve to connect the creative and innovative nature of computing to learners, FITness can be assured regardless of language or technology discipline used (Levy, 1995; Hu, 2003).

2.2 Scaffolding Learning

This section expands upon the idea that there has to be alignment between a learner's cultural background and his educational experience. Learning is a cultural activity. In order for it to be meaningful, it must be presented from a culture that is known to the learner. Evidence for this necessity can be drawn from Situated Learning Theory. A brief background is presented here to provide a basis for extrapolating an understanding of the impact of culture on learning.

Situated Learning Theory examines knowledge acquisition through active participation in the social, environmental, and cultural merits of a situation (Lave and 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.

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.

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); or simply a derivative of active cultural participation. As a result, it is wondered can it serve as a solution to alleviate the disparities (Johnson & Kristsonis, 2006) in educating adult learners stemming from diverse backgrounds enriched with a lifetime of culture experiences? If identifying the sociocultural setting as the community of people 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 (Lave and Wenger, 1990). Learning is then a tool resulting within a community of practice by which it loses some of its validity if separated from its culture.

2.2.1 Culture and Learning

Situated learning must involve activity, concept and culture; comprehension of one will not abide with the other two, because they are interdependent (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 by means of certain characteristics. An understanding of these sets of tools is obtained through first accepting the belief system of the culture to which the tool belongs, and then through use (McLellan, 1996). In the same fashion, others may not necessarily understand the community-learning tool of members of a culture without the acceptance of the functioning of that tool with respect to the culture.

There are several examples in research, and other disciplines and domains of various efforts of using culture attributes, practices and experiences to facilitate learning and to connect to the mental model of the target audience. Numerous tools and agents have been developed in response to the understanding of the importance of culturally relevant learning. For example, Say Say oh Playmate is a program that builds on students prior knowledge, lyrics from popular songs, and incorporated music to motivate reading and to support beginning literacy skills (Pinkard, 2001). Also African-American Distributed Multiple Learning Styles System (AADMLSS) City Stroll is an interactive game-like environment that uses culturally relevant cues, gestures, sounds lyrics and animation to identify with the culture of middle school and high school African-American students from the inner city to teach them algebra. (Gilbert et al., 2008). MindRap is another tool that harnesses the power of culture and the students' creativity to energize the learning process and encourage an interest in math and science by combining interactive teaching applications with hip-hop music and culture (Gilbert et al., 2008). Another example, Lee uses culture modeling to teach literature. Culture modeling in essence provides instructional organization that makes academic concepts, strategies, and habits explicit and provides ways of engaging in the work of the disciplines familiar and that provides supports for instances where the learner is unsure (Lee, 2007). She uses the culture of everyday practices as a lens for understanding the role of perception in influencing actions. Within culture modeling, culture data sets are used, which are familiar examples that new learning can be anchored and used to provide problems whose solutions mirror the demands of the academic task that the learner is to discover (Lee, 2007). Similarly, Eglash investigates fractal geometry as in geometric patterns, calculations and theories, as facets expressed in various African cultures (Eglash, 1999). Making connections across relevant schemata or clusters of schematic networks helps to create connections between the known and the unknown.

Table 1 shows how Lee engages inner city students in conversations about symbolism by discussing well-known rap lyrics and drawing parallels to similar ideas in literature.

Table 1: Lee's Culture Data Set Example

Culture data sets	**Literature**
Rap lyrics "The Mask" by the Fugees 1996 Students analyze the meaning of the Mask and terms in the Mask like "why Golden Child was not symbol but figurative language such as saying 'you star bright is a another way of saying you light-skinned'"	Symbolism
Rap video "I use to Love Her" by Common Sense 1994	Symbolism
Short story "Everyday Use" by Alice Walker 1994	Symbolism
Novel "Beloved" by Toni Morrison 1987	Symbolism

Similarly, Table 2 below shows the connection made by Eglash in identifying illustrations of fractal geometry in indigenous African architecture designs, decorative arts, ceremonies and customs. Much like the models created by Eglash and Lee, this research demonstrates a similar model.

Table 2: Eglash African Fractals Example

Culture	**Fractals**
Kinship and descent	Recursion
Divination	Binary codes=> numeric systems
African windscreen (the Sahel have strong wind and dust. The shortest rows keep the dust out the best because they are the tightest weaved, but also require more material and effort. They know that wind blows stronger when you go up from the ground, so they make the windscreen to match)	Scaling
African windscreen: Maximum in function (keeping dust out) for a minimum of cost (effort and materials)	Cost benefit analysis

Finally, all knowledge is not obtained via situated cognition. Knowledge can be acquired through formal and informal ways. The interaction of the types of knowledge is beneficial when the strengths of both forms of knowledge are used (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.

Regardless of how the knowledge is acquired, it must prove to be meaningful to the learner. 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, 1999). In other words, if a learner has experiences that are unique to her/his identity, then meaningful learning occurs when s/he is able to relate new potentially meaningful information. Situating a learning experience within a culture where a learner is an active participant is an example of how to make it meaningful.

As a caveat to the dialogue of culture and learning, it is presented with a caution on knowledge transfer. Saxe's (1988) study on the math of street vendor children, displayed the perplexing scenario of their cultural knowledge of mathematics not manifesting itself in tasks that required their understanding of the conventional rules for composing digits into multi-digit values, even though they used appropriate linguistic descriptors in their everyday activities. Gasson (1999) explains this phenomenon in that individual knowledge is therefore based in the context of action and transferable between tasks only when concepts may be generalized and made apparent from experience gained through previous learning activities. She reveals, the transfer of knowledge therefore becomes possible only when sociocultural practices can be translated to a new context of social action.

2.3 Technology Design Consideration

2.3.1 e-Learning

In understanding that the majority of adult learners that will be engaging in the learning of computing technology via computer technology, care must be taken in how the experience is structured. In some sense, for many of these learners it will be like submersing oneself in a foreign country with limited, to no knowledge of their language and expecting to not only survive, but to thrive. Though, as difficult as the challenge may sound, it is possible, and less painful, with the right tools. Thus, C-CAL will be designed as an e-Learning tool. For the purpose of this study, the term e-Learning is 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. 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. e-Learning techniques can be divided into four categories:

- Knowledge databases provide index explanation and guidance for software questions, along with step-by-step instructions for performing a specific task as often seen in popular help menus.
- Online support such as forums, chat rooms, online bulletin boards, email, or live instant messaging support.
- Asynchronous training, self pace learning that is CD-ROM-based, Network-based, Intranet/Internet-based, allowing learners to participate according to their schedule and be geographically separated from the instructor.
- Synchronous training happens in real-time using various e-Learning technologies and occurs much like a traditional classroom session (Obringer, 2006).

E-Learning involves the use of a number of technological tools that can be applied in various contexts; it is not a distinctive education system in itself (Nichols 2003). Though many are the opportunities that e-Learning affords, the fact still remains that e-Learning doesn't change anything about how human beings learn. e-Learning is one of the youngest learning tools as far as research is concerned. The bulk of literature in e-Learning is practice-based and is typically presented in a descriptive format (Nichols, 2003). Thus, much of e-Learning has been conducted on a trial and error bases. The rapid growth of e-Learning technologies and the desire to see these technologies integrated in the learning process has caused a lapse in verifying its validity. The true educational potential of these tools may never be realized until developers see links between established theoretical prospective on learning and useful applied techniques in e-Learning course design, as well as find ways to improve the dissemination of research for more specified guidance (Bannan-Ritland, Bragg & Collins, 2004). For the true value of e-Learning to be reached, those presenting it must look past the novelty of the technology delivery formats and apply what they know about teaching and learning to the creation of these environments basing their decisions on sound pedagogical constructs relevant to their own domains (Bannan-Ritland, Bragg & Collins, 2004). As a result, C-CAL will be a learning tool that utilizes the e-Learning platform as a vehicle to reach a broader audience, yet rooted in learning theories such as Situated Learning and Meaningful Learning Theory.

2.3.2 Culturally-Relevant Design

Understanding the needs of adult learners, and the challenges of getting these learners to the level of fluency in information technology as described by the National Academies of Science, can culture be used as an ethnic-social construct to bridge the world of adult learners and the learning of computing technology?

In order embark on such an effort it would be wise to heed to the lessons learned how to present culture based learning. Classroom based teaching, is one area where culturally relevant learning has been explored extensively. Teaching in a culturally relevant manner requires that educators of adults examine the learning environment for communicative processes, instructional practices, classroom customs and expectations, learning evaluation criteria, and instructional content that are potentially culturally incompatible. Guy (1999) explores a model for teaching in a culturally relevant way that is compatible with the learners. The model explores four elements of culture, (1) the instructor's cultural identity, (2) the learner's cultural identity, (3) the curriculum, and (4) instructional methods and processes. This model can become difficult to implement in practice because of the daunting task of customizing the learning experience for each student. The four elements of culture become the bases of forming design consideration for culturally relevant design.

Chapter 3

System Design

Marie is a 28-year-old woman of an ethnic minority and living in the southeast region of the United States. She graduated from high school about 11 years ago and has been working a series of odd jobs as she pursues her acting career. She has been acting for about 14 years, appearing in at least two productions a year. Marie also loves to cook, coming up with a range of recipes and is trained in martial arts. Marie wants to find a way to improve her earning capacity until she gets her big break. Marie has rich cultural knowledge that can be used to enhance her learning experience. Marie sits down to C-CAL, and in the Culture Inquiry Form, enters the cultures in which she participates. Once her Culture Inquiry Form is submitted, it is clustered to determine the dominant culture with respect to others in the database. Once the dominant culture in which she participates is determined, in this case theatre, it is then manually linked to a computing concept; variables in this case.

Marie is presented with the idea that a performer can be considered a variable. In linking variables to the culture attributes of theatre, we will focus on the common trait of a symbolic representation. In theatre, symbolic representation can be likened to that of a performer. For example, in the production of Shakespeare's Romeo and Juliet the role of the female protagonist character Juliet, has been played by a variety of performers all representing the same persona. However, as long as the rules were followed for example the experiences of the character, it is understood what symbolic representation the performer is portraying. When performing, every *thought, action and reaction is performed in character to denote or convey the character. Hence, the actress becomes a symbolic representation of a persona or character. Much like a variable labeled "int i," it doesn't matter which integer is placed in the variable i (high/low or positive/negative), as long as it is reflective of the symbol integer. Therefore, regardless what quantity or expression is given, the variable must stay in character.*

This scenario describes the intended use of Culture based Computing for Adult Learners (C-CAL); supporting adult learners in understanding computing concepts through culture-based instruction. This chapter will describe the components of the (C-CAL) system that operationalized the design considerations discussed in the previous chapter. C-CAL contains four major components – Culture Inquiry Form, Cultural Data Mining, Culture Dyads, and Learning Modules (Figure 1) – each of which was designed, implemented, and evaluated as a part of this research. The C-CAL system was designed using an iterative design methodology. For each component an initial design was composed, then presented to several test users. Based upon the feedback received from the test users the design was refined to account for any shortcomings in the design. The process was repeated until user issues have been addressed at an acceptable level (Nielsen, 1993). The sections below discuss the design rationale for these components as well as research conducted to inform their implementation. This will serve as the system design road map. A discussion of the implementation of the entire C-CAL system will be presented in Chapter 4.

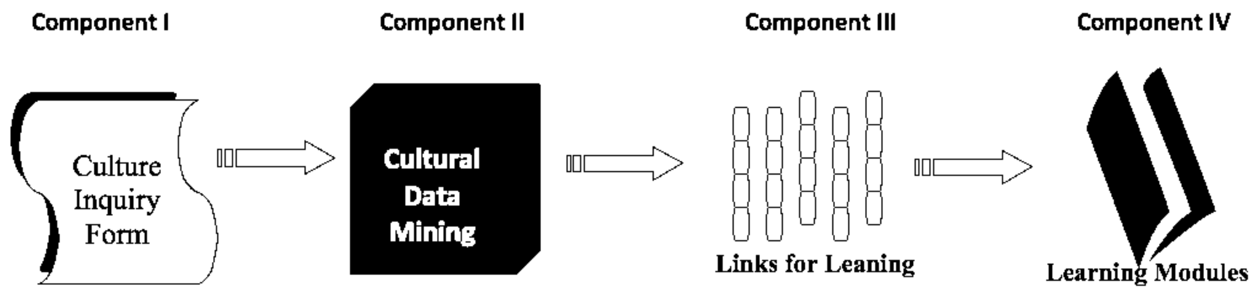


Figure 1: System Architecture

3.1 Component I: Culture Inquiry Form

The goal of Component I of the system was to answer the question, can one's culture of participation be identified and captured? The Culture Inquiry Form (CIF) allows the learners to self identify with the culture(s) in which they participate. The CIF collects culture participation information based on "who you are" and "what you do" (Gilbert and Eugene, 2009). In order to formulate a design centered about the target audience, the design of the first component required input from the target audience regarding their culture of participation. Cultures of participation are best understood and explained by their participants. Thus the design, set out to determine the adaptive responses and/or activities that reflect a person's knowledge base as a participant of that cultural practice. The researcher hypothesized that by asking adults about their shared experiences regarding their participation within a community of practice they will reveal both cultural attributes that will provide insight into how they identify themselves as participants of these cultures. The design of Component I consisted of: 1) creation of the Culture Participation Focus Group Protocol; 2) an initial test the protocol; and 3) translation of the protocol into an online space.

3.1.1 Creating a Protocol

The initial focus group protocol, the Culture Participation Focus Group Protocol (CPFGP), was designed (see Appendix A) by adapting the Family Math Protocol created by the Family Math Project (Martin et al., 2009). The Family Math Project and team are affiliates of Stanford University School of Education and the Learning Informal and Formal Environments (LIFE) Center. The project's goals are to identify contexts, activities, and resources involved in learning and using mathematics in families where they seek out and design for points of synergy between math in the home, and math and school. Using the protocol, the Family Math team conducts two-hour interviews in the family homes where they investigate the family as a cultural context for learning and doing math. The questions are focused on everyday activities and designed to solicit narratives. Although the Family Math Protocol's primary purpose related to demonstrations of math in everyday activities, its ability to capture a groups' depiction of their everyday activities and solicit narratives provides an avenue for understanding a group's culture of participation.

The first portion of the CPFGP covers context and activities, where questions centered on generating discussion on the various activities, people experience in different places and times. The questions in this portion of the protocol stemmed from topics such as home design and improvement; hobbies and collections; favorite or leisure activities; cooking, shopping, work and travel. Next, the CPFGP investigates problem-solving strategies, and a deeper exploration of preferred activities is conducted by investigating how various activities are done. In keeping in the customs of the Family Math Protocol, the CPFGP also seeks computing in a minute stories, where everyday experiences imitate experiences encountered in computing are shared. The protocol concludes with a final question of, "what is computing to you," in an effort to provide a chance to explore any uncovered arenas. The CPFGP was used to conduct the focus groups discussed below.

3.1.2 Testing Protocol

The focus group method was selected because of some of its immediate benefits, such as the group effect (Lindlof & Taylor, 2002). It provides an interactive group setting, where participants are free to talk to one another. As participants listen to others' verbalized experiences it stimulates memories, ideas, and experiences of their own. As such, group members begin to communicate in a common language to describe similar experience, allowing the capture of a common shared ontology. The focus group provided a means of understanding the cultures of participation of the targeted audience and their ontology for characterizing their participation in these cultures.

3.1.2.1 Settings

The focus groups were conducted in collaboration with the Information Management and System Engineering (IMSE) Program in Detroit, Michigan. The IMSE program, under Wayne State University's National Science Foundation Broadening Participation in Computing Project, is a collaboration of Wayne State, Focus Hope, and several industry partners to support disadvantage students at critical junctures from a GED through the completion of a post secondary degree (Brockmeyer, 2007).

3.1.2.2 Procedure

In preparation for the focus groups, there was some concern regarding the length of the protocol and the time allotment for the focus groups. The flow of a focus group or interview depends heavily upon the engagement of the group. A highly engaged group can produce extensive discussion in which rich data can be obtained, however this can limit how many protocol questions can be covered in a session. As a result, in order to diminish the length of the protocol and provide adequate time for the researcher to dig deeper into questions, ten of the focus group questions and demographic questions were sent out to participants a week prior to the study in the form of a survey (see Appendix B.). The first three questions consisted of demographic questions such as gender, ethnicity and age. The remaining questions were related to industry experience and technology usage. The questionnaire provided a foundation to tailor the focus group discussions.

As prescribed by the protocol, on the first day the instructional sheets are provided then each focus group began with a round of introductions and explanation of the study to the participants to establish rapport. The audio recorder was started as participants then engage in a brief icebreaker, in which they talk about themselves, successes, and challenges. In the beginning of the focus group, each question was presented to participants in a round robin fashion. As participant's comfort level began to rise, as a new question was introduced, participants began to chime in at will. The researcher made note of each speaker to ensure that every participant had a chance to respond to a question before moving on to the next question. On the last day, the participants were thanked for their time, and asked if they have any questions before completing the focus groups.

3.1.2.3 Participants

Participants of Focus: HOPE cohort 3, which was the current group of students in the program, was invited to participate in the focus groups. Eleven participants were divided into two groups (n = 4 in Group 1 and n = 7 in Group 2). Focus groups were conducted over two days, at the Focus: HOPE facility in Detroit, MI. Each session, with each group, lasted 1-1.5 hours. The study took place during the participants' math class time on day one and computing class time on day two, thus the groups where formed based upon the participants math class affiliations and time of arrival on the day of the study. Each participant was compensated with a $25 credit to their IMSE co-payment for each day they participated.

According to the pre-survey, the focus group consisted of 81% African American's, 55% male, 44.4% female, and average age ranged from 45 to 54. More than half the participants considered themselves as novice computer users, yet admitted to using a computer daily. In the pre-survey, participants mentioned several industries in which they have been previously employed. This allowed the researcher to conduct a cursory overview of the participants' past industries of employment prior the day of the focus groups to support additional probing during the course of the focus group.

3.1.2.4 Analysis

Data gathered from the focus groups were manually analyzed by the researcher in search for common themes that emerged from the respondents. Data analysis codes were not developed prior to data analysis to prevent bias. Thus initial analyses were conducted more in terms of a review of which questions produced more dialogue among the group. And then followed by determining which questions caused participants to provided a more deep reflection or in-depth explanation of cultural activities.

3.1.2.5 Results

Table 3: Focus Group Culture Examples depicts a sample of the participants' responses shared in the focus groups as it relates to their sections for the categories of hobbies and jobs. In

the participants' responses, there were several overlaps in hobbies, jobs, and traditions. For example, though cooking is listed in Table 3 as an example of a hobby, several other participants discussed it in reference to family traditions or industries in which they have been previously employed. Their participation in cooking ranged from a daily activity, to one that is done only with family on given holidays. Participants also discussed their process and preparation patterns for engaging in their hobby. For example, one participant, reinforced by other participants, discussed the concept and strategy to playing the game of Bones also known as Dominoes; while another spoke at length about preparation for a seasonal fishing excursion.

The majority of participants possessed an extensive job history ranging across several industries. On average, each participant worked a minimum of three jobs over a three-year period. Participants discussed several of their past work experiences, their positions and some of the training or knowledge they considered essential to the job. One participant, who supervised a team of teens conducting road clean-up on the freeway, focused on the safety precautions that he enforced. Another stressed the importance of angles in power washing semi-trucks. Yet another depicted the process of delivering trash cans and recycle bins and the various factors that come into play.

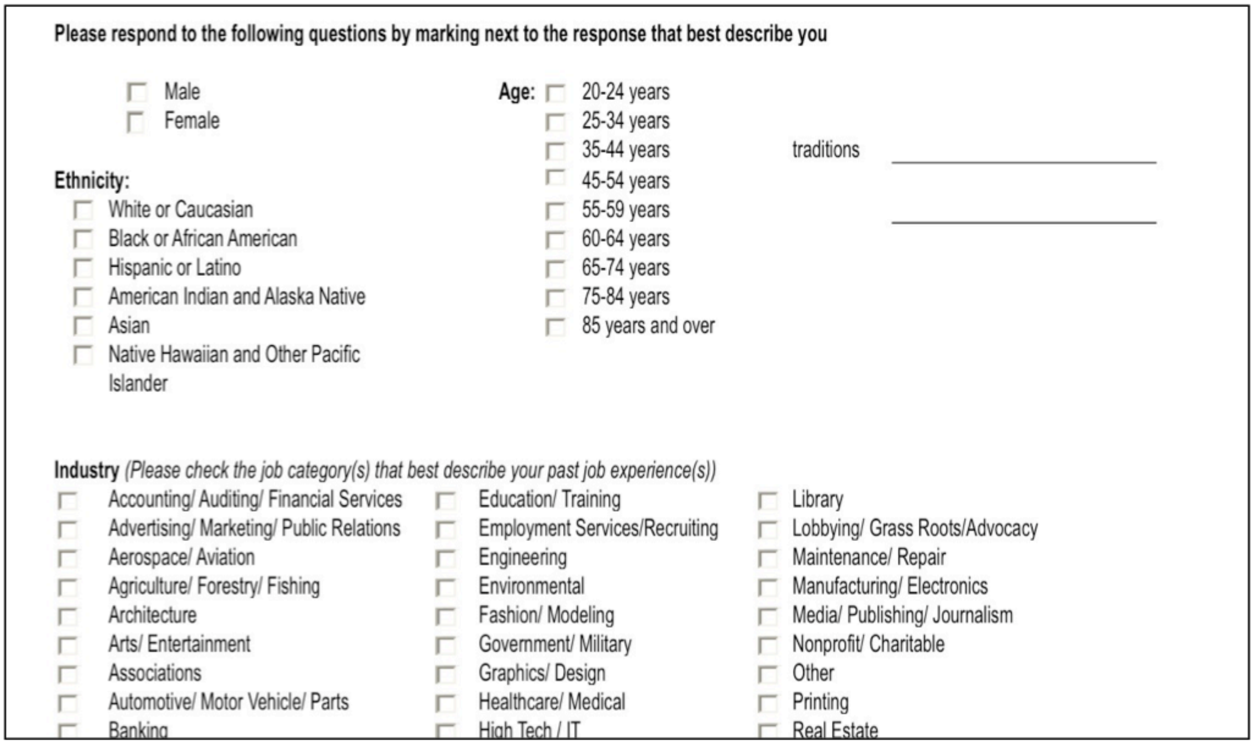
In addition, one of the most valuable discoveries of the focus groups was the participant's ontology. This provided the researcher with a roadmap of how to capture culture in future development, of the C-CAL system. Also gauged was which questions on the protocol participants had little or no response to. For example, questions about home design and improvement, and communications structures and patterns didn't provide much insight within the focus groups. Thus, these questions were not included in the design of the final Culture Inquiry Form.

Table 3: Focus Group Culture Examples

Hobbies	**Cooking**	**Fishing**	**Dominoes/Bones**
	Frequency: ranges from once/twice a week-daily; family tradition *Process* Culture the food; creating new recipes'; Cooks for family size How 2 cook for large groups Preparation entails having resources space, time. Some meals require advance preparation to be done days in advance Preparation Example: go to store, get ingredients, organizing ingredients; Layout all other needed supplies timeframe where you would not be disturbed put everything together	*How to prepare:* Know the season to catch the best fish Devise a plan (Plan when you go, who going with, where you going), get there early to get the best spots, pack some lunch and a cooler…much like planning an event	*How to prepare:* Play for 5 pts or 10 pts develop a game strategy, for example: watch what hasn't been played Goal is the person behind you doesn't score Be prepared to sacrifice your hand to keep block opponent
Jobs	**Road Clean-up**	**Power Wash**	**Trash Collector**
	Duration: 3 yrs Position: supervise teens *Training Required*: Adapt to different Personalities build good relationship with workers Safety Precautions: must walk precisely 150 ahead of the vehicle and 150 feet back towards the vehicle; beware of your surroundings; beware of oncoming traffic	Duration: 10 yrs Position: Power-wash semi-trucks *Training Required:* o Learn how work the machines o Technique to washing the trucks to the satisfaction of the owner (angles, and spots: example= looking at under the tire well/rim normally not an area cleaned in normal car washes—so technique entails getting all the spots)	Duration: 5 yrs Deliver Trash/recycle cans to residential areas *Process:* 2-3 people running and dropping down the cans then another came by and scanned (the can's barcode) safety precautions: Beware of traffic Weather effect on work conditions

3.1.3 Translating Protocol Online

The CPFGP and the lessons learned from its use in the focus groups, served as the bases for the creation of the online version of Culture Inquiry Form. The first part, or the “who you are” portion, includes the demographics section of the instrument, which 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 US Census Bureau demographic categories serve as a model for this study, entailing questions such as age, ethnicity, and gender (Figure 2). The second part of the CIF allowed for the capture of the “what you do” part of the learners’ culture of participation. The design of the second part of CIF stems from the Culture Participation Focus Group Protocol (CPFGP) and the collected data. Thus, the second part of the CIF contains selections pertaining to hobbies, employment, and traditions. All of the questions in CIF were designed as radio buttons or check boxes except for hobbies and traditions. The hobbies question presented the participant with a drop-down list of a several hobbies. These hobbies were gathered from the focus group study. If the learner is unable to identify with the listed hobbies another avenue is provided for learners to enter in the cultural hobbies in which they participate. Participant’s entries are then added to the list, such that later participants will see it when the CIF is loaded again. This will be discussed further below. Traditions were also designed as a text box so the participants’ could enter their traditions and describe them accordingly. A sample portion of the CIF is displayed in Figure 2 and the CIF in its entirety can be found in Appendix C. Also included were questions pertaining to computer usage and perceived level of computer experience.



Please respond to the following questions by marking next to the response that best describe you

- Male
- Female

Ethnicity:

- White or Caucasian
- Black or African American
- Hispanic or Latino
- American Indian and Alaska Native
- Asian
- Native Hawaiian and Other Pacific Islander

Age:

- 20-24 years
- 25-34 years
- 35-44 years
- 45-54 years
- 55-59 years
- 60-64 years
- 65-74 years
- 75-84 years
- 85 years and over

traditions ______________________

____

Industry *(Please check the job category(s) that best describe your past job experience(s))*

- Accounting/ Auditing/ Financial Services
- Advertising/ Marketing/ Public Relations
- Aerospace/ Aviation
- Agriculture/ Forestry/ Fishing
- Architecture
- Arts/ Entertainment
- Associations
- Automotive/ Motor Vehicle/ Parts
- Banking
- Education/ Training
- Employment Services/Recruiting
- Engineering
- Environmental
- Fashion/ Modeling
- Government/ Military
- Graphics/ Design
- Healthcare/ Medical
- High Tech / IT
- Library
- Lobbying/ Grass Roots/Advocacy
- Maintenance/ Repair
- Manufacturing/ Electronics
- Media/ Publishing/ Journalism
- Nonprofit/ Charitable
- Other
- Printing
- Real Estate

Figure 2: Sample Culture Inquiry Form

3.1.3.1 Add Hobbies

Because the hobbies originally presented in the drop-down list is not a complete list, and mainly meant to help participants reflect on what some of their hobbies could be, an add hobby field is also included. The hobbies field was thought to be a key field because it encompassed an array of cultural practices. In the focus groups conducted, participants provided vivid explanations of their hobbies, how they themselves participated in these hobbies, and how they interacted and identified with others that had shared experiences in these activities. For example, two participants talked extensively about their hobby of cooking. One person explained a detailed process of preparation, recipes, ingredients, supplies and layout of the kitchen. Another participant discussed cooking in regard to it being a shared family holiday activity thus focusing more on the people that were was involved. Several of the hobbies mentioned in the focus group were basic and general enough where other adult learners, including those in the focus group, could identify such as baking, golfing, watching TV, etc. The researcher decided, then, to make use of this rich information. Thus, the hobby field was designed as a drop-down menu and hobbies shared during the course of the focus group by the participants were then added as the initial options to choose from a drop down menu.

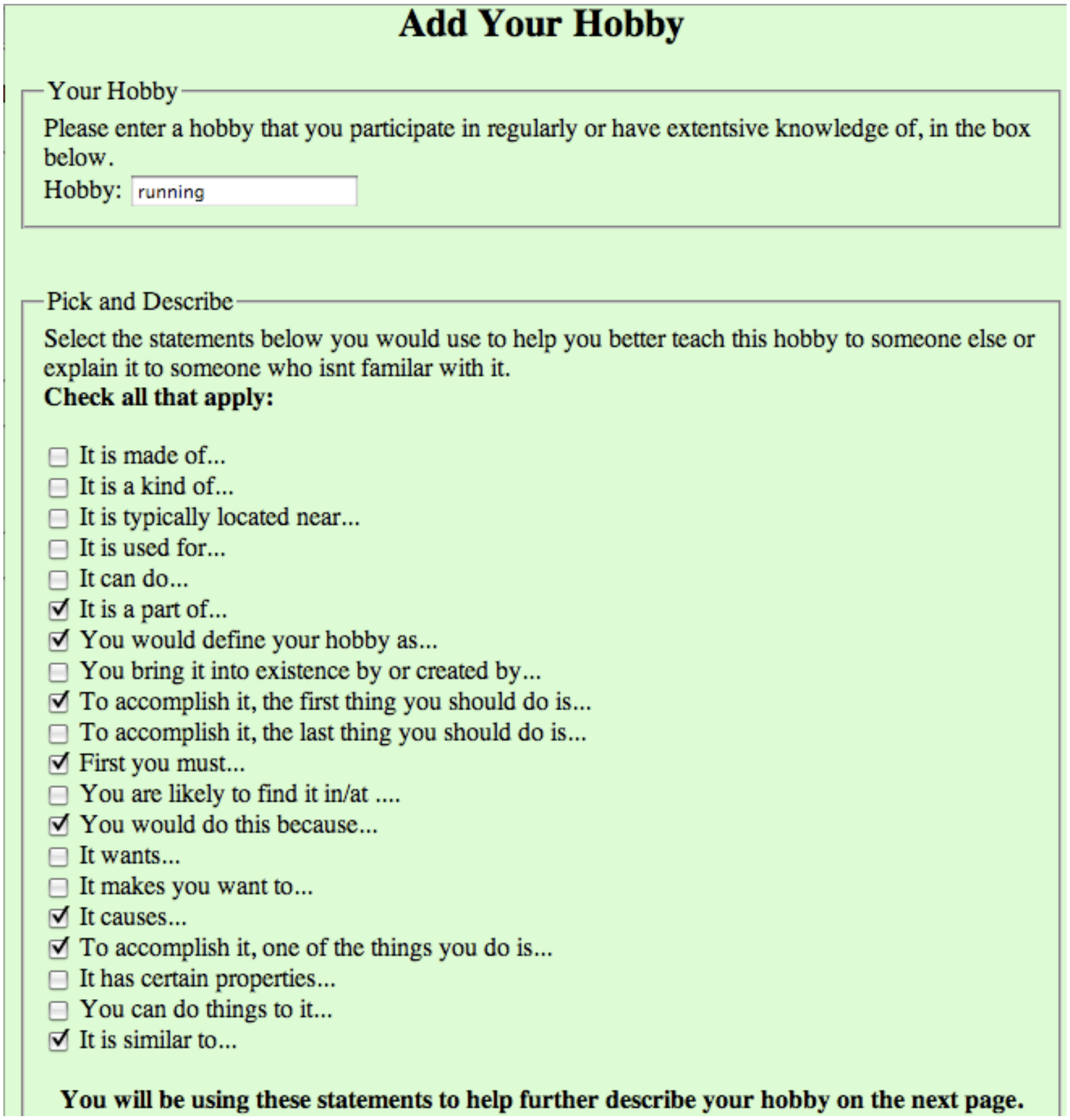
During the focus group, it was discovered that some participants needed seeds, or ideas, to help them brainstorm what their hobbies might entail. The majority of participants initially responded as having no hobbies, yet when an example was given or other participants began describing their hobbies, it would spark a memory or an idea for the other participants of activities they frequently engaged in but seldom refer to as their hobbies. Assuming the same would be true for other participants who would later complete the CIF in a virtual space, some of the more common responses received in the focus group were placed in the drop down menu to serve a similar purpose of sparking ideas and memories as the examples did for the focus group participants.

The next goal was to devise a way to capture the same rich information about knowledge and participation of their hobbies, in a systematic way. It is key to capture a participant's ontology of their hobby more than an understanding of what they identify or label that hobby to be. As previously discussed, participants in a culture have a shared ontology. The ontology, or language, of a culture is one factor that helps us distinguish between our various cultures of participation. It is also where a better understanding, of what that culture entails is gained. For example, if I said that one of my cultures of participation was Kabaddi, it would be useless information to another person, system, etc. However, if I then described it as an activity having the objective of to tag as many opponents as possible before returning to the home half of the field, you can begin to better identify ways that this person's ontology and description of their culture of participation can be likened to a task, process, or skill set to which they can be connected. To do so, the researcher tapped into the Common Sense Computing Initiative (http://xnet.media.mit.edu/, 1999).

The Open Mind Common Sense project, a product of the Common Sense Computing Initiative, has developed the machine-interpretable semantic network, ConceptNet 3. ConceptNet 3 consists of sets of semantic relations (e.g. EffectOf, DesireOf, CapableOf), known as binary predicates, which serve as the edges within a semantic network between compound concepts (e.g. 'buy food', 'drive car') that are the nodes (Liu & Singh, 2004; Havasi et al, 2007). According to Speer (2007), predicates are assertions depicted in their three parts: a relation, which can be thought of as a function of two arguments, the left concept, and right concept that form the arguments of that function. Some examples of these predicates are DefinedAs, IsA, UsedFor, HasProperties, MotivatedByGoal, etc. ConceptNet semantic network consists of over 21 of these predicates (Havasi et al, 2003).

The CIF went through several rounds of testing and redesigning. The alpha design of the CIF was then put before a team of usability experts, the members of the Human-Centered Computing Lab. In this iteration the focus was primarily on the usability features of the CIF.

To gain a better understanding of a participant's hobby, these predicates were employ, which allow participants to invoke their own ontology and description of their stated hobby (see Figure 3). Thus, in the CIF, if a participant cannot identify with a hobby in the drop-down list and decides to add a new hobby, a new window will open where the participants are prompted to enter their hobby and select the natural language statement(s) the predicates are extracted from that best describes their hobby Figure 4.



Add Your Hobby

Your Hobby

Please enter a hobby that you participate in regularly or have extentsive knowledge of, in the box below.

Hobby: running

Pick and Describe

Select the statements below you would use to help you better teach this hobby to someone else or explain it to someone who isnt familar with it.

Check all that apply:

- [ ] It is made of...
- [ ] It is a kind of...
- [ ] It is typically located near...
- [ ] It is used for...
- [ ] It can do...
- [x] It is a part of...
- [x] You would define your hobby as...
- [ ] You bring it into existence by or created by...
- [x] To accomplish it, the first thing you should do is...
- [ ] To accomplish it, the last thing you should do is...
- [x] First you must...
- [ ] You are likely to find it in/at ....
- [x] You would do this because...
- [ ] It wants...
- [ ] It makes you want to...
- [x] It causes...
- [x] To accomplish it, one of the things you do is...
- [ ] It has certain properties...
- [ ] You can do things to it...
- [x] It is similar to...

You will be using these statements to help further describe your hobby on the next page.

Figure 3: Add Your Hobby

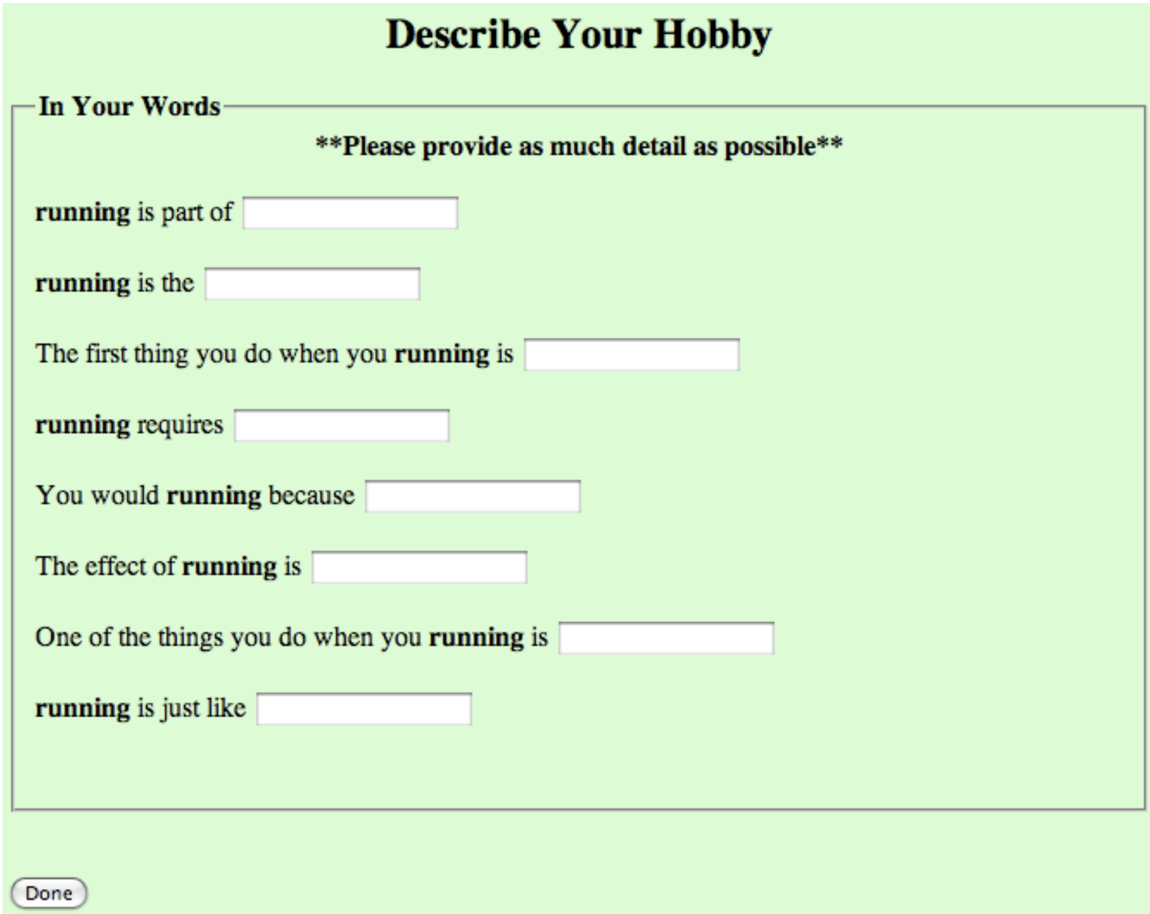


Figure 4: Describe Your Hobby

3.2 Component II: Culture Data Mining

The vast amount of data about individual learners that can be captured through the CIF, creates the need for characterizing groups of learners in order to constrain their cultural traits used by C-CAL. Cultural data mining is a means for accomplishing this characterization of learners interacting with the system. Taken into consideration the vast differences between learners and their experiences, personal customization for each learner quickly becomes a costly challenge. Though the goal of C-CAL is to provide a unique personalize learning experience for each learner, C-CAL uses cultural data mining to capitalize on the shared cultural practices and ontology's that the learners expressively participate in or can relate to, and form clusters of learners.

In general, data mining provides a means of transforming large groups of data into information by extracting a pattern. It also designates fitting a model to data, finding structure from data, or in general, any high-level description of a set of data (Fayyad et al., 1996). Data mining algorithms' ability to extract patterns from data facilitates a growing need to analyze a subset of data or a model applicable to that subset, within a large data set.

As societies quickly move from data sets consisting of kilobytes to now petabytes of data, it quickly becomes a daunting task to extract useful information. As computers grow in speed, number-crunching capabilities, and memory, scientific researchers are edging into data overload as they try to find meaningful ways to interpret these data sets (Kamath & Parker, 2000). Giving thought to the notion of varying culture identities that exist in our society, data mining offers a means of extracting these unique patterns enumerated from data, as opposed to relying upon assumption or sweeping generalizations.

For this reason, the idea of cultural data mining is taking root. Manovich observes that, until now, the study of cultural processes relied on two types of data: shallow data about many people (statistics, sociology) or deep data about a few people (psychology, ethnography, etc) (Manovich, 2009). Utilizing data mining, detailed data about very large numbers of people, objects and/or cultural processes can now be collected, and no longer will one have to choose between size and depth (Manovich, 2009).

In an effort to gain a better understanding of the learner and the learner's experience, the study of Educational Data Mining has emerged as the area of scientific inquiry centered around the development of methods for making discoveries within the unique kinds of data that come from educational settings, and using those methods to better understand students and the settings in which they learn (Baker, in press). Educational data, regardless of its origin, often has multiple levels of meaning hierarchy, which often need to be determined by properties in the data itself including issues of time, sequence, and context (Baker, in press).

Within Educational Data Mining tools, popular methods such as prediction, clustering, relationship mining, discovery with models, and distillation of data for human judgment have been used for applications such as improving student models, discovering or improving models of the knowledge structure of the domain, studying the pedagogical support provided by learning software and scientific discovery about learning and learners. Thus, applying educational data mining to answer questions in any of the three areas of student models, domain models, and pedagogical support can have broader scientific benefits of enriching theories and assist the scientific community in making better provisions for learners at all stages of learning.

C-CAL builds upon the concepts of culture and educational data mining in utilizing clusters to better understand learners. The data collected from the CIF was analyzed using cultural data mining, by running a clustering algorithm, Application Quest™, to determine the dominant culture of participation among the participants. Applications Quest™ is a dynamic software tool developed to perform holistic comparisons using a hierarchical clustering approach (Gilbert, 2006). Applications Quest™ (AQ) takes in numerical values and nominal attributes to determine clusters of similar applications. AQ compares every application to every other application using n C r = n! / [(n-r)! r!] comparisons, and places the result of each comparison into a database table called the similarity matrix. All numeric attributes are scaled to values between 0 and 1 and used in a squared Euclidean distance measure. When considering nominal values, the Nominal Population Metric (NPM) is used, which results in values between 0 and 1 as well. The NPM begins by identifying the nominal attributes within the similarity matrix and then processes them as follows (Gilbert, 2007):

1. Compute the total number of combinations for all applications using n C r.
2. Compute the number of unique nominal attribute values.
3. Compute the number of combinations for the unique nominal values using n C r.
4. For those combinations of the nominal attribute value pairs, compute the coverage percentage within the application similarity matrix.
5. The nominal population matrix shows nominal attribute pair coverage across all comparisons. This is an accurate measure of the impact of the nominal attribute value pairs based on their actual existence within the data population. The next step in this process is to adjust the Coverage values if necessary. This is the desired goal when the application is measuring difference vs. similarity.
6. The Coverage values in the nominal population matrix are now the Nominal Population Metrics that can be used in clustering algorithms to accurately compare nominal attribute values.

Using the squared Euclidean distance measure, AQ computes a similarity matrix. To determine the clusters, AQ uses a divisive clustering approach by identifying the two most different applications using the similarity matrix. Using the two most different applications, AQ forms clusters around them based on each individual application's closeness to one or the other. The Applications Quest™ algorithm provides diverse clusters that make it ideal for cultural data mining, in which similar culture attributes can be clustered holistically. Thus, it forms clusters of similar cultural practices obtained from the Culture Inquiry Form. The clusters are then analyzed for dominant attribute values, i.e. those that are shared the most. The dominant attribute value(s) represent the actual cultural traits of the cluster.

3.3 Component III: Culture Dyads

In a full implementation of the C-CAL system, the dominant culture obtained from the cultural data mining of the CIF data, would be automatically linked to the computing concepts based on the similarities of the understanding of attributes and processes. These newly formed dyads (dominant culture and computing concept) would then be infused into a template, to form the basis of a culturally relevant learning module. Instead, a Wizard of Oz (Woz) method was employed in order to prove the utility of linking culture to learning computing concepts rather than focusing on the design of the system. WOz is a method used to test device concepts and techniques and suggested functionality by evaluating unimplemented technology by using a human to simulate the response of a system (UsabilityNet, 2006). The "wizard" or the researcher simulates the systems response in real time (UsabilityNet, 2006). The WOz paradigm was conducted to simulate and frame the information retrieval aspect of the system. Using the WOz paradigm allowed for the development of a model that can be later formalized.

In this research, the "wizard" uses the dominant culture as the input, it is then anatomizes in search of the generally understood attributes, practices, and processes that mirror any of the basic properties of the concept. This process entails an extensive review of the shared ontology discovered through the focus group, and is followed by additional research obtained by conducting a guided search using a search engine, all to depict a more contextual understanding of the culture. The information from the shared ontology and the guided search allows for more concrete points to match the culture to the concept. The dyads that are formed as a result are reviewed by at least one participant in the culture of practice. If the foundational structure used to relate the culture to the concept is not seen as logical to a current participant in the culture, the process is repeated.

This model implemented using WOz, as explained in more detail below, is dependent upon trial and error practices to refine the basis of the dyads. This refinement entails beginning with the dominant culture cluster attribute(s) concept obtained from the cultural data mining of the CIF data, and the additional information obtained regarding that concept when it was first evaluated. For example, given a culture of participation of golf or baking, the system uses the participants' given ontology from the add hobby section or that which was provided in the focus groups. A framework can then be established as to what this concept involves, i.e. its tasks, steps, purpose, procedures, objectives, and goals. Such as with baking, participants discussed the steps to following recipes; or in golf, they mentioned the purpose and goals of the different clubs. Using that information as the primary knowledgebase, an online search is then conducted on the cultural activity using various search engines, such as Google, Bing etc to retrieve additional information that will help fill in more of the systems knowledge pool of this concept. For instance, it is learned from guided search via the search engine: following recipes, which often involves following a sequential or ordered list of steps, or the understanding that golf clubs, though they vary in goals have a similar function.

As the guided search stage is entered, several factors are taken into consideration. Being aware that the goal for this portion of the system is to link the culture concept to our computing concept, the search is commenced with the definition that is derived from the computing concepts. Thus, as the search is conducted for additional details related to what the culture concept involves, (tasks, steps, purpose, procedures, objectives, and goals of the culture concept) it will be done from the perspective of those related to the computing concept. Ideally, this would be a sort of matching game. For example, match the culture and concept as they relate to the process of queuing or a series of steps. Also, at this stage, once the information has been retrieved, the wizard takes into consideration the "who you are" aspect of the participants' culture, and the stored findings are strictly based on how participants have identified themselves demographic wise. For example, it is unclear what is the stage or the range of participation of all participants that fall into a given cluster, depicted by the culture attribute of golf, are involved with golf. Without knowing the occasional players from the semi-pro hobbyist, there is an attempt to strike a balance of what would be considered general knowledge. Thus, most of the golf information is gathered from sites geared towards beginners, novice learners, or general information sites such as Wikipedia or various basic "how to" or introduction to golf sites.

For clusters formed around industries, the researcher review participant's educational background, and thus restrict our stored findings to that which would be considered common knowledge with the range of education displayed by the participants in that cluster for that given industry. For example, if a cluster is formed around the medical industry, and the participants' education ranges from high school diploma to some college, the focus would be on jobs in the medical industry that do not require advance degrees and what would be common knowledge among those participants would become the focus. After gathering the background knowledge of the respective cluster attribute or what is understood to be the shared ontology for participants of that culture attribute, it is time to attempt to link them to the corresponding computing concepts.

3.4 Creating Culture & Computing Dyads

Much like the above scenario, using the dominant attribute of each culture cluster produced by Application Quest™, dyads are based upon the culture's processes, procedures and description. For example, if the named culture were characterized by a series of steps, thus having a likeness of a function, it would be linked to functions. A culture cluster can be linked to multiple computing concepts especially in cases where a culture cluster has more than one dominate culture. Based on what is known or expressed by the participant regarding the dominant culture, the linking is done on what appears to be the more apparent, clear and logical relationships between the culture concept and the computing concept. For example, baking is linked to functions based upon the participant's acknowledgement and identification with its steps and processes. The linking is done based on the shared ontology expressed by culture participants and/or the culture processes, procedures and description that are considered common public knowledge.

3.5 Conclusion

Capturing a synopsis of the vast amounts of culture activities and processes any given person participates in on a regular basis can be challenging, as the researcher found very limited tools and resources providing guidance in this manner. In addition, because this body of research implements a broader definition of culture, the possibilities of the activities that encompass the cultural of participation of any one person can be a part of can become quite large quickly. As a result it was understood that in this initial design the goal will be more to employ a workable method as appose to a precise tool.

Creating a culture and computing model is geared to create a method to link the participant's cultural knowledge to the similar practices within a set of computing concepts. As a caveat, it should be mentioned that linking learners' culture based knowledge to that of computing concepts is not an exact science and, thus will require human input. For example, it is clear or implied that a fetch and pre-fetch process is a part of the culture of doing laundry, however it is difficult to design a tool to decipher such a concept from a learner's description, because, they may view and describe their participation in a range of methods. Such research, and the automation of this discovery process, is beyond the scope of this dissertation, yet the same goal can easily be reached with human input. However, this is fertile ground for future research. This phase will be assessed via a control study of learners.

Chapter 4

System Implementation

As a proof of concept, objects, functions, and variables frequently found in introductory computing lessons were selected to serve as the bases for computing concepts to be introduced by the C-CAL system. The concepts of objects and functions were specifically chosen because it has been proven that they are often regarded for the higher level of difficulty they present to novice learners to grasp.

The search to find a layman's definition for the three computing concepts was initiated at Wikipedia and other non-expert driven domains found via Google searches. The online definitions found were then combined with those used in standard introduction to computing text books commonly employed in college courses among novice learners such as Deitel and Deitel series on How to Program (Deitel and Deitel, 2007); or Programming for the Absolute Beginners (Ford, 2007); and Head First Programming (Griffiths and Barry, 2009) that are targeted for novice learners with limited to no computing experience to forge a suitable working definition. Again an iterative design process was employed. First, detailed definitions of each of the three terms were presented in the form of a matching game to three usability subject matter experts. The experts were instructed to match the term to its definition. After several rounds of cycling through the design process, the feedback of the participating experts was used to refine, the definitions. These definitions were then presented to two novice adult learners. The learners were instructed to enter a hobby into a text box (Figure 5), in which they engage in extensively, possess an in-depth understanding of, and participate regularly at a high level of regular participation in. The participants were then given the three definitions. Each definition was followed by a generic example (Figure 6), similar to the first introduction to the given topic in one of the traditional book sources previously discussed such as the Head First Programming and the Programming for the Absolute Beginners.

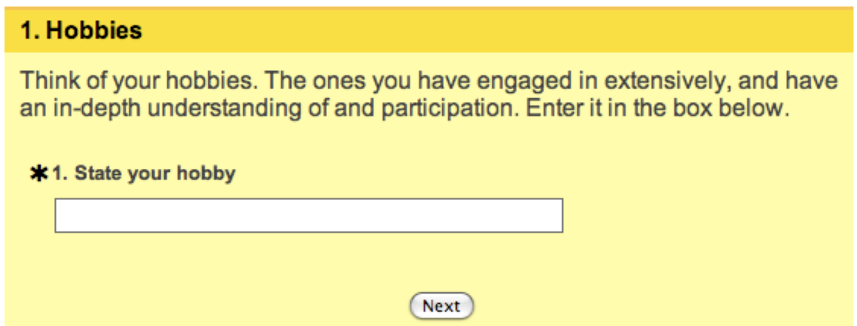
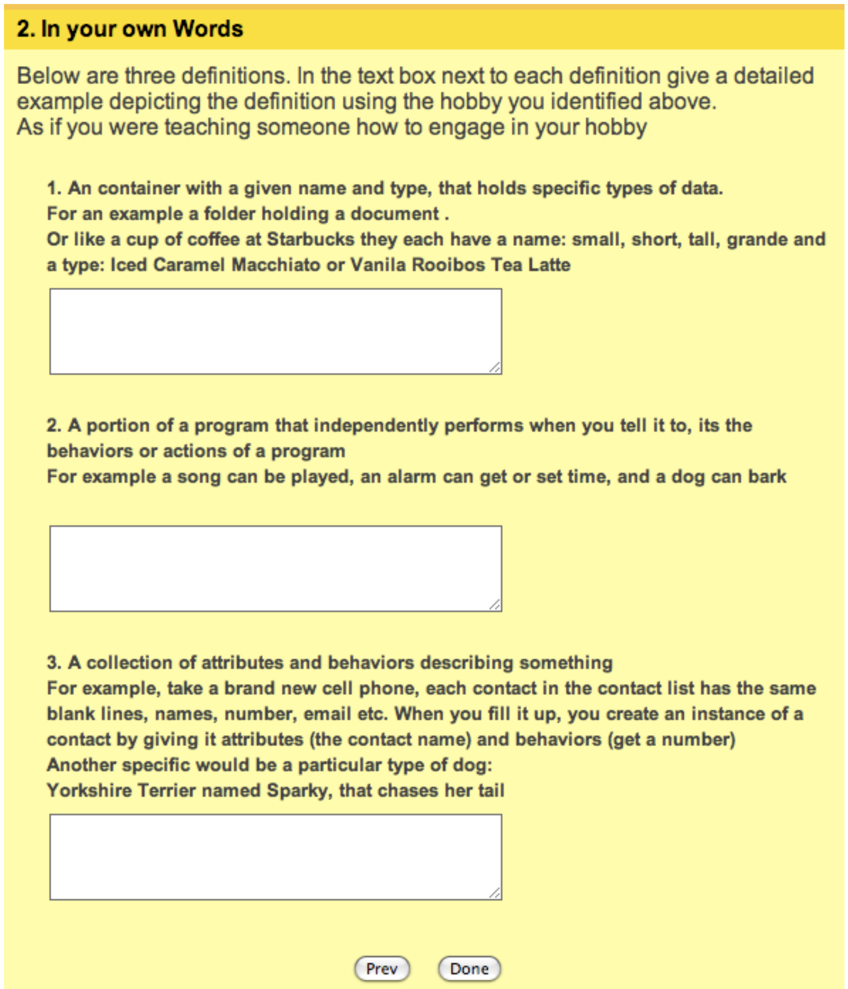


Figure 5: Defining Hobby


2. In your own Words

Below are three definitions. In the text box next to each definition give a detailed example depicting the definition using the hobby you identified above.
As if you were teaching someone how to engage in your hobby

1. An container with a given name and type, that holds specific types of data.
For an example a folder holding a document .
Or like a cup of coffee at Starbucks they each have a name: small, short, tall, grande and a type: Iced Caramel Macchiato or Vanila Rooibos Tea Latte

2. A portion of a program that independently performs when you tell it to, its the behaviors or actions of a program
For example a song can be played, an alarm can get or set time, and a dog can bark

3. A collection of attributes and behaviors describing something
For example, take a brand new cell phone, each contact in the contact list has the same blank lines, names, number, email etc. When you fill it up, you create an instance of a contact by giving it attributes (the contact name) and behaviors (get a number)
Another specific would be a particular type of dog:
Yorkshire Terrier named Sparky, that chases her tail

Prev Done

Figure 6: Hobbies in Context

The participants were instructed to create their own detailed example depicting the given definitions using the hobby they previously identified. In addition, they were instructed to present their examples as if they were teaching someone how to engage in their hobby. After this step, the working definitions for the three concepts were finalized.

4.1 Component IV: Learning Modules

The design and implementation of the C-CAL learning module essentially follows the ADDIE model, five phases to designing e-Learning instruction: Analyze, Design, Develop, Implement, and Evaluate (Smith and Ragan, 1999). The design of the C-CAL learning module will be explained within this context.

4.1.1 Analyze

In this phase the problem in which the learning module will be designed to address, is clarified; the delivery option is determined; and the instructional goals and objectives in the learning environment are established. Recall, the Culture Inquiry Form (CIF) collects the demographic information, cultures of participation, and the learners existing knowledge and skills. This information provides answers to analysis questions such as the characteristics of the target audience and the existing, if any, learning constraints. The problem and objective presented in the learning module will be for learners, using their cultural knowledge, to gain an understanding of the computing concept, and demonstrate that understanding. Given the C-CAL's system focus on adult learners, though debatable in the larger body of research, adult learner theories such as andragogy (Knowles, 1984) are employed for the design. Thus, factors such as need-to-know (the reason for learning will be presented at the very beginning of the learning module), relevance (the learning module immediate relevance to the learner will be clear), and orientation (the learning module will be presented in a problem centered fashion) must be accounted for in the learning module. The overall goal here is to lower the entry barrier by presenting the system as a low risk, minimum commitment type of a system. In addition, because time is a major factor with the target audience, the required time commitment for the learners also served as an objective of how to structure the material such that the learner will not be deterred from engaging. Finally, delivery medium will remain as an online application, as the C-CAL system is foundationally an e-Learning tool. The analyze phase institutes the basic direction of the learning module, now the design and development of the learning module can commenced.

4.1.2 Design and Development

Each learning module presented to learners follows the learning module template outlined in this design section. In the C-CAL study each experimental module consisted of five pages: 1) Welcome to the study, 2) culture based example (entitled "A Good Day"), 3) the lesson (entitled "Learning a Concept"), 4) the place where both the culture and concept are presented together for one last time, and 5) the page where user turn to demonstrate understanding entitled "Your Turn". The control module follows the same template as the experimental module, with the exception that there is no "Concept Relation" page. The layout of each page will be discussed separately below. The learning modules were developed in php using an sql database.

The introduction page, Figure 7 contains the basic instructions guiding the learner to begin the study, through the learning module and finally to the feedback section. Participants begin the actual study when they click "Begin Study" on the second page.

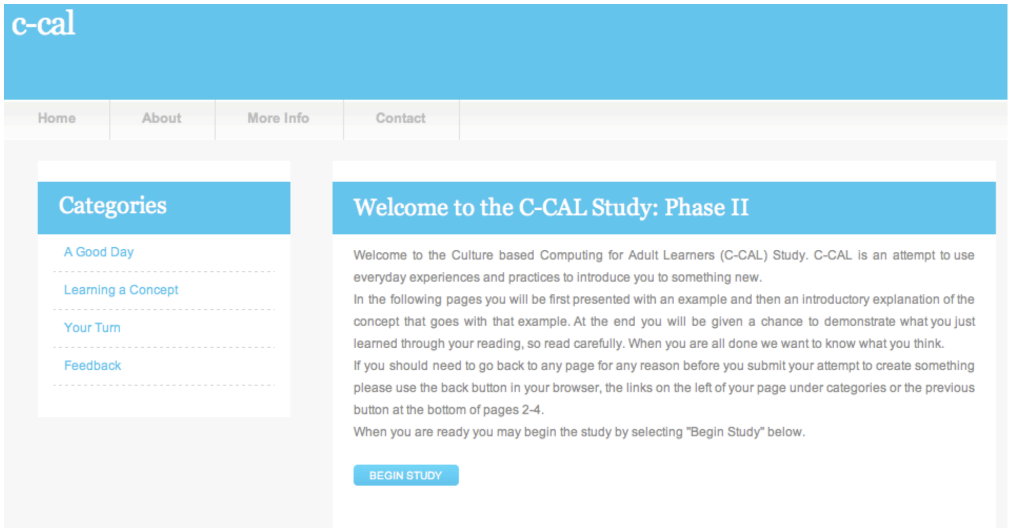


Figure 7: Introduction Page Screenshot

The second page of the module is designed such that it presents an example or a scenario that is comparable to a situation in which the computing concept can be demonstrated or explained. For the purposes of testing C-CAL the control module uses examples and scenarios similar to those presented in Guzdial & Ericson (2006) as seen in Figure 8.

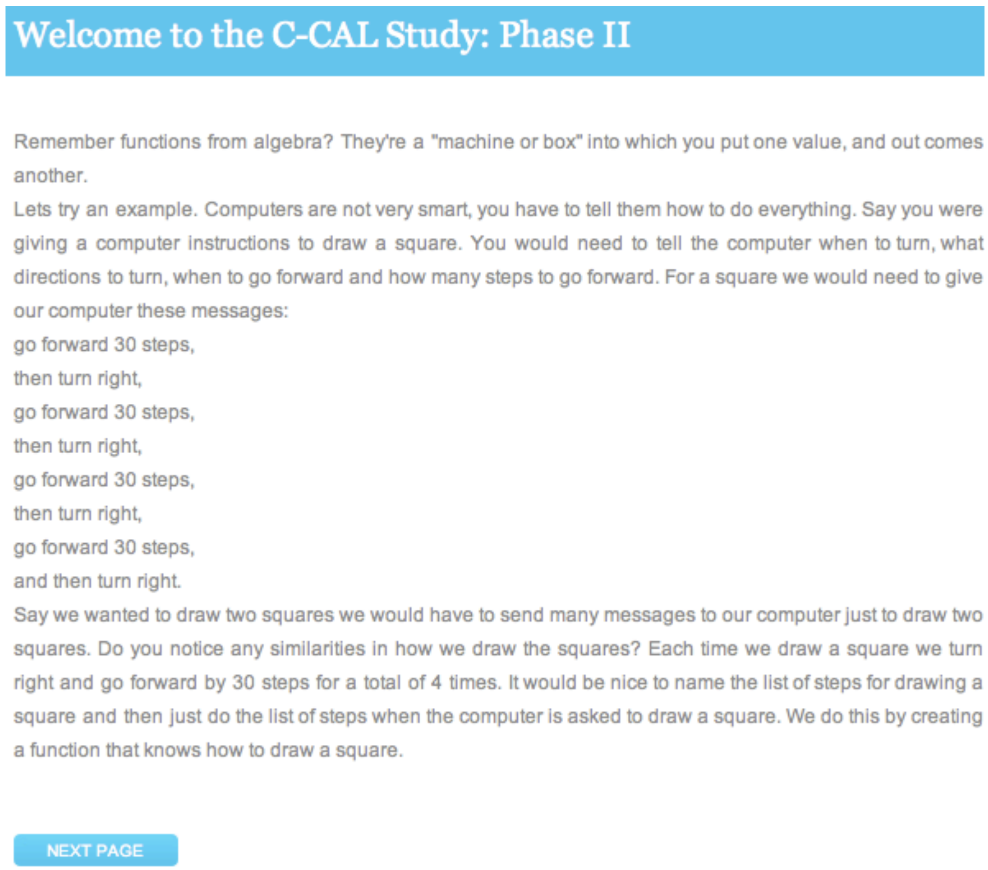


Figure 8: Page 1, Control Screenshot

In the experimental learning modules, the second page is the cultural based example entitled, “A Good Day.” At this juncture, a detailed culturally situated scenario is presented. Our goal here is to initiate the introduction of the computing concept to the learner with what is already familiar, thus lowering the entry gate of this learning process. Each scenario is fashioned around the dominant cluster attribute, for the given cluster that the learner is apart of as seen in Figure 9, where this participant, for example, was placed in the holiday traditions cluster.

Figure 9: Culture Based Example Screenshot

The design of page three of the learning module entails a simplified definition of the computing concept and its characteristics as seen in Figure 10.

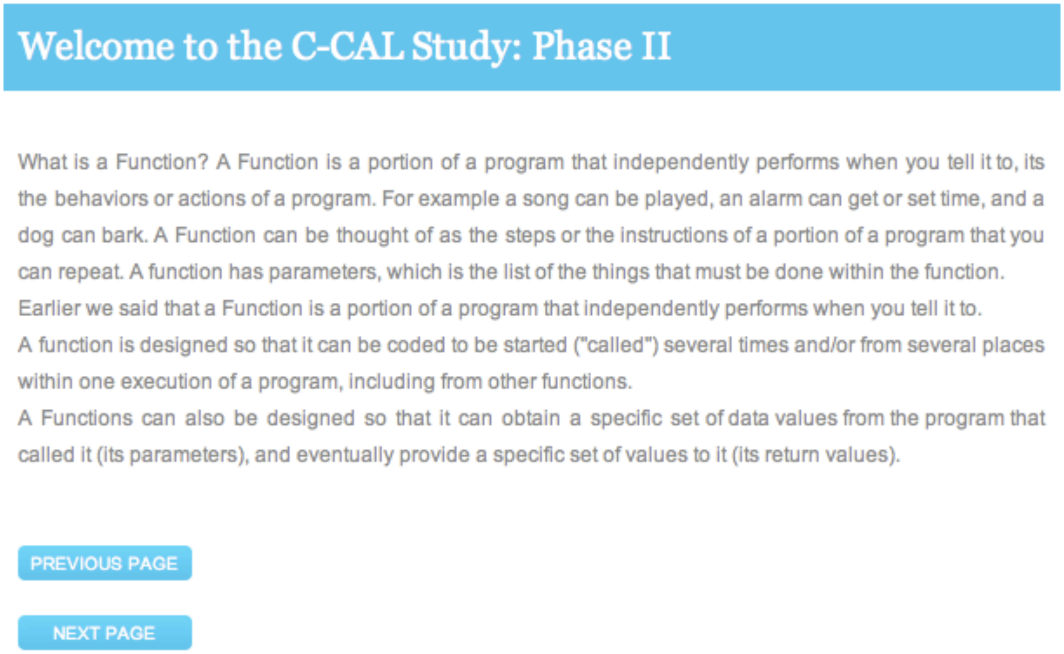


Figure 10: Concept Defined: Control Screenshot

In addition, the C-CAL learning module follows the definition with a recall of the scenario by continuing the culture-based example from page two. Thus, the related computing lesson on page three entitled, “Learning a Concept,” is immediately introduced. This ties into the notion of a new vocabulary. This is done as an effort to show relevance to the learner and ease them into understanding this new concept. Figure 11 demonstrates the same functions concept definition as presented in the control in Figure 10, however it reconnects the idea of a function to that of the gift-wrapping scenario that was previously presented in Figure 9. The definition presented in the module was massaged earlier as discussed in the C-CAL Concepts section. Because C-CAL is focused towards novice learners, and the main goal of building a bridge from their current knowledge of the culture activity depicted on page two of the learning module, to the computing concept introduced on page three, a streamlined, high-level explanation of the computing concept is presented.

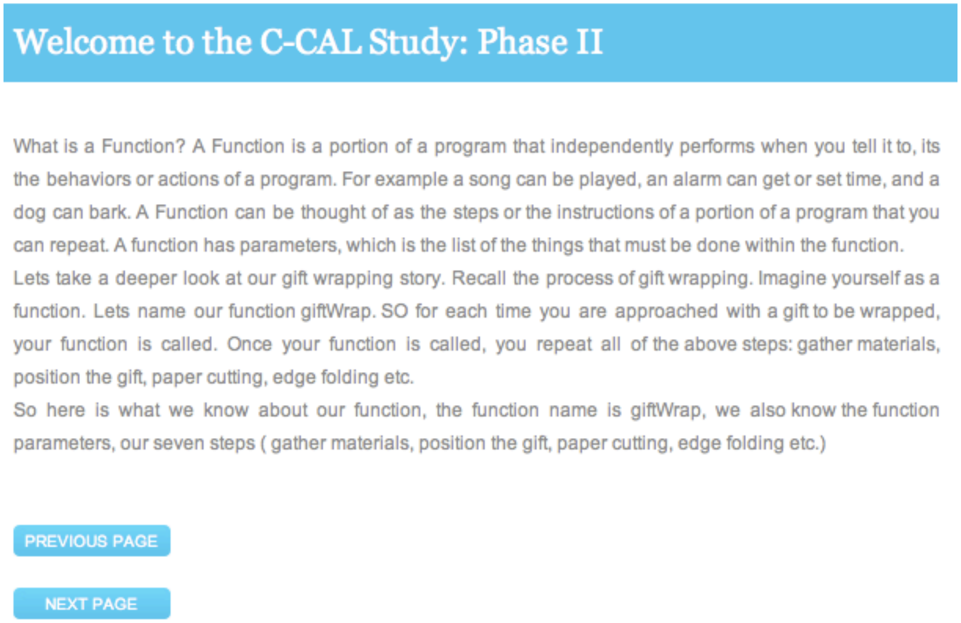


Figure 11: Concept Defined-Experimental Screenshot

At this stage, C-CAL has merely pointed out to the learner that there is a similarity to their knowledge base and this computing concept, and has provided the vocabulary to better understand the concept. Thus, on page three of the learning module more depth is provided to the learner to move them from simply being aware of the concept, to gaining understanding of it and its parameters. Also on this page, an example of the computing concept is offered that continues to draws from the original scenario. This page only exists in the experimental C-CAL learning module and not in the control, as its design is to reinforce the cultural base learning. Figure 12 continues with the introduction of the functions concept presented in the gift-wrapping scenario context. The learner is asked to recall the definition of the concept presented on the previous page. Additional information on the concept is then given to reinforce the definition and solidify its meaning and its characteristics. A final example is presented using the culture concept structured in the fashion of the computing concept.

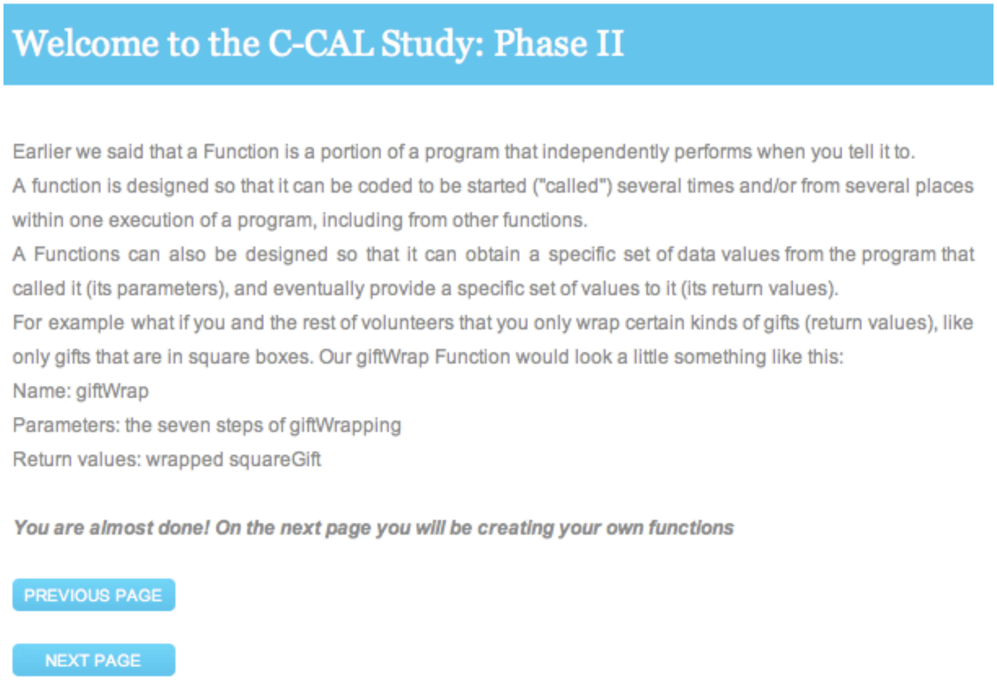


Figure 12: More on Concept in Culture Screenshot

Finally, on the last page entitled, "Your Turn," the learner is challenged to create their own everyday example of the contextualized computing concept and its characteristics they learned on the previous pages to demonstrate understanding. This can be seen in Figure 13. Hints are provided along the way that relate back to what the learner has been exposed to throughout the lesson to help guide them, to serve as a reference and to remind them of the meaning of the new vocabulary they are being asked to create an example around.

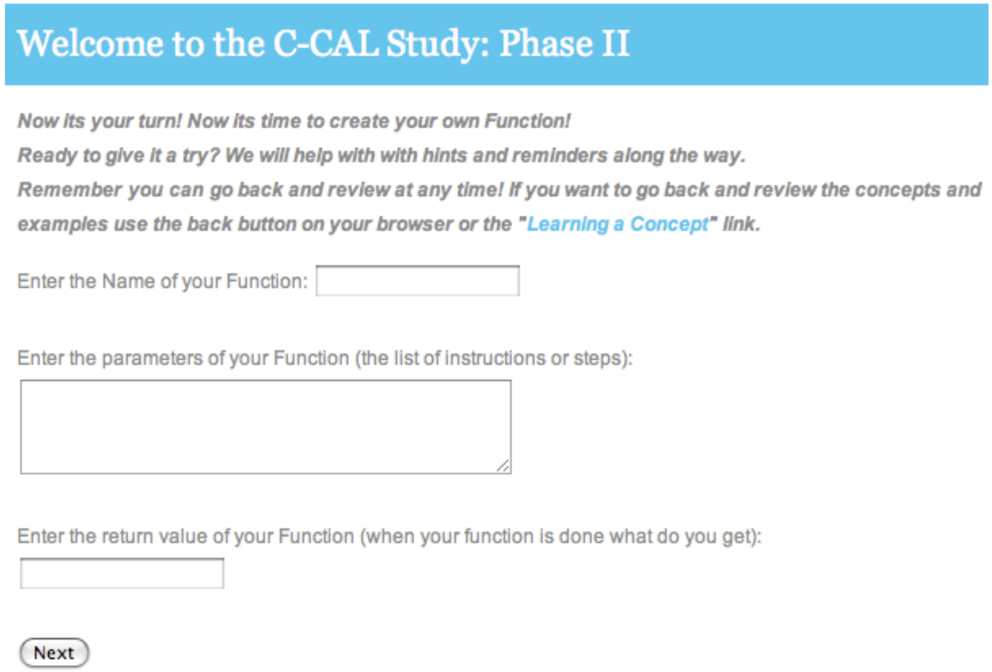


Figure 13:Your Turn Screenshot

4.2 Implementation and Evaluation

For the purpose of this study the C-CAL system will be implemented as within subjects study. As such all participants will use both the control learning module and the experimental C-CAL learning module. Figure 14 flowchart, demonstrates an example of this process. For example, if a participant begins with the experimental learning module they will go through the welcome page, the cultural example, the concept, the chance to demonstrate understanding, a feedback section and then immediately loop through the corresponding pages for the control learning module, and vise versa if they begin alternatively with the control. The C-CAL system doesn't require any training for the learners and because it is an e-Learning support tool, there are no facilitators for the system.

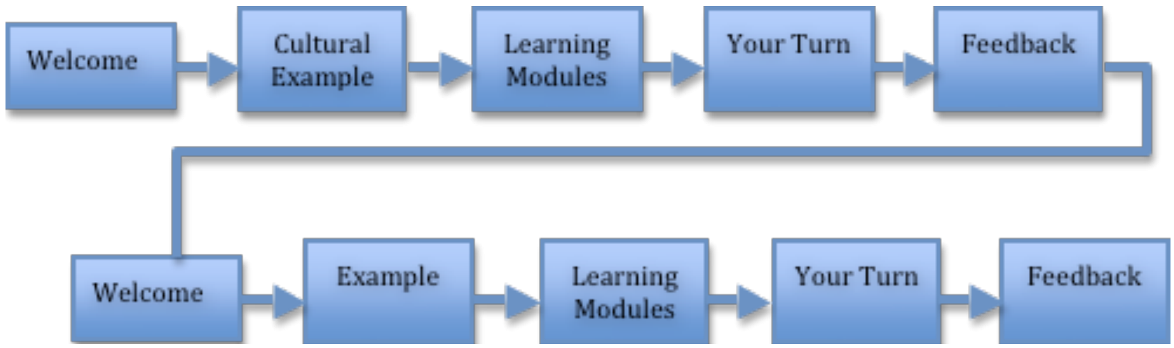


Figure 14: Learning Module Flowchart

Each scenario was fashioned around the dominant cluster attribute, for each given cluster. These attributes reflect the "what they do" portion from the CIF, derived primarily from the sections of industry, hobbies and traditions. Scenarios created around industry were designed to reflect the basic knowledge of someone, in the industry, with no more than a trade school level of education or training. Scenarios derived from the hobbies and traditions culture segments reflect the general culture knowledge that is commonly shared and understood by participants of that activity and that often are understood at a surface level explanation of the activity. Though, in creating the scenarios, the culture cluster attribute was used as the base, and the "who you are" information gathered to frame the scenario. For example, for a participant in the in the cultural activity of golf, golf balls and clubs is understood. After a series of iterative tests and from what is known about our target audience time restraints, the researcher made sure that each scenario was as clear and direct as possible.

4.3 Conclusion

Finally, in creating the learning instruction, using the ontology drawn from the database and based upon the links created, an information retrieval model was used to do a document comparison and create content using the ontology from the identified culture. Within every culture there is a shared ontology, an organizational structure of knowledge, rich with language and vocabulary that is understood by participants of that culture, representing knowledge and the organization of knowledge in a particular domain for problem solving (Merrill, 1999). The researcher believes that culturally relevant software should reflect the ontology of the culture to which it aims to teach. For example, the instructions given should emulate the manner in which instruction is given within the target audience's culture. In the domain of football, if one were designing a piece of software for football players, the instructions would be very brief and concise, without the use of superfluous language, much like the interaction between a football coach and his players. Similarly, the manner in which feedback is given should be representative of the way in which feedback is generally given within the culture of the targeted audience. It is also important that the learning technology makes use of the vocabulary common to the culture of its audience. Furthermore, the learning technology should use a familiar vocabulary when discussing the main ideas, abstract concepts, as well as activities found within the tool. Generally speaking, all spoken or written words within the context of the educational software should also utilize the language conventions practiced by the target audience. The assessment will be designed based on the ontology.

Chapter 5

Experimental Design & Findings

Building from the discussion in Chapters 3 and 4, of the design and the implementation strategies of the C-CAL system, this chapter presents the experimental design used to address the research question, and the findings from the analysis. The research question: "Is culture based learning a feasible option to introduce adults to computing; and does culture based learning enhance the learning experience for adult learners when being introduced to computing concepts?" will be answered by looking to the C-CAL system first via its components, then as a system in its entirety in addressing/answering the research question.

The experiments used in this study assess the design of C-CAL, test and evaluate it as a means for capturing a person's cultural understandings, uses these cultural understandings to construct a learning module teaching culturally relevant computing constraints, and then assesses the usability of the system in its entirety.

The study is designed to gain a better understanding of how one's various silos of knowledge concerning the culture in which he or she participates can be used to enhance their learning experience of computing constraints. Specifically, the purpose of this study is to increase the understanding of how to utilize culture in the design of computing artifacts. Findings from this study are intended to inform computing designers and developers. The data to be analyzed in the study were collected from several iterations of experiments that shaped the development of the final system. This study is a complete analysis of data using both descriptive statistics and inferential analysis.

Each experiment is discussed below, in the context of the research question and the C-CAL system. The experimental design and findings are presented in the format of the approach and the results are followed by the analysis. The approach used will expound upon a hypothesis; the experimental method used; the procedure followed; an overview of the participants and the measures, if a user study was conducted, else, an overview of the design strategy and implementation used to address specific aspects of the research question. This chapter presents the methods used in this research study, the purpose and design of the study, population and sample selection, instrument validity and reliability, and data collection strategies.

Data Collection: Several data collection methodologies were employed throughout this research. A focus group protocol, survey instruments, and a questionnaire were all employed for data collection. Participants were informed before each part of the study of what the study would entail, their rights to withdraw from the study at any time, and the estimated time commitment.

Analysis: Various statistical analyses were employed throughout this body of research, comparable to the data collection used. Descriptive statistics were analyzed using statistical software, such as Microsoft Excel and Statistical Tools, to use for the Kolmogorov-Smirnov test (Kirkman, 1996) to provide a thorough analysis of the data. In addition, all the data received from the focus groups, instruments and questionnaires were then compared and analyzed for any noticeable trends or phenomena originally not accounted for throughout the study and the literature.

Delimitation and Limitation of Study: Though the research produced in this study can be applied to various groups of learners, a delimitation of the study includes those people of color of

African descent, 19 years of age or older, and having limited, advanced, or formal education. The sample population is composed of a range of adult learners from all walks of life. The sample population was selected based upon availability and accessibility of subjects to the researcher and how closely they resembled the target audience.

There are certain limitations to this study. The surveys were dispersed via an online system. The researcher had no control over response time, willingness and accuracy; however, because it is a self-reporting study, an accurate response is assumed. In addition, this delivery method opened the research up to participants that do not fit neatly into the confinements of the target population, thus, adding some variability to the demographics. This method was chosen because it was the most effective for this study. Another limitation that the researcher is aware of, is regarding the data collection method of experiments conducted on the entire system. Participants that complete both parts of the study could reflect the segment of participants that are self-driven and motivated.

5.1 Understanding Culture of Participation (Component1):

In chapter 3, System design section (3.2.1), the use of focus groups was demonstrated and proven to be a viable means to determine the adaptive responses and/or activities that reflect a person's knowledge base as a participant of that cultural practice. By asking adults about their shared experiences regarding their participation within a community of practice, they reveal cultural attributes that provide insight into how they identify themselves as participants of these cultures.

The design of a culturally relevant system depends heavily on the system's ability to identify the culture(s) of which the learner is a participant and how the notion of culture is then fitted onto the learner. Because this body of research employs a definition of culture that is a conjunction of the two more commonly used definitions of culture, there was a need for a tool that reflected a more holistic view of the learner. The challenge of component 1 was how to create such a tool. The replicable process presented in chapter 3 of the creation of the CIF demonstrates how to create such a tool and meet the need. As a result the CIF produces a holistic profile of each learner's culture of participation as provided by the learner.

5.2 Mining for culture (Component 2):

Culture data mining is the second component of the C-CAL system. To validate C-CAL's ability to determine the dominant culture of participation for a group and correlating processes, a validation study was conducted using the CIF to collect participant's information and the Application Quest™ algorithm to analyze the data.

5.2.1 Hypothesis

Application Quest™ is an effective algorithm to accurately determine the dominant culture of participation for a group of CIF users.

Independent variable: Dominate culture determination

Dependent variable: Accuracy of dominant culture participation

5.2.2 Method

The questionnaire methodology of the CIF tool was used to collect participants' information as it provided several benefits. Using the questionnaire methodology, responses are gathered in a standardized way, so questions are more objective. It also allows for faster collection of information from a large portion of a group. The questionnaire methodology also presents a sense of familiarity to most people; it reduces bias because of its uniform question presentation; and allows for easy quick analysis. Thus, the data collected from the questionnaire allows for a snapshot of culture to be depicted by the system that can be easily fed into a cluster algorithm for further analysis.

5.2.3 Procedure and Participants

After obtaining human subjects approval, participants were recruited from Auburn University Comp 1200, which is the introduction to computing course, and Auburn University Human-Centered Computing Lab. Notices of the study were announced to students during their respective class times. Participants were first provided with a link to an information letter that explained the purpose of the study. The link to CIF was located at the bottom of the information letter. Participants were informed that the study would last about 5 minutes. Upon completing the CIF, the data was submitted and entered into the database. The study ran for about a week, just until there were approximately 100 participants. Upon completion of the study, the data was downloaded from the database, uploaded into Applications Quest™, collated, and tabulated.

5.2.4 Measure

Standard statistical data provided little information on nominal data, thus, the researcher relied on Application Quest™ for measuring the data.

5.2.5 Results and Analysis

Overall, the study had 104 participants of which 65% were male, 35%, female. Eighty-one percent said they were in the age range of 19-24, 16% said they were in the age range of 25-34, and 3% were in the age range of 45-54. Regarding ethnicity, participants identified themselves as 79% Caucasian, 17% African American, and 4% Asian. The demographic information for this study is depicted in Table 4.

Table 4: Validation Study Demographic

Demographic Variable	N	%
Gender		
female	36	35.00%
male	68	65.00%
Age		
19-24	84	81.00%
25-34	17	16.00%
45-54	3	3.00%
Ethnicity		
asian	4	4.00%
black	18	17.00%
white	79	79.00%
Education		
coll	74	71.15%
ged	16	15.38%
grad	13	12.50%
Totals	***104***	

Application Quest™ was run on the 104 collected responses. In reviewing the collected data, it was decided to manually regroup attributes, such as hobbies and traditions into buckets, much like clustering methods used in data mining. After reviewing the entries for hobbies and traditions, it was discovered that there were several overlaps. Thus, the researcher decided to condense these separate entries into one larger grouping. For example, several entries included: 'sports', 'football', 'basketball', and 'sports in general'. All such entries were then identified under the larger category of sports. Another example, the entries of 'watching TV' and 'watching movies', was condensed to the category of entertainment. The buckets created for hobbies can be seen below in Table 5. A complete list of all the entries and buckets created based on these entries are in **Appendix D**. A similar approach was taken for the traditions attribute. For the traditions question, the participants entered more of an explanation of what their tradition entailed. For example, one entry would be "Christmas dinner with the family". Observing the entries, the researcher created buckets around the central themes and checked all that apply for each given tradition. Using the example above, holidays, dinner, and family would have been the buckets checked off. The majority of participants in this particular study didn't enter a tradition, and given the amount of variability in the entries, it was not included it in the final analysis.

Table 5: Hobby Bucket

Hobbies	HobbyBucket
crafting	arts
singing	arts
theatre	arts
collector	collector
cars	collector
watching movies	entertainment
watching TV	entertainment
music	entertainment
surfing the web	entertainment
video games	entertainment
swimming	sports
basketball	sports
running	sports
golf	sports
soccer	sports
baseball	sports
tennis	sports
sports	sports
Hunting	sports
hiking	sports
Triathlons	sports

Upon uploading the data to Application Quest™, k the desired number of clusters the responses to be grouped into, had to be determined. As with other clustering algorithms the researcher randomly determines the k-means clustering value. In doing so, the researcher will determine, using trial and error, which k-value is appropriate and will yield the best partitions of n cultures. So several numbers were tried with the goal that the clusters would remain relevant an acceptable result, where irrelevant entries are not grouped or forced together, and that did not result in several clusters all having one entry. Thus, after several runs and trials the k-means clustering value, the number of clusters, was set to nine. k-means clustering value of 9 was chosen because it provided a more logical distribution. For example, k larger than 9 resulted in several clusters with only one entry, however k smaller than 9 produced a cluster that placed well over half of the participants into one cluster. Table 6, below, is a summary overview of the results. There were 84 participants in the age range 19-24, 17 in the age range 25-34 and 3 in the age range 45-54. Fifty-eight partipants identified their computer level as intermediate, 34 as expersts and 11 as novice. When asked where they most frequently use the computer 89 particpants said at home, 8 said at work and 6 said another location. Sixty-four particpants identified the highest-level education obtained at some college, 16 said diploma/GED, and 13 siad graduate or professional degree. Seventy-nine identified their ethnicity as White or Caucasian 18 as Black or African American and four as Asian. Participants were asked about how often they used the internet for personal use 96 participants said daily, 6 said weekly and one no response. Sixty-eight of the partipants identified themselves as males and 36 as females. Participants listed a range of hobbies they participated in, for example 46 participants listed some kind of a sport as a hobby 22 listed some form of entertainment such as watching T.V. or surfing the web, and five participants listed fishing as a hobby.

Table 6: AQ Summary

AU AQ Application Summary (104 applications and 9 clusters)			
Difference Index for all Applications 26.97% Standard Deviation 17			
Difference Index for Recommended Applications 48.07% Standard Deviation of 14			
Age:	19-24 (84)	25-34 (17)	45-54 (3)
CompLevel:	intermediate (inter) (58)	expert (34)	novice (11)
CompUsage:	home (89)	work (8)	another (6)
Education:	some college (coll) (64)	Diploma/GED (ged) (16)	Graduate or professional (grad)(13)
Ethnicity:	white (79)	black (18)	asian (4)
Frequency:	daily (96)	weekly (6)	empty (1)
Gender:	male (68)	female (36)	
Hobbies:	sports (46)	entertainment (22)	fishing (5)

Of the nine clusters, 86 participants fell into clusters one, five, and eight. The dominant attributes of those clusters are depicted in

Table 7 below. Cluster number 5 has 44 applications (Table 8 below). Of the 44 applications, all of them had attributes of age and gender in common while the majority, 50 percent or more, of them had the attributes that indicated where they gained access to a computer (computer usage), how frequently they used a computer (frequency), and ethnicity in common. Clusters 8 and 1 had a similar break down with twenty-two and twenty-one applications, respectively, as can be seen below in

Table 7. Table 8-Table 10 are a summary of each of these dominant clusters produced by Application Quest™.

Table 7: Dominant Attribute

<table>
<tr><th>Cluster</th><th>Number of Applications</th><th colspan="4">Dominate Attributes</th></tr>
<tr><td>5</td><td>44</td><td colspan="2">Age, gender,</td><td colspan="2">Usage, ethnicity, Frequency</td></tr>
<tr><td>8</td><td>22</td><td colspan="2">Usage, frequency</td><td>Gender, level</td><td>Age</td></tr>
<tr><td>1</td><td>20</td><td>Frequency</td><td colspan="2">Level</td><td>Gender</td></tr>
</table>

Table 8: Cluster 5 Summary

Cluster 5 Summary (44 Applications)			
Difference Index for this Cluster 9.22% Standard Deviation 8			
Age:	19-24 (44)		
CompLevel:	inter (37)	novice (5)	expert (2)
CompUsage:	home (41)	another (3)	
Education:	coll (30)	GED (8)	AS (6)
Ethnicity:	White (42)	Black (1)	Hispanic (1)
Frequency:	daily (41)	weekly (3)	
Gender:	male (44)		
Hobbies:	sports (27)	fishing (4)	entertainment (3)

Cluster 5 profile depicts primarily white males, ranging in ages of 19-24, that utilize the internet for personal use daily from home that consider themselves regarding internet usage, as “intermediate;” and in which more than half of them identified sports as a hobby. Also in cluster five, understanding the homogeneity of the group and that the majority of the study’s participants were recruited from an undergraduate course populated by majority freshmen and sophomores, one can also determine that the difference in the “highest level of education attained” depicted in this group can be really a matter of perspective. The highest levels of education attained in this group were “some college”, high school diploma/GED, and associates degree. These categories were separated to allow for a variation in description to provide participants with a variety of options as to how they view their academic level, however, for this body of research they will be viewed as similar and grouped together. This is done because the participants from this study were primarily college freshman and sophomore, thus, their prior education is considered similar. For example, the options of “some college” and “having obtained an associates degree” can be viewed as one and the same for participants. Thus, reducing the variability and further displaying cluster five as comprised of participants with very similar dominate cultures of participation.

Cluster 8 profile depicts primarily white females, ranging in ages of 19-24, that utilize the internet for personal use daily from home that consider themselves, in regards to internet usage as “intermediate”. Thus, cluster eight is similar to cluster five with one major difference, gender. Cluster 8, gender population is majority female. Much like cluster 5, there is a similarity in education in that the two dominant selections for highest education attained were “some college” and high/GED which can, once again, based on prospective of the participant, be reduced to being one in the same, especially in regards to the participants in this clusters whose selection for highest education attained were graduate or professional degree.

Table 9: Cluster 8 Summary

Cluster 8 Summary (22 Applications)			
Difference Index for this Cluster 12.25% Standard Deviation 9			
Age:	19-24 (20)	25-34 (1)	45-54 (1)
CompLevel:	inter (21)	novice (1)	
CompUsage:	home (22)		
Education:	coll (14)	GED (5)	grad (2)
Ethnicity:	White (17)	Black (3)	Asian (2)
Frequency:	daily (22)		
Gender:	female (21)	male (1)	
Hobbies:	entertainment (7)	sports (6)	traveling (3)

Cluster 1 profile depicts primarily white males, ranging in ages of 19-24, that utilize the Internet for personal use daily from home, that consider themselves regarding internet usage as "expert". Thus, cluster 1 is similar to cluster 8 with one major difference, the participant's perceived level expertise of Internet usage. The majority of participants within cluster one consider their level of expertise regarding Internet usage as "expert".

Table 10: Cluster 1 Summary

Cluster 1 Summary (20 Applications)			
Difference Index for this Cluster 13.98% Standard Deviation 10			
Age:	19-24 (17)	25-34 (3)	
CompLevel:	expert (19)	novice (1)	
CompUsage:	home (17)	another (2)	work (1)
Education:	coll (15)	GED (3)	grad (2)
Ethnicity:	White (15)	black (3)	asian (1)
Frequency:	daily (20)		
Gender:	male (18)	female (2)	
Hobbies:	entertainment (8)	sports (8)	dancing (1)

5.2.6 Conclusion

The clusters produced by Applications Quest™ provide an accurate and efficient way to capture the dominant cultures of participation. The efforts of determining dominant cultures of participation are normally determined after extensive ethnography studies. Which entails a researcher conducting fieldwork while living like those they are studying usually for a year (Genzuk, 2003). Though valuable are the findings and discoveries of such fieldwork regarding a deeper understanding of a given culture, this process isn't always feasible. Application Quest™ within the C-CAL system provides a similar conclusion to that of an ethnographic study would have reached requiring much more time and effort. Thus, AQ tremendously aids in the effort to capture the same essence of a learner in a quantitative approach. In this very basic study it was easy to see and draw logical conclusions regarding each cluster. In running Application Quest™, industries and traditions were excluded in the specified attributes to simplify the data analysis. The similarities were so few they did not contribute to the clusters.

5.3 Culture Dyads (Component 3):

Using the dominate culture clusters provided from component 2, culture dyads, are formed as prescribed by the design of component 3. Here a demonstration of is provided of the use of component 3 for the matching of culture processes to the corresponding processes of computing concepts.

5.3.1 Hypothesis

A culture process can be correlated to one or more computing concept.

Independent variable: Culture & Computing concept

Dependent variable: culture processes, correlation between culture & computing concept

5.3.2 Method

The method used to match the culture and computing concept will follow the steps prescribed in the system design chapter. Thus, by seeking out the tasks, steps, purpose, procedures, objectives, and goals of the culture concept found within culture practices as related to the computing concept the correlations between culture and computing will be made.

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5.3.3 Procedure and Participants

In this initial design of C-CAL, the matching of culture processes and computing concepts will be done manually. The dominant culture processes produced from the database will be researched to discover parallel phenomena concepts, logic, etc. to that of the computing concepts. Ideally, the procedure for this method will flow closely to that of Information Retrieval. Information Retrieval (IR) is the process in which the information retrieval system responds to a request by presenting documents to the patron in a sequence, gathering feedback as the process proceeds, and using this information to modify future retrieval presenting a means to capture expressed information and text collection (Bookstien, 1983). IR's two main components, indexing and query processing, allows for an effective means for an independent search of documents and subdocuments. Gauging the information needed via an entered query, IR attempts to make decisions regarding document relevance, thus, dictating the appropriate action (Bookstien, 1983). Indexing, mostly done by an inverted list, enables fast access to a list of documents containing a term (Singhal, 2001). The probabilistic model of information retrieval, as discussed by Singhal (2001), ranks documents in a collection by decreasing probability of their relevance to a query based on the estimated probability of relevance. Probability of relevance for a document D is denoted by P(R|D). The Bayesian approach to IR uses the probabilistic IR model and applies Bayes' Law. This approach circumvents the shortcomings of the probabilistic model, by requiring an alternative method to produce the initial document ranking for the relevance judgment for the current query to estimate its parameters as discussed by Keim, Lewis & Magidan (1997). The Bayesian approach is able to produce an initial document ranking without relying on alternative retrieval methods or ad-hoc considerations, using the same model both before and after relevance feedback data is available, and allows for incorporation of relevance feedback information from other queries. Future works of C-CAL will entail the automation of this portion of the tool.

5.3.4 Measure

The actual deliverables will themselves serve as the measure, thus, providing a yes or no to the feasibility of this question.

5.3.5 Results and Analysis

Using the method indicated above, the cultures were correlated with the given concepts and formulated examples/scenarios bridging the two notions. Table 11 below demonstrates some of the correlations that were formed. These correlations or links/matches were made across hobbies, traditions, and industries. A more thorough list can be found in **Appendix E.**

Table 11: Sample of Correlated Culture and Concept

Culture Name	Link	Concept	Example
music	play-list	objects	It’s a nice day and you just got some new music to add your computer. You figured this would be a good time to create a new play-list. So you sort all your music by title and gather your favorite tracks that will give you the sound you are seeking for this play-list. Then you sort your music by rhythm and search through and see what other songs in your collection would be a good fit. You want one more short song to add your play-list so then you search through your list of songs my time periods. Your play-list is just about done. Now its time to put it to the test.

training	preparing to teach a training class	functions	Its a nice day and a friend is in need of your expertise to help him prepare to present his first training class. You carefully explain and demonstrate the detailed process of preparing the lesson, gathering and sorting the material, creating handouts, and creating visual aids. Finally, you are done, and your friend seems to be ready to start his first training class. Now, its training day, and all we have to do is wait, for the trainee's to arrive.
shopping	looking for something in a store	variables	It was a nice day. You are out shopping. Suddenly, something caught your eye. It is an ad for a Big screen LCD TV on sale for only $200. Imagine entering the very large store with lots of departments, tables, shelves, etc. All these places have different things stored in them. You head to the department for your Big screen LCD TV. Once you find the right department, you have to find the type that was on sale.
golf	golf balls	objects	Its a great day for golf, and a friend has asked you to help them learn the basics. As you make your way across the green you start off by explaining some basic golf fundamentals the difference in golf clubs, golf balls, varying golf holes, while using examples that include known golf players and commonly known golf concepts. You make it over to the first hole, after a couple of demonstrations, you guide them through their first swing.
server	training a trainee	functions	Its a nice day and you are heading into work at the restaurant today, they just hired a new server and asked you to train him. You carefully explain and demonstrate the detailed process of a servers responsibility of explaining the menu to the customer, taking the customer's order, and delivering the customer's meal from the chef. Finally the training session is over, and the new server seems to be ready to start serving the customers. Now all we have to do is wait, for them to arrive.

5.3.6 Conclusion

Using the process designed and outlined in this body of research, culture concepts and computing concepts were successfully linked. Thus, demonstrating the feasibility of creating such dyads and concluding on a method to correlate culture to computing.

5.4 Creating culture based learning modules (Component 4):

The use of culture data mining for the creation of culture based learning modules uses the dyads of component 3 to facilitate creating tailored lessons as discussed in the design of component 4. The creation of culture based learning modules using the above-mentioned components is demonstrated below.

5.4.1 Hypothesis

A tailored lesson based on the correlated matches of the culture processes and computing concepts can be manifested.

Independent variable: culture

Dependent variable: correlated matches, lessons

5.4.2 Method

Basic modules were designed around these matches to reflect the computing concept to be learned. Thus, there will be template lessons for each of the computing concepts with portions that can be interchanged to personalize the learning experience. Drawing from the database, which will store the ontology derived from the focus group and the additional ontology entered in the CIF, methods derived from the Wizard of Oz study will be used, to match the ontology of the participant in the portions of the template lesson to create the tailored lessons.

5.4.3 Procedure and Participants

The procedure for creating the learning modules followed the five phases to designing eLearning instruction: Analyze, Design, Develop, Implement, and Evaluate as discussed in the system design chapter.

5.4.4 Measure

The actual deliverables will serve as the measure, thus providing a yes or no to the feasibility to this question.

5.4.5 Results and Analysis

Using the correlated matches of the culture attributes and computing concepts, along with the method discussed above, learning modules/lessons were successfully created, which were accessed as web pages online. The modules were broken down into four or five pages (the experimental module contained one more page than the control). The first page of the modules began on with a culturally situated example that demonstrated an idea, process, or notion that is understood within the given culture, but also demonstrated the computing concept. On the next page, using the module template, a very basic overview of the computing concept is introduced in hopes to lay the foundation for the learner. On the same page, immediately after the introduction of the computing concept, the previously culturally situated presented example is recalled. This is done in hopes to assist the learner to situate this new knowledge in their mental model as it pertains to their already understood and accepted understanding of their culture activities (see Figure 15). The next page, with additional basic details of the computing concept, provides a more in-depth understanding of the concept. Also provided, is an additional example situated within the same culture scenario that was originally introduced but presented in the fashion, naming the attributes of the concept (see Figure 16).

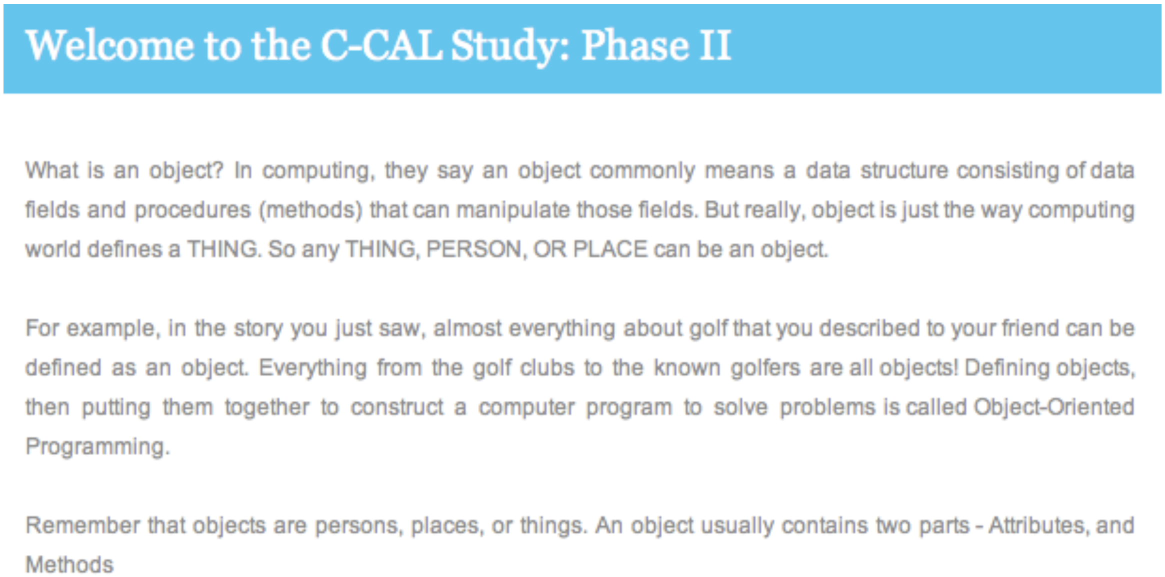

Figure 15: Learning Module Sample Page 1

Welcome to the C-CAL Study: Phase II

Earlier we said that THINGS are what we in the computing world call objects.
Attributes describe the 'thing' characteristics. So attributes can be a name, size, style, type, etc
Methods describe what 'things' can do. In many ways, your method is your objects behavior like cars-drive, and dogs-bark. So methods can be *actions* that the 'thing' can do, OR that can be done on it.
Example:
Golfer object: (Name: Jack)
With attributes: (gender: male, female) (status: pro, amateur) (handicap: (0, 15, 30..))
With methods: (can swing) (can walk) (can putt) (can change clubs)

Another example of an object would be a golf ball.
Example:
Golf Ball object: (Manufacture: Titleist, Pinnade)
With attributes: (color: white, yellow) (compression: 80, 90, 100)
With methods: (can be marked) (can spin)

You are almost done! On the next page you will be creating your own object

You are almost done! On the next page you will be creating your own objects

Figure 16: Learning Module Sample Page 2

5.5 Enhancing the learning experience of adult learners when being introduced to computing concepts

5.5.1 Data Collection

To initiate the study, potential participants were provided a link via email or a message sent directly to them via Facebook, a social network site, which connected them directly to the information letter. At the bottom of the information letter another link was provided to the Culture Inquiry Form (CIF). Participants were asked to complete the form in its entirety. Participants were told that the purpose of the form was to obtain demographic information and some basic information regarding hobbies, traditions, and industries they have worked in previously. An approximate time commitment of less than five minutes was also mentioned. Additional instructions regarding part two of the study was also provided. The initial groups were told they would receive a link via email to part two of the study a week later. This was due to having to populate the database before the initial clusters could be run. The time frame for later participants was drastically reduced because the links for part two were then available within hours. Participants were informed that the purpose of the lesson was to introduce them to a computer concept. Finally, approximate time commitment of the second portion of the study was approximated to being about 15 minutes.

5.5.2 Method

Study participants for this portion ranged in age, gender, and education background (see Table 12: Full Study Demographics). Female participants accounted for more than 63% of this study, of which 46% ranged in the age of 25-34 years of age. African-Americans accounted for more than 62% of all participants. Over 66% of the participants reported their education level as ranging from some college to an associates degree.

Table 12: Full Study Demographics

Demographic Variable	N	%
Gender		
female	51	63.75%
male	29	36.25%
Age		
19-24	20	25.00%
25-34	37	46.25%
35-44	10	12.50%
45-54	5	6.25%
55-59	4	5.00%

60-64	3	3.75%
65-74	1	1.25%
Ethnicity		
asian	3	3.75%
black	50	62.50%
hispanic	5	6.25%
other	1	1.25%
white	21	26.25%
Education		
AS	22	27.50%
BS	15	18.75%
coll	31	38.75%
ged	9	11.25%
grad	3	3.75%
Totals	***80***	

5.5.3 Control Treatment

The control treatment for this study represents traditional instructions used for introduction to computing. One of the challenges for this task was the lack of resources available that focused on the targeted audience. The majority of the introduction to computing materials the researcher came across was geared towards traditional students enrolled in a degree seeking program at an institution of higher learning, or assumed that the user has some computing background prior to beginning the lessons. Thus, the researcher sought a control treatment with claim and purpose for a similar type target audience, geared towards learners that have no prior computing experience. For this reason, the researcher was lead to selecting Mark Guzdial and Barbara Ericson's (2006) "Introduction to Computing and Programming in Java: A Multimedia Approach" as the control treatment. Though this text was designed for use in an institution of higher learning, it contains a core focus on introducing computing and programming to novice learners culturally situated in a multimedia context. Thus, it appeared to be the best-case scenario in a selecting a tool to compare to C-CAL that had, generally speaking, a related method to reach a comparable audience.

5.5.4 System design to support system usability for adult learners

5.5.4.1 Hypothesis

The learners will deem the design of the system as being usable in respect to usability.

Independent variable: culture

Dependent variable: usability factor

5.5.4.2 Method

After participants navigate through the C-CAL system, they are directed to a feedback page. The participants were asked to provide their feedback for the C-CAL system, in which questions on the usability of the system are explored. The Technology Acceptance Model (TAM) was adapted to determine the perceived ease of use and the perceived usefulness of the C-CAL system to gauge usability. TAM is frequently used in information systems research to gauge users perception towards accepting and using technology (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Gao, 2005). Derived from psychology research of Theory of Reasoned Actions (TRA), TAM proposes that perceived ease of use and perceived usefulness of technology are predictors of user attitude toward using the technology, subsequent behavioral intentions, and actual usage (Gao, 2005). Perceived usefulness (PU) is defined by Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989)". Davis defines perceived ease-of-use as the degree to which a person believes that using a particular system would be free from effort. TAM has been used in a variety of studies. In this study, TAM is used to assess the C-CAL system in its purpose of delivering information to and interacting with the user through a computer interface.

The instrument was designed so that it measured the perception towards the use of the C-CAL system. The questionnaire, written in English, is adapted from the questionnaires of Davis (1993). The primary modification was the rewording of the question items and reducing the number of items to five items per construct. Items were removed that were not directly applicable to this proof of concept of the C-CAL system and that did not reflect the overall goal of the instrument. Several items in the original Davis questionnaire (1993) were in regards to the participant's perception of the tool in relation to their jobs. All such questions were removed in the adapted version employed. These questions were seen as irrelevant to the study. All the items utilized a five-point Likert scale ranging from "strongly agree" to "strongly disagree" with a middle neutral point.

5.5.4.3 Procedure & Participants

Upon completion of the learning module, the participants were redirected to a survey hosted by Survey Monkey™ where they were provided with five questions regarding perceived usefulness and five questions regarding perceived ease of use. They were asked to fill out the survey to provide a subjective evaluation of the system performance. Because the study is based on a within study design, if participants conduct the experimental version of the study first, they are directed to the survey to provide feedback and then redirected to the control version of the study, and finally another feedback page for the control version. This occurs in reverse if the participant begins with the control version first.

5.5.4.4 Measure

Descriptive statistics, such as the mean, the standard deviation, and the range, were collected from the survey. Cronbach's alpha was used to measure the reliability of the instrument. Further inferential statistical analysis was conducted by using the t-test and the Kolmogorov-Smirnov test (K-S-test) analysis to determine if a statistical difference exists between the control and experimental groups of the study. The t-test assesses whether the means of two groups are statistically different from each other. The K-S test is a nonparametric test, which makes no assumption about the distribution of data, for the equality of continuous one-dimensional probability distributions (Kirkman, 1996). The K-S test quantifies a distance between the maximum vertical deviation of the two cumulative proportion or curve of the treatment versus the control, as the statistic D. Given the statistic D, a P-value is also able to be determined, which is ultimately use to determine if there is a statistical significance between the treatment and control group by evaluating the distributions considered under the null hypothesis.

5.5.4.5 Results & Analysis

After removing all erroneous and incomplete entries from the data set, the data was organized for analysis. The remaining thirty complete entries were assessed and are summarized below.

5.5.4.5.1 Perceived Usefulness

Respondents were asked via five items how useful they perceived the C-CAL system. Below, their response of the experimental treatment (Table 13) is compared to that of the control treatment (Table 14).

a. On average, responses for question one revealed that 86.7% and 76.6% of participants of the experimental treatment and of the control strongly agreed or agreed that they found the program useful, respectively.

b. On the second question, "using this program would make it easier to learn computing concepts," 90% and 83.3% of participants of the experimental treatment and of the control, respectively, strongly agreed or agreed that they found the program useful.

c. On the third question, "this program appears to do everything I would expect it to do," 80% and 73.3% of participants of the experimental treatment and of the control, respectively, strongly agreed or agreed that they found the program useful.

d. On the fourth question, "using this program would enhance my effectiveness in learning computing concepts," 86.6% and 76.6 of participants of the experimental treatment and of the control, respectively, strongly agreed or agreed that they found the program useful.

e. On the final question, "This program would make the things I want to accomplish easier to get done," 90% and 76.6% of participants of the experimental treatment and of the control, respectively, strongly agreed or agreed that they found the program useful.

Table 13: Perceived Usefulness Experimental Results

EXPERIMENTAL								
PERCEIVED USEFULNESS								
Answer Options	Strongly Agree		Agree		Neutral	Disagree	Strongly Disagree	Response Count
I found this program useful	**15**	**50.0%**	11	36.7%	4	0	0	30
Using this program would make it easier to learn computing concepts	**16**	**53.3%**	11	36.7%	2	1	0	30
This program appears to do everything I would expect it to do.	**14**	**46.7%**	10	33.3%	6	0	0	30
Using this program would enhance my effectiveness in learning computing concepts	**13**	**43.3%**	**13**	**43.3%**	3	1	0	30
This program would make the things I want to accomplish easier to get done.	**14**	**46.7%**	13	43.3%	3	0	0	30
							answered questions	**30**
							skip questions	**0**

Table 14: Perceived Usefulness Control Results

CONTROL								
PERCEIVED USEFULNESS								
Answer Options	Strongly Agree		Agree		Neutral	Disagree	Strongly Disagree	Response Count
I found this program useful	10	33.3%	**13**	**43.3%**	6	1	0	30
Using this program would make it easier to learn computing concepts	10	33.3%	**15**	**50%**	4	1	0	30
This program appears to do everything I would expect it to do.	9	30.0%	**13**	**43.3%**	7	1	0	30
Using this program would enhance my effectiveness in learning computing concepts	10	33.3%	**15**	**43.3%**	4	1	0	30
This program would make the things I want to accomplish easier to get done.	11	36.7%	**12**	**40.0%**	6	1	0	30
							answered questions	**30**
							skip questions	**0**

At first glance, the initial findings of perceived usefulness show there is little to no difference between respondents' perception of the experimental treatment and the control. There appears to be a slight preference for the experimental treatment, however, it is not clear if there is a statistical difference, thus, an additional analysis was conducted. Table 15 displays the mean, the standard deviation, and the minimum and maximum of the experimental treatment and the control treatment and the results of the performed t-test. Assuming the null hypothesis, the probability of this result is 0.184. Using the conventional significance p- value of 0.05 we are unable to reject the null hypothesis, thus, indicating there is no statisical difference between the experimental treatment and the control for perceived ease of use.

Table 15: PU Analysis

PU	
N	30
Exp PU Mean	8.333
Con PU Mean	9.567
Exp PU SD	3.437
Con PU SD	3.664
Exp PU Max	17
Con PU Max	20
Exp PU Min	5
Con PU Min	5
Exp PU Range	12
Con PU Range	15
t-test=	0.184

The t-test assumes normal distribution. Given the increase risk of error with a t-test on non-normal distributions and when datasets are not sufficiently large a K-S-test was also conducted. The K-S-test was conducted on each question that pertained to perceived usefulness. In addition, it was conducted on the sum of the responses of each question. In conducting the K-S-test it is confirmed that both datasets do not show a normal distribution. Table 16 shows the statistic D and the corresponding p-value for each question regarding perceived usefulness and the statistic D and corresponding p-value for the sum of each question. The p-values for each of the K-S-tests conducted are all well above the conventional significance value of 0.05. The results of the K-S-test of each question and of the sum of questions confirm the t-test findings and the initial assumption of no significant difference between the experimental treatment and the control. Figure 17 shows the cumulative fraction plot that displays how the data is distributed.

Table 16: PU K-S-Test Results

PU	D	P-value
I found this program useful	0.1667	0.7600
Using this program would make it easier to learn computing concepts	0.2000	0.5370
This program appears to do everything I would expect it to do.	0.1667	0.7600
Using this program would enhance my effectiveness in learning computing concepts	0.1000	0.9970
This program would make the things I want to accomplish easier to get done.	0.1333	0.9360
SUM	0.1667	0.76

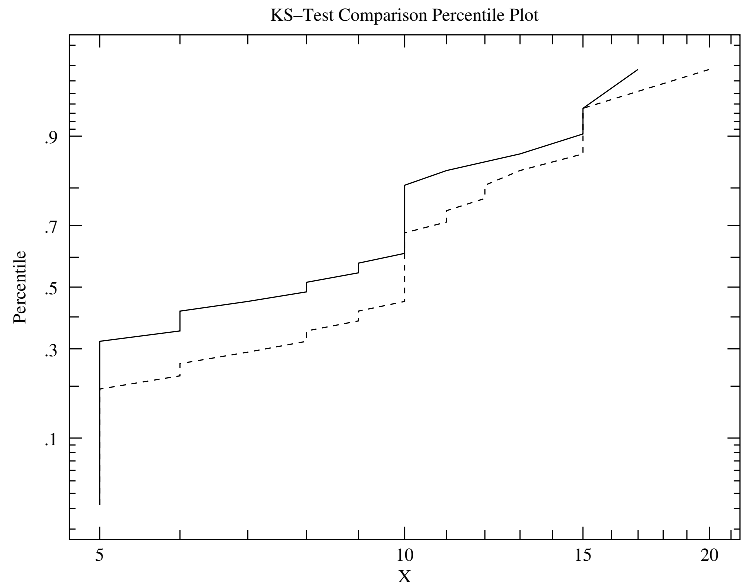

Figure 17: PU K-S-Test Plot

5.5.4.5.2 Perceived Ease of Use

Respondents were asked via five items to express their perceived of ease of use of the C-CAL system. Below, their response of the experimental treatment (Table 17) is compared to that of the control (Table 18).

a. On average their responses for the first question "Learning to use this program would be easy to me," 90% and 83.3% of participants of the experimental treatment and of the control strongly agreed or agreed that they found the program useful respectively.

b. On the second question, "I would find it easy to get this program to do what I want it to do," 83.3% and 80% of participants of the experimental treatment and of the control, respectively, strongly agreed or agreed that they found the program useful.

c. On the third question, “My interaction with this program would be clear and understandable,” 90% and 83.3% of participants of the experimental treatment and of the control strongly agreed or agreed that they found the program useful, respectively.

d. On the fourth question, “It would be easy for me to become skillful at using this program,” 96.6% and 83.3% of participants of the experimental treatment and of the control, respectively, strongly agreed or agreed that they found the program useful.

e. On the final question, “I would find this program easy to use,” 83.3% of participants of the experimental treatment and of the control, strongly agreed or agreed that they found the program useful, respectively.

Table 17: Perceived Ease of Use Experimental Results

EXPERIMENTAL								
PERCEIVED EASE OF USE								
Answer Options	Strongly Agree		Agree		Neutral	Disagree	Strongly Disagree	Response Count
Learning to use this program would be easy for me	**17**	**56.7%**	10	33.3%	3	0	0	30
I would find it easy to get this program to do what I want it to do	**16**	**53.3%**	9	30.0%	5	0	0	30
My interaction with this program would be clear and understandable	12	40.0%	**15**	**50.0%**	3	0	0	30
It would be easy for me to become skillful at using this program	**19**	**63.3%**	10	33.3%	3	0	0	30
I would find this program easy to use	**14**	**46.7%**	11	36.7%	5	0	0	30
answered questions								**30**
skip questions								**0**

Table 18: Perceived Ease of Use Control Results

CONTROL								
PERCEIVED EASE OF USE								
Answer Options	Strongly Agree		Agree		Neutral	Disagree	Strongly Disagree	Response Count
Learning to use this program would be easy for me	**15**	**50.0%**	10	33.33%	5	0	0	30
I would find it easy to get this program to do what I want it to do	**13**	**43.3%**	11	36.67%	6	0	0	30
My interaction with this program would be clear and understandable	**13**	**43.3%**	12	40.00%	5	0	0	30
It would be easy for me to become skillful at using this program	**13**	**43.3%**	12	40.00%	5	0	0	30
I would find this program easy to use	**13**	**43.3%**	12	40.00%	5	0	0	30
							answered questions	**30**
							skip questions	**0**

There appears to be a bit more variability between the experimental treatment and the control of the perceived ease of use compared to that of perceived usefulness judging by the projections of the initial tables. Though there appears to be more of a range within the individual questions regarding percentage, the majority of the respondents seem to favor both systems equally. Additional analysis is conducted to determine if there is a significant difference between the two groups. Table 19 displays the mean, the standard deviation, and the minimum and maximum of the experimental treatment and the control and the results of the performed t-test.

Table 19: PEOU Analysis

PEOU	
N	30
Exp PEOU Mean	8.1
Con PEOU Mean	8.633
Exp PEOU SD	3.294
Con PEOU SD	3.615
Exp PEOU Max	15
Con PEOU Max	15
Exp PEOU Min	5
Con PEOU Min	5
Exp PEOU Range	10
Con PEOU Range	10
t-test=	0.553

Assuming the null hypothesis, the probability of this result is 0.553. Using the conventional significance value of 0.05, we are unable to reject the null hypothesis, thus, indicating there is no statistical difference between the experimental treatment and the control for perceive ease of use.

The t-test assumes normal distribution. Given the increase risk of error with a t-test on non-normal distribution and when datasets are not sufficiently large, a K-S-test was also conducted. The KS-test was conducted on each question pertaining to perceived usefulness. In addition, it was conducted on the sum of the responses of each question. In conducting the KS-test, it is confirmed that both datasets do not show a normal distribution.

Table 20 show the statistic D and the corresponding p-value for each question and the statistic D and corresponding p-value for the sum of each question. The p-values for each of the KS-tests conducted are all well above the conventional significance value of 0.05.

Table 20: PEOU K-S-Test Results

PEOU	D	P-value
Learning to use this program would be easy for me	0.0667	1.0000
I would find it easy to get this program to do what I want it to do	0.1000	0.9970
My interaction with this program would be clear and understandable	0.0667	1.0000
It would be easy for me to become skillful at using this program	0.1333	0.9360
I would find this program easy to use	0.0333	1.0000
SUM	0.1000	0.997

The results of the KS-test of each question and of the sum of questions confirm the t-test findings and the initial assumption of no significant difference between the experimental treatment and the control. Figure 18 shows the cumulative fraction plot, which displays how the data is distributed.

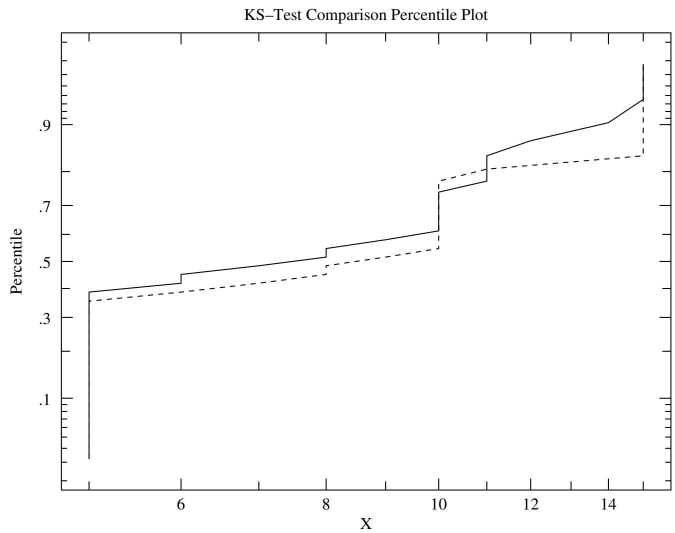

Figure 18: PEOU K-S-Test Plot

The solid line represents the data for the experimental treatment and the dotted line represents the data for the control treatment responses. Using a logarithm scale for the x-axis it is clearer to see where the majority of the data is positioned. PU in Figure 17 appears to show more of a non-normal distribution than PEOU in Figure 18. Both plots confirm previous findings of no statistical difference between the two treatment groups.

5.5.5 Demonstrating cognitive understanding

5.5.5.1 Hypothesis

The participants will be able to immediately apply their knowledge by constructing their own culturally based example of the computing concept they just learned.

5.5.5.2 Method

The participants will be required to create an example of the computing concept covered in the given lesson with all its parameters.

5.5.5.3 Procedure & Participants

After participants engage in the learning experience via the learning module they are given an opportunity to demonstrate their knowledge. Given a definition, description, and example of the computing concept, the participant created their own example. Participants in this study were recruited from online via email or media groupings such as Facebook. This study targeted adult learners with limited to no classroom experience beyond a high school diploma and/or those removed from engaging in the learning process during the course of the technology age.

5.5.5.4 Measure

Bloom's Taxonomy was applied to assess the results of the examples generated by the participants in the C-CAL portion entitled "Your Turn." The results were coded using the top level of the cognitive process dimension, based on Thompson et al (2008) categories of the revised taxonomy, to assess participants' demonstrated understanding of the material they just learned. The cognitive process dimension across the top of the level consists of six levels defined as Remember, Understand, Apply, Analyze, Evaluate, and Create (Forehand, 2005). Thompson et al (2008) description of these cognitive categories was used, in which they provide an interpretation along with examples specific to computing geared towards computer science educators as our guide to assessing participants' inputs in hopes this will better equip us in assessing the participants cognitive understand of the material.

5.5.5.5 Results & Analysis

The "Your Turn" portion of the study focused specifically on the participants' ability to demonstrate understanding of the computing concept they just learned and to use it to create their own culturally situated example of the same concept. All respondents had to agree to the consent document to get access to begin the C-CAL study. Thus, it was not needed to begin this portion of the study. Skip logic was not added, thus, participants could choose to complete all parts or no parts of the "Your Turn" portion of the study. Respondents were not obliged to make a selection. The results were filtered based upon completion. Therefore, if participants' entries were left completely blank, their entry was filtered out. There was also a means to filter out responses with large blocks of missing data. After cleaning the data, 25 pairs remained. Because the study was conducted as a within study, it resulted in 50 valid entries which were analyzed. The computing concept variables, portion of the "Your Turn" did not have sufficient entries for both the control and experimental for analysis, so it was removed. This can be attributed to participants not returning to complete the study or beginning the study and then opting not to complete both parts. It was observed that, in the randomization, participants that began the study as a part of the control group had a substantial higher withdrawal rate either.

Every lesson for each concept ended with participants being given the opportunity to demonstrate their understanding. This was called "Your Turn". The participants were asked to come up with their own illustration of the computing concept. They had to create an example of the computing concept in which they had to specify all of its parameters or attributes. Table 21 and Table 22 are samples of the "Your Turn" responses of the control treatment group and the experimental treatment group, respectively, of which the computing concept was functions. For the functions concept participants had to supply a name, a set of parameters, and a return value for their function. As you can see in the tables below, the quality of their responses varied greatly. Further analysis was conducted to better assess the findings.

Table 21: Results for "Your Turn" for the Functions Concept -Control Group

CONTROL			
functionID	**fName**	**fparameters**	**freturn**
1	Creating a triangle	Gp forward in a diagonal directionb for 30 steps, then turn around and walk diagonally forward in the opposite direction, then turn right and go forward until you reach your starting point	Triangle
2	cutting a mat board	determine materials needed by (1) measuring (2) resources available	framed picture
5	hairdresseer	firstaval thisis the step to wash the hair . you drap the customer you make sure they don't wait than you wash.	a good job
6	Party Planning	Getting the necessary drinks and food, Inviting the necessary guests, Finding the necessary venue	one great party
7	turning on your car	1) unlock driver side door 2) open door and sit 3)take key and place it in the ignition 3) turn your key away from you 4) wait to hear your car fully start then shift into Drive	basic skill
8	Art of Communication	noun + verb = sentence. A naming word + Another word that asserts something about the naming word and voila!	A complete sentence
9	Rectangle	Go forward 10 steps, then turn right, Go forward 20 steps, then turn right, Go forward 10 steps, then turn right, Go forward 20 steps, then turn right,	Draws a rectangle
10	Painter	Buy paint, Put paint on surface to be painted, Clean up brushes	Painted surface
11	addition	add one to one	2

Table 22: Results for "Your Turn" for the Functions Concept- Experimental Group

EXPERIEMNTAL			
1	sending an email	log-in, new-message, write, find sender, send	sent email
2	Responding to studies	decide if you want to help that person calculate risks involved decline or accept solicitation	satisfaction that time was well spent
4	Babysitting Children	1. Be very gentle and caring towards the children. 2. Follow their parents instructions. 3. Make sure you have a list of emergency contacts.	Happy children and parents.
6	Business	Employee's	Good Business
7	Living on your own	1)moving out of your parents home 2) buying your own grocery's 3)supporting yourself	independence
8	Art of Communication II	n+v and n+v = cs To every sentence add a conjunction (and, or, nor, but, yet, so,) plus another set of noun and verb.	Compound Sentence
9	Teacher	Explain concept, give assignment, grade assignment	Taught a group of high school students
10	Seeder	Buy seed, Load seed, Drive tractor to spread seed	
11	Student	Take notes and study for test	Good grades

Similarly, Table 23 and Table 24 are samples of the "Your Turn" responses of the control treatment group and the experimental treatment group, respectively, of which the computing concept was objects. For the objects concept, participants had to supply an object name, some attributes associated with the object and a method for the object. As you can see in the tables below the quality of their responses varied greatly. Further analysis was conducted to better assess the findings.

Table 23: Results for "Your Turn" for the Objects Concept- Control Group

CONTROL			
objectID	**oName**	**oAttr**	**oMethod**
17	Wallet	Leather	Discretely transport personal items
16	Steak	juicy, brown, large	fry it or bake it and eat it
19	learningT	learningTe	LearningTest
20	A job	40 hours a week	it will give me pice of mind
21	Dress	Blue	Sewn
22	auto	blue	transport me
23	medication	small round water pill	swallow the pill
24	cookie called 'College Days'	oatmeal raisin with choclate chips and pecans	it can be sold or eaten
25	papers	medium, white, lined	written on, fold, picked up
26	Phone	small/compact	commucation/connect with others by dailing
33	motorbike	two wheels	accelerate
41	ball	round	bounce
42	a battery	small. round, with oppsite ends	generate power for an eletric device
43	home	3 bedroom	provides shelter
44	lamp	hologen	shine
45	It is a fruit,mango	green and little bit of yellow	First of all it needs to be planted and the ground and wait a couple years before you can have it ready to eat.

Table 24:Results for "Your Turn" for the Objects Concept -Experimental Group

EXPERIMENTAL			
objectID	**oName**	**oAttr**	**oMethod**
16	CD Spindle	Round, Plastic	Neatly stack multiple compact disks
15	Jeans	Size 7, color dark blue	Make you look thinner while wearing them
19	job	40 hours a week	give me a pice of mind
20	Frame	8x10	place a picture within it
21	computer	laptop	help me gather info
22	classmate M	loves to have fun	taught to dance
23	musical baby swing	beige and soft	play music and swing in 2 direction
24	Bentley	car, red, convertable, sleek	it drives, stops, plays music
25	Haven	Camp for HIV + Kids	Having fun in a safe place / teaching healthy living,,etc.
28	ibruprofen	round, pink, hard	stops immflamatory
29	pen	round, with a point and is about 5in long	helps put words on a page, writes with ink, or it can draw a picture
30	cellphone	Samsung, blue, flip style	make calls, provides date and time, take pictures
31	bottle	blue	can be filled
32	Lesly F. Maniga	He is one of the most famous haitian that still alive.	He is very educated and he can rebuild the haitian education system.

Following a similar analysis convention as discussed in Thompson et. al (2008), a team of computer scientists, those that were instrumental in conceptualizing the learning modules, were assembled to code and classify the responses using Blooms Taxonomy. Because the learning module presented a very basic understanding of the concepts and the manner the “Your Turn” portion was framed, it was decided that only the lower three levels of Blooms Taxonomy, Recall, Understand, and Apply, would be applicable in assessing the responses. Each person was given a breakdown of Thompson et. al (2008) cognitive categories as seen below:

Remember is defined as ‘retrieving relevant knowledge from long-term memory’ (Anderson et al. 2001). In the revised taxonomy, this category includes recognizing and recalling. This is interpreted in programming assessment terms to mean:

1. Identifying a particular construct in a piece of code;
2. Recognizing the implementation of a subject area concept;
3. Recognizing the appropriate description for a subject area concept or term;
4. Recalling any material explicitly covered in the teaching program. This might be factual knowledge, the recall of a conceptual definition, the recall of a process, the recall of an algorithm, the recall of a design pattern, or the recall of a particular algorithm or design pattern implemented as a solution to a specific problem in exactly the same context as a classroom based exercise.

Understand is defined as ‘constructing meaning from instructional messages, including oral, written, and graphical communications’. In the revised taxonomy, this category includes Interpreting, Exemplifying Classifying, Summarizing, Inferring, Comparing, and Explaining. This is interpreted in programming assessment terms to mean:

1. Translating an algorithm from one form of representation to another form;
2. Explaining a concept or an algorithm or design pattern;
3. Presenting an example of concept or an algorithm or design pattern.

Apply is defined as ‘carrying out or using a procedure in a given situation’. In the revised taxonomy, this category includes Executing and Implementing. This is interpreted in programming terms to mean:

1. That the process and algorithm or design pattern is known to the learner and both are applied to a problem that is familiar, but that has not been solved previously in the same context or with the same data or with the same tools; or

2. That the process and algorithm or design pattern is known to the learner and both are applied to an unfamiliar problem

In addition, the analyzers were also supplied with the definitions of functions and objects that the participants were presented with in the study (see Appendix F). Each analyzer was instructed to code the responses as a 1 if they thought the learner demonstrated that cognitive category and 0 if they did not. As a caveat, the analyzers were cautioned that the participants were novice learners, who completed these responses immediately after completing the learning module. Table 25 and Table 26 present the descriptive statistics and the probability value as a result from the t-test for the objects and functions, respectively.

Table 25: Object Concept Analysis

Objects		
N (exp/con)	16/15	
Exp Obj Mean		2.133
Con Obj Mean		2.063
Exp Obj SD		1.060
Con Obj SD		1.181
Exp Obj Max		3
Con Obj Max		3
Exp Obj Min		0
Con Obj Min		0
t-test=		**0.86208758**

Table 26: Functions Concept Analysis

Functions		
N (exp/con)	13/14	
Exp Func Mean		1.786
Con Func Mean		1.462
Exp Func SD		1.122
Con Func SD		0.877
Exp Func Max		3
Con Func Max		3
Exp Func Min		0
Con Func Min		0
t-test=		**0.413324582**

In addition, we also conducted a KS-test as presented in Table 27 as an additional step to account for the non-normal distribution. Figure 19 and Figure 20 depict the K-S-Test comparison percentile plot as a visual of the distribution for the objects response and the functions response respectively.

Table 27: Results for "Your Turn" K-S-Test Analysis

KS-Test	D	P
Functions	0.2308	0.828
Objects	0.1333	0.998

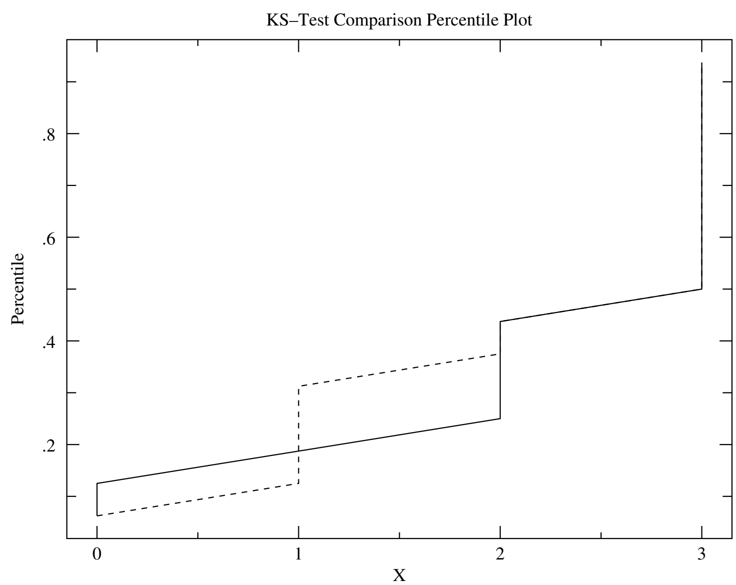

Figure 19: Objects K-S-Test Plot

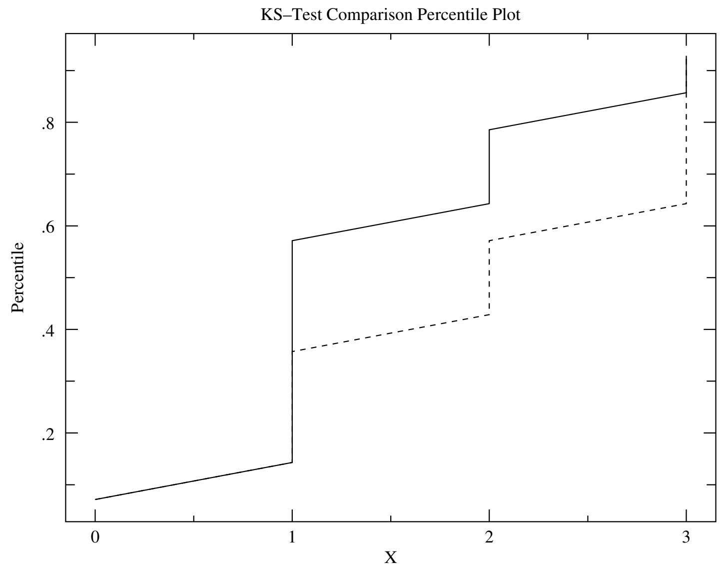

Figure 20: Functions K-S-Test Plot

In observing the results from the t-test and the p-value of the KS-Test, we can conclude there is no statistical difference between the experimental treatment and the control treatment for the "Your Turn" responses. In understanding the context of which the "Your Turn" was completed, the researcher realizes there are several factors that played into the responses. Because this was conducted as a within study, some participants could have experienced fatigue as they moved into the second test. Also, participants were asked to demonstrate understanding on concepts they were still processing. In general, for many learners, more time is required for the learned information to be absorbed and computed before they can successfully apply it in a useful manner.

Chapter 6

Conclusion

6.1 Summary

The C-CAL system gave rise to a new methodology and design that allows for the use of culture in the introduction of computing concepts to adult learners that are not formally educated. Its main goal is to provide a means to capture a learners culture(s) of participation; organize them into workable clusters based upon their culture of participation; use the dominate culture of each cluster and link it with a computing concept; and then create learning modules based upon the association created of the dominate cluster and the computing concept. Through experimentation, the C-CAL system has shown to be a viable alternative to introducing computing concepts to adult learners. The combination of the Culture Inquiry Form (CIF) and the Application Quest™ clustering algorithm proved to be an informative means to identify a persons culture and organize and present it in a fashion that it can be used as an input for future design endeavors. Using an iterative design process, two methodologies were developed by which culture and computing can be correlated and then a learning module could be crafted. There was no statistical difference between the C-CAL system and the control in regards to perceived ease of use and perceived usefulness, thus indicating the C-CAL system performed just as well as the control. However, C-CAL was consistently rated higher than the control on along all measures.

This manuscript began by asking three key questions that led to the development of the C-CAL system.

First, the researcher asked, if one's culture of participation can be identified and captured. In attempting to gain the rich culture information captured via ethnographic studies the CIF was crafted to capture a holistic view of individuals. The focus groups conducted provided the scope of questions that respondents best connected to, the ontology associated with some common cultures of participation and in-depth understanding of how participants relate and participate in their respective cultures. CIF resulted in as the electronic manifestation of those findings.

Second, the researcher asks if culture data mining can be used to create culture based learning modules. To answer this question, three sub-questions were addressed. Can C-CAL accurately capture a learners' culture of participation and correlating processes? This question was answered via a validation study utilizing the Application Quest™ clustering algorithm. This algorithm proved to be an informed means for capturing and organizing clusters of responses based upon the common culture attributes and processes the participants identified. Next, can culture processes be matched to the corresponding processes of computing concepts and can tailored lessons be designed around these matches? Using an iterative design process a methodological approach and template were forged for the correlating culture and computing and for design of learning modules that employ culture in introductory lessons computing concepts. Based on the positive findings of the sub-questions and the designed deliverables produced, the question of the use of culture data mining in the production of learning modules can be answered in the affirmative.

Finally, the researcher addressed, does culture based learning enhance the learning experience for adult learners when being introduced to computing concepts? This question was also examined in two sub-questions. Initially, does the design of the system support the system's intended use in terms of usability for adult learners? Results of the Technology Acceptance Model revealed that, on average, over 50% of all participants perceived the C-CAL system to being useful and easy to use. Next researchers had to determine if participants could demonstrate cognitive understanding of the concepts they just acquired via their interactions with the C-CAL system. In constructing their own culturally based example of the computing concept they just learned, participants were able to demonstrate their ability to recall, understand, and apply their knowledge at a rate comparable to that of the control method. In addition, there was no statistical difference found between the C-CAL system and the control. Indicating that the C-CAL system performed just as well as current methodology introducing computing concepts making it a viable alternative. However, C-CAL outperformed the control across all measures.

6.2 Conclusion

This research puts forth the novel idea of the C-CAL system that embodies the notion of a design that meets the needs of non-traditional learners in computing education by the use of computing tactics such as data mining and informational retrieval to create a self-directed online autonomous learning application. As a result of experimentation, this experimental concept was compared and found to perform just as well, and sometimes slightly better than traditional, non-culturally engaging methods currently used. Thus indicating the C-CAL system is a feasible system to utilize whose benefits can manifest itself in the array of adult learners returning to educate them. The nuances of this study basically accumulated into one overarching thought, is culture based learning a feasible option to introduce adults to computing and does culture based learning enhance the learning experience for adult learners when being introduced to computing concept? Can one capture culture, and use it as a design parameter that will prove to being beneficial for adult learners in learning computing. At the conclusion of this study the C-CAL system has proven its ability to answer in the affirmative on this question. Further studies are required to assess C-CAL's full range of capabilities and impacts on learning and the ultimately get a statistical gain in C-CAL over the control.

6.3 Contributions

This research demonstrated that the C-CAL system is a viable alternative to current methods of introducing computing concepts to adult learners. The C-CAL system in all its components fills a void in making the following contributions to the field of Human Centered Computing and Computer Science Education:

- A practical tool for identifying culture of participation for a group
    - Research in better understanding and connecting with users is ongoing. In the design world there are frequent collaborations and efforts to connect with social scientists to gain a deeper understanding of the target audience. However, in situations where those connects do not exist, many of our technological designers suffer. It is unfeasible and illogical to ask a resource restricted project or scientist to spend years collecting the rich culture understanding of people that ethnographers have been doing for years. Yet is that very knowledge that is needed to ensure that our designs are capable of reaching our globally diverse society. Thus, the Culture

Inquiry Form is the first step in bringing the two worlds together when it would have not been possible otherwise.

- Modeling a process for the use of culture as a design construct
  - Though there is some research on the significance of culture in computing, and an assortment of efforts of how best to account for it in computing designs, there are still some challenges of how exactly do we use a holistic view of the target audience culture of participation within the design construct. This model presents a process by which a computationally enriched learning experience can be fashioned around the learner's culture of participation using their own ontology and their views of how things relate within that culture context.
- Introduced a new system for increasing digital fluency for among Adult learners
  - The C-CAL system provides a rich culturally induced learning environment, where culture is dictated and defined by the target audience.

6.4 Future Research

The C-CAL system was designed as a proof of concept, thus there were several lessons learned in the course of this design and discoveries made during analysis that warrant further investigation and continued research.

A portion of this study was conducted as a Wizard of Oz study. After refining a process that appears to capitalize fully on the information that can be used in better depicting and providing detailed picture of a cultural concept, it is now possible to complete the system design such that C-CAL can be a fully autonomous system. It is also speculated that the replacing of the wizard of oz study could eliminate chances of human error that could factor into the participants perception of the system. A comparison study on the replacement of the Wizard of Oz study with an Information Retrieval design, would be interesting to explore the trade-offs of the system with the inclusion and removal of the human element.

In this study the researcher was fortunate to have conducted a focus group in which we obtained much of the background information and ontology associated with various culture attributes later used in the study. Future research would be heavily dependent upon semantic relations established in areas of "add hobby." Thus the next version of C-CAL should require a response from all participants for such options. In additions the same semantic relations should be utilized in gaining a better understanding the industries participants have been worked in, in the past.

Future research is needed on testing the C-CAL system with a homogeneous group of participants. Participants in the C-CAL study were from all walks of life various regions of the country and from abroad. However there is much to be learned on the impact of C-CAL on a group having range of commonalities. For example, it would be interesting to conduct the study with a group of construction workers.

The Technology Acceptance Model (TAM) has been expanded to the Unified Theory of Acceptance and Use (UTAUT) Model where the core constructs are performance expectancy, effort expectancy, social influence, and facilitating conditions that were not featured in this study but are worthwhile in future research (Venkatesh et. al., 2003).

Though the C-CAL system and all its components was designed primarily for culturally relevant computing for adult learners, it uses can been seen in other domains. The ability to better connect with a target audience is a universal need that spans product development, military strategy and various other markets. Further research is needed on this matter.

6.5 Final Thought

"*Start where you are. Use what you have. Do what you can*"- Arthur Ashe

This research endeavor began with a man who wanted to be a grocery bagger. The researcher watched a man enter a grocery store to apply for a job as a bagger. As the man was directed to a nearby computer to complete an application, she watched on as disappointment and defeat came over his face and he turned and left the store. The man looked to be in his mid-forties, his education status and academic background is unknown, his acquired skills and area of expertise is also unknown. However what is assumed is that he lacked the basic skills needed to seek employment that would impact his earning capacity and change his life.

In December 2007, the US had officially entered into a recession. This resulted in job loss placed at 8.4 million (Bureau of Labor Statistics, 2010). The hardest impacted group over the course of the recession, and the group that still struggles to find employment, are adults who possessed, limited to no formal education beyond high school. As a result it is probable, that millions of Americans have found themselves in the same position as the researcher's want-a-be bagger did years ago. Many of them will turn to education, willing or reluctantly. Though armed with a lifetime of knowledge that now seems void and useless, these digital immigrants will have to learn fast beyond, the basic skills they have acquired from past employment or their occasional web surfing or social networking or face marginalization.

The C-CAL system is an effort to reach out to this growing sector of our population. It is an attempt to help them start where they are and use what they have, with the lifetime of knowledge and skills they already have there by building confidence and lowering the entry bar.

It is an attempt to provide guidance into a new way of thinking that can lead to them being contributors of our ever changing society. The researcher understands that in looking at the bagger story it would have suffice to simply embark on a design that would introduce basic computer skills (such as this a mouse, this is a screen, etc). However as discussed by the National Academies of Science, those skills are not enough to sustain one in this society. Fluency, the ability to continue on with the learning process as technology evolves, and an understanding that computational thinking is already embedded in their current knowledge set can empower people.

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Appendices

Appendix A: Culture Participation Focus Group Protocol (CPFGP)

Adult Learners Focus Group Protocol
May 2008
Culture of Participation

Overview

Goal: The goal of this focus group is to help us discover the culture of participation that is most prominent for these adult learners. Thus, we seek to get a better understanding of the knowledge and experiences these learners bring to their learning experience. The goal is to capture the understanding and language of the cultural attributes that these adult learners do as part of their individual or joint activities, events, and planning. We are interested in discovering the general and particular contexts for computing relevant teaching and practice, so we are encouraging adult learners to talk freely and describe and discuss their interactions and strategies.

Timeframe: 1-2 hours

Guidelines:

Instructional Sheet
Welcome participants and hand out informational sheets as they come in. The moderator will read the information sheet out loud, as participants follow along on their own copy. Each participant must agree to participate and to being recorded prior to beginning the study and recording.

Establish rapport.
You want the participants to feel as comfortable as possible. Offer snacks. Make sure you introduce yourself and what you are doing at Auburn University and how you are part of this study. You should give them a simple explanation of the study such as, We are trying to discover the different activities things that they participate in that, together or alone, that may use the same fundamental concepts of problem solving skills in computing. Computing constraints may be under the surface of their favorite activities, so we want to learn about the ones that are most

obvious to you, and we will want to ask about all kinds of other activities that you participate in.

Emphasize that the interview does not have any right or wrong answers, does not count towards grades, and is separate from the school. Explain that we will record the interviews with digital voice recorders so we can remember exactly what they say and look back when they are all talking together. Make sure to tell them that the audio is for research purposes and they will be given fictitious names when we use the audio records.

Tell them the basic structure of the interview and the timeline. Make sure to tell them that they do not have to answer any questions that make them uncomfortable, and they can end the interview at any time. Make sure to tell them where the lavatories are, and remind them that they will have a break about one-half way through the interview.

TURN ON THE AUDIORECORDER

HIT RECORD

Be sensitive to your interviewee's situation.
Remember that people's lives are private places. Let people speak as much as they want and try not to rush them too much. People may want to add to each other's stories and descriptions, and that will be wonderful.

Use prompts.

Ask for examples as a way to prompt. Also pick up their language and ask what they mean. For example, "Well, I always estimate, but that's not computing. Ask, "Tell me more about the times you estimate?" Head the conversation to examples of things that they mention that may be on the inventory. Ask them to be specific and Give you a problem and the ways they approach or solve it.

Questions

A. Ice Breaker

1. Tell me how things are going for you.

a. *Explore further on specifics of response, if student doesn't provide details:* e.g., if student says, "It's been a lot harder than I thought," ask, "In what ways?"

Note: Follow the subject's lead on how to handle this question – in some cases, it might be best used as an icebreaker, just to begin the conversation and move on to other questions. However, some subjects will have quite a lot to say, on a range of topics. In this case, don't be too quick to move off of this question – explore all of the issues the subject seems willing to get into.

b. *Before moving on to other questions, give subject a chance to say more, e.g.,* "What else is happening with you these days?"

B. Contexts and activities:

"People participate in all kinds of activities in different places and times. We will talk about some of these places and times and ask you to tell us about your own experiences.

Home Design and Improvements:
Have you decorated or made any improvements to the inside or outside of your home? What are they? Can you describe what you did? When you do it? A favorite story about it? Who do you do it with? Where?
What was the most fun about the project? Most complicated?

What needs or challenges have you had in making your home "work" for you? How have you addressed them?

***Hobbies, Collections:**
Do you have hobbies? What are they? Can you describe what you do? When you do it? A favorite story about it? Who do you do it with? Where?
Do you have a collection? Tell me about it? How do you learn about your collection?

***Special/favorite Activities/Leisure**

How do you like to spend your free time? Family time? How do you prepare for those events?

Any special holidays or celebrations? What do they involve?

Out of school or home activities? Play games? Play or watch sports? Courses you take? Arts or music you watch or participate in? Programs you participate in? Do you do anything special on weekends or in the summer?

Do you play games? Which ones? With whom? When? How do you get new games to play?

Cooking:
Does anyone in the family cook? Who? How often? What are your favorite dishes to cook? Can you tell me about the recipes? Any favorite cooking stories? Do you cook for parties, charity events? A large number of people? What is that like? What do you prepare? Tell me about a time you cooked a large quantity?

Shopping:
What kind of things do you like to shop for? Food? Clothing? Tools? Browse? Tell us about some shopping excursions and stories?

Work:
What kind of work experiences did you have in the past? Was training necessary to get that job? Are there any favorite stories from work?

Planning travel:
Do you travel locally or long distance? What travel? How do you plan for it?
Tell me about a trip you have taken or are planning. Describe how you think about it?
Do you commute to work or to school?

Special Family Events:
What are the most special events to you? Can you tell us about them and how you prepare for them?

***Communication Structures and Patterns**
How do you keep in touch with family and friends?
Relatives live close by or some distance away?
Do you use cell phones, land lines, email, Internet, cards and letters, face-to-face to arrange and meet with them?

End-of Interview Questions:

Is there anything else you think we should know?

Day 2: Full Group

A. Strategies

1. What would you say has been the most difficult thing here for you so far? *[Students might mention non-academic difficulties. Make sure to explore further to get at academic difficulties.]*

a. How did you handle (or how are you handling) that?

The following sub-questions can be asked if time permits.

b. What else have you found difficult?

i. How have you handled that?

c. Do you have strategies for handling difficult situations?

i. *Explore further for specific examples.*

2. What's been easy for you here so far?

a. Explore further if subject doesn't elaborate.

B. Task

Teach Task

Instruct participants to think about their favorite activity. Think about why it's their favorite.

Learning Sources
How did you learn or get involved in that activity/task?
How often do you participate in that task? Can you name some times when you used that activity? Can you tell me more about that? Describe a day or time to me? A story?

Then explain to the group how to do some part of that activity or how best to engage in that activity. Give them 15 minutes to write it down, and then each person will report out to or teach the group how to do this activity. We will give them a worksheet to help organize their thoughts and let them know we have paper, pens/pencils, etc available.

C. Computing in a minute story

Can each of you tell me about an experience you had with computing that reminded you of some other activity that you do? It can be from school or home, positive or negative, recent or distant past. Try to tell it in one minute.

Prompts: Have a story about computing in your own life prepared and tell it in less than a minute. For example: "When I lived in New Jersey I wallpapered the kitchen in my apartment with a large patterned paper. I had to measure the walls and calculate the number of rolls I needed. It was complicated because of the length and width, plus the length of the pattern and getting it to line up evenly down each panel. The paper was expensive and I was on a budget so I didn't want to purchase too much. The people in the store were really helpful. I had to match the design on the paper with the measurements I took of the walls. I felt good that I finished the wall and got it right and didn't have too much extra paper left over."

D. <u>What is computing to you</u>

Can you think of any other time you might use computing that we have not mentioned?
Start with simple computing and work up:
Here is a list of kinds of computing. Can you tell me a time when you do them? (Show list that includes the following kinds of computing constraints and an example for each: data structures, condition statements, variables, odds, logical reasoning.
Abstraction and decomposition in tackling a large complex task.
Looking up a name in an alphabetically sorted list

- Linear: start at the top
- Binary search: start in the middle

• Standing in line at a bank, supermarket, customs & immigration
  - Performance analysis of task scheduling

• Putting things in your child's knapsack for the day
  - Pre-fetching and caching

• Taking your kids to soccer, gymnastics, and swim practice
  - Traveling salesman (with more constraints)

• Cooking a gourmet meal
  - Parallel processing: You don't want the meat to get cold while you're cooking the vegetables.

• Cleaning out your garage
  - Keeping only what you need vs. throwing out stuff when you run out of space.

• Storing away your child's Lego pieces scattered on the LR floor
  - Using hashing (e.g., by shape, by color)

• Doing laundry, getting food at a buffet
  - Pipelining the wash, dry, and iron stages; plates, salad, entrée, dessert stations

For any they choose:
When?
How often?
Can you tell me about a time you remember doing this?

Closing
End the interview by thanking them for their time and asking if they have any questions for you. Recheck their contact information and ask if they would be interested in participating in other research and activities.

Appendix B: Culture Participation Survey

Culture Participation Survey

Please respond to the following questions by marking next to the response that best describe you

- ☐ Male
- ☐ Female

Age:

- ☐ 20-24 years
- ☐ 25-34 years
- ☐ 35-44 years
- ☐ 45-54 years
- ☐ 55-59 years
- ☐ 60-64 years
- ☐ 65-74 years
- ☐ 75-84 years
- ☐ 85 years and over

Family size:

Number of adults in house (18 or older) ________

Number of children (0-17) ________

Ethnicity:

- ☐ American Indian and Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Hispanic or Latino
- ☐ Native Hawaiian and Other Pacific Islander
- ☐ White or Caucasian

Industry *(Please check the job category(s) that best describe your past job experience(s))*

☐ Accounting/ Auditing/ Financial Services	☐ Education/ Training	☐ Library
☐ Advertising/ Marketing/ Public Relations	☐ Employment Services/Recruiting	☐ Lobbying/ Grass Roots/Advocacy
☐ Aerospace/ Aviation	☐ Engineering	☐ Maintenance/ Repair
☐ Agriculture/ Forestry/ Fishing	☐ Environmental	☐ Manufacturing/ Electronics
☐ Architecture	☐ Fashion/ Modeling	☐ Media/ Publishing/ Journalism
☐ Arts/ Entertainment	☐ Government/ Military	☐ Nonprofit/ Charitable
☐ Associations	☐ Graphics/ Design	☐ Other
☐ Automotive/ Motor Vehicle/ Parts	☐ Healthcare/ Medical	☐ Printing
☐ Banking	☐ High Tech / IT	☐ Real Estate
☐ Beauty/ Personal Care	☐ Hospitality/ Tourism/ Travel	☐ Restaurant/ Food Service
☐ Biotechnology/ Pharmaceutical	☐ Human Resources	☐ Sales/ Retail/ Wholesale
☐ Communications/Public Relations	☐ Insurance	☐ Science
☐ Computer-Hardware/Software	☐ Interior Design/ Furnishings	☐ Social Services
☐ Construction/ Trades	☐ International/ International Trade	☐ Sports/ Fitness
☐ Consulting Services	☐ Internet/ E-Commerce	☐ Telecommunications
☐ Counseling	☐ Landscaping	☐ Transportation/ Logistics
☐ Defense	☐ Law Enforcement/ Security	☐ Utilities/ Gas/ Electric
☐ Domestic/ Childcare/ Eldercare	☐ Legal	☐ Veterinary/ Animal Care
☐ Economics		

Where do you use the computer most often?
(Please check all that apply)

- ☐ Own a home computer
- ☐ Have a PC at work
- ☐ Utilize a PC at another location

Highest level of education Attained

- ☐ Less than high school/ no diploma
- ☐ High school diploma (including equivalency)
- ☐ Some college, no degree
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Graduate or professional degree

What level do you consider yourself in regards to internet usage:

- ☐ No experience
- ☐ Novice
- ☐ Intermediate
- ☐ Expert

How often do you use the internet for personal use :

☐ Daily	☐ Monthly
☐ Weekly	☐ Rarely
☐ Bi-weekly	☐ Never

Machines, electronic and Computers:

What machines, electronics do you have in your house?
What do you do with the ones you have?
How much time do you spend with the various machines in your home?
Where else do you get access to machines? (friends, work, family members, libraries, schools)

Appendix C: Culture Inquiry Form

Culture Inquiry Form

Please complete all the questions below and then hit submit at the bottom.

Gender
- ○ Male
- ○ Female

Age
- ○ 19-24 years
- ○ 25-34 years
- ○ 35-44 years
- ○ 45-54 years
- ○ 55-59 years
- ○ 60-64 years
- ○ 65-74 years
- ○ 75-84 years
- ○ 85 years and over

Ethnicity

Select the ethnicity that you identify with:
- ○ White or Caucasian
- ○ Black or African American
- ○ Hispanic or Latino
- ○ American Indian or Alaska Native
- ○ Asian
- ○ Native Hawaiian or Other Pacific Islander
- ○ Other

Education

Highest level of education Attained:
- ○ Less than high school/ no diploma
- ○ High school diploma (including the equivalency)
- ○ Some college, no degree
- ○ Associate degree
- ○ Bachelor's degree
- ○ Graduate or professional degree

Industry

Please check the job categories that best describe your past job experience(s). Check all that apply:
- ☐ Accounting/ Auditing/ Financial Services
- ☐ Advertising/ Marketing/ Public Relations
- ☐ Aerospace/ Aviation
- ☐ Agriculture/ Forestry/ Fishing
- ☐ Architecture
- ☐ Arts/ Entertainment
- ☐ Associations
- ☐ Automotive/ Motor Vehicle/ Parts
- ☐ Banking
- ☐ Beauty/ Personal Care
- ☐ Biotechnology/ Pharmaceutical
- ☐ Communications/Public Relations
- ☐ Computer-Hardware/Software
- ☐ Construction/ Trades
- ☐ Consulting Services
- ☐ Counseling
- ☐ Defense
- ☐ Domestic/ Childcare/ Eldercare
- ☐ Economics
- ☐ Education/ Training
- ☐ Employment Services/Recruiting
- ☐ Engineering
- ☐ Environmental
- ☐ Fashion/ Modeling
- ☐ Government/ Military
- ☐ Graphics/ Design
- ☐ Healthcare/ Medical
- ☐ High Tech / IT
- ☐ Hospitality/ Tourism/ Travel
- ☐ Human Resources
- ☐ Insurance
- ☐ Interior Design/ Furnishings
- ☐ International/ International Trade
- ☐ Internet/ E-Commerce
- ☐ Landscaping
- ☐ Law Enforcement/ Security
- ☐ Legal
- ☐ Library
- ☐ Lobbying/ Grass Roots/Advocacy
- ☐ Maintenance/ Repair
- ☐ Manufacturing/ Electronics
- ☐ Media/ Publishing/ Journalism
- ☐ Nonprofit/ Charitable
- ☐ Printing
- ☐ Real Estate
- ☐ Restaurant/ Food Service
- ☐ Sales/ Retail/ Wholesale
- ☐ Science
- ☐ Social Services
- ☐ Sports/ Fitness
- ☐ Telecommunications
- ☐ Transportation/ Logistics
- ☐ Utilities/ Gas/ Electric
- ☐ Veterinary/ Animal Care

Other ______

The next two questions we want to know how do you like to spend your free time? Family time? Special holidays or celebrations? Traditions?

Hobbies/Leasisure Time/Free Time Activities

Below is a list of hobbies, leasisure time activities and favorite activities. Select one that best reflects the activities you participate in.

[choose one ▾]

If the listed activities does not reflect one of which you are a participant, please add it below.
(Please be advised that the "add me" will open in a seperate window. If it doesnt open, try temporarily disabling your pop-up blocker)

[Add me] (your added option will be displayed in the confirmation page that follows)

Traditions

Please type any traditions (example: family traditions) that you participate in regularly, in the box below.
Tradition: ______

Computer Usage & Access

Where do you use the computer most often?

- ○ at home
- ○ at work
- ○ at another location

What level do you consider yourself in regards to internet usage:

- ○ No experience
- ○ Novice
- ○ Intermediate
- ○ Expert

How often do you use the internet for personal use :

- ○ Daily
- ○ Weekly
- ○ Bi-weekly
- ○ Monthly
- ○ Rarely
- ○ Never

Phase II Contact

Please enter your email address below. Your email address will ONLY be used to send you the link two Phase II of the study. Phase II is created based upon the analysis of the information that you entered here, thus will take a couple of days to process. Once completed we will email you a link to read through and complete.

Email:

submit

Appendix D: Hobbies and Traditions Buckets

Hobby Bucket

Hobbies	HobbyBucket
church	church
watching movies	entertainment
swimming	sports
crafting	arts
basketball	sports
watching TV	entertainment
reading	reading
reading	reading
collector	collector
traveling	traveling
watching movies	entertainment
reading	reading
running	sports
shopping	shopping
also running	sports
sports in general	sports
traveling	traveling
fishing	fishing
golf	sports
watching TV	entertainment
shopping	shopping
flying	flying
watching movies	entertainment
church	church
sports in general	sports
formula team, building cool stuff	
fishing	fishing

Hobbies	HobbyBucket
basketball	sports
sports	sports
golf	sports
church	church
Hunting	sports
Hunting	sports
Hunting	sports
fishing	fishing
sports	sports
watching movies	entertainment
fishing	fishing
watching TV	entertainment
watching movies	entertainment
music	entertainment
flying	flying
sports in general	sports
dirt biking, girlfriend	sports
music	entertainment
running	sports
singing	arts
running	sports
tennis	sports
surfing the web	entertainment
beach, boyfriend	entertainment
watching TV	entertainment
dirt biking, girlfriend	
sports	sports

watching movies	entertainment
running	sports
soccer	sports
sports in general	sports
sports in general	sports
sports in general	sports
Baseball	sports
reading	reading
soccer	sports
fishing	fishing
swimming	sports
dirt biking, girlfriend	
watching movies	entertainment
cars	collector
tennis	sports
watching TV	entertainment
dancing	dancing
basketball	sports
reading	reading
traveling	traveling
tennis	sports
sports	sports
traveling	traveling
beach, boyfriend	entertainment
basketball	sports

church	church
sports	sports
sports in general	sports
hiking	sports
cooking	cooking
sports	sports
Hunting	sports
cooking	cooking
watching movies	entertainment
golf	sports
soccer	sports
Triathlons	sports
tennis	sports
music	entertainment
surfing the web	entertainment
basketball	sports
Baseball	sports
video games	entertainment
watching TV	entertainment
Hunting	sports
shopping	shopping
Friends	friends
working out	sports
theatre	arts
Friends	friends

Traditions Bucket

Traditions	Tfamily	Tholidays	Treligious	Tgameday	Tparty	Tget2gether	TmovieNight	Tvacation	TsharedMeals	Tdrinking	Tstudying
family reunion, major holidays	x	x									
n/a											
holiday dinners		x							x		
kwanzaa		x									
fireworks with family on 4th of July.	x	x									
fireworks with family on 4th of July. Gift exchange with family on Christmas day.	x	x									
family reunions on my Grandfather birthday	x	x									
Mid-week bible study			x								
volunteering on christmas and/or thanksgiving		x									
none											
Family Christmas reunion - cooking	x	x							x		
Church			x								
Family	x										
easter egg hunt		x									
annual family vacations	x							x			
sunday game day/lunch				x					x		
opening presents on Christmas day, not any earlier		x									
party					x						
Fraternity						x					
occasional trip to europe to see my family	x							x			
Thanksgiving family reunion	x	x									
Family traditions	x										
eating at the table									x		
Sunday lunch with the whole family!	x										
drinking										x	
thanksgiving		x									
National Lampoon's Christmas Vacation at christmas time with my family.	x	x									
christmas		x									
dinner as a family once a week	x								x		
toomers corner, thanksgiving, christmas		x		x							
Family get togethers for thanksgiving/christmas/new years	x	x									
get-to-gethers						x					
movie nights							x				
yearly vacation								x			
Auburn Football				x							
Family traditions	x										
religous traditions			x								
family traditions	x										
spring Festival		x									
Sunday Morning Worship Service			x								
Homework and studying											x
family traditions	x										
tailgating											
family traditions	x										
family dinners	x										
family dinners	x										
Basketball				x							
Eating									x		
Christmas dinner		x							x		
holiday get-togethers		x				x					
movies every christmas		x					x				
christmas		x									
family traditions	x										
going out with friends	x					x					
furious masturbation											
Christmas with the family	x	x									
family traditions	x										
Christmas breakfast		x							x		
family reunions.	x										
sunday lunches									x		
holiday meals		x							x		
Christmas		x									
Holidays together	x	x									
Aunts house every year for Christmas. Thanksgiving traditions.	x	x									
Thanksgiving Dinner		x									
supper time									x		
having pasta for christma dinner		x							x		
Holidays together	x	x									
Holiday Gatherings	x	x									
family traditions	x	x									
Thanksgiving, Christmas, going to football games		x		x							
snowboarding											
snowboarding											
Tailgating, Family Functions	x			x							
family traditions including holiday dinners	x	x							x		
Christmas		x									
Church			x								
Thanksgiving at my cousin's house	x	x									
family traditions	x										
Family Reunion	x										
family traditions	x										
we always get together for thatnksgiving every year	x	x									
annual family christmas dinner	x	x							x		
family holiday traditions											

Appendix E: Culture-Concept Examples

Culture Name	Concept	Example
fishing	objects	A collection of attributes and behaviors describing something For example, take a brand new cell phone, each contact in the contact list has the same blank lines, names, number, email etc. When you fill it up, you create an instance of a contact by giving it attributes (the contact name) and behaviors (get a number)
shopping	objects	It was a nice day. You was surfing the Internet. Suddenly, something caught your eye. It is Big screen LCD TV on sale for only $200 and even better, free shipping! You clicked the advertisement link and went to the online store, found the discounted Big screen LCD TV, and put it into shopping cart. Since you are a member of the store already, all you had to do was enter your user ID and password, click the "Login" button, selected the saved billing/shipping address, selected the credit card for payment, clicked "check out" button and... Done! The online store sent a confirmation e-mail to you. Now all you have to do is wait. And, you know, it's always the most difficult part.
shopping	variables	It was a nice day. You are out shopping. Suddenly, something caught your eye. It is an ad for a Big screen LCD TV on sale for only $200. Imagine entering the very large store with lots of departments, tables, shelves, etc. All these places have different things stored in them. You head to the department for your Big screen LCD TV. Once you find the right department, you have to find the type that was on sale.

baking	functions	It was a nice day. Some kids in the community have come to you to learn how to bake cookies for their fundraiser. You take out your baking supplies and gather all your ingredients. Now its time to show these eager beavers how its done. After explaining to them when to add all the ingredients and how to measure accordingly we finally have our big batch of cookie dough. Now you carefully explain to your captivated audience how to spoon the dough and its placement on the cookie sheet. You stress the importance of the amount of cookie dough per cookie the effects of this size is to big or two small. Then you remind them to be mindful of the space between the cookies so they have room when they expand. Finally our cookie sheet is filled with cookie dough, and now its time to put them in the pre-heated oven. Now all we have to do is wait. And, you know, it's always the most difficult part.

holiday	functions	Picture this, its the holidays, you have volunteered to oversee the community fundraising event of gift wrapping. You, several friends, and family have come together to make it a success.Prior to embarking on your journey, you all sat through a briefing on the art of gift wrapping. This entailed detailed skills of: 1) gather your materials- lay them out on a clean, flat work surface. Remember to remove the price tag from the gift before wrapping it 2) positioning the gift: Place the box containing the gift along the length of wrapping paper and unroll enough paper to wrap it around the box, leaving at least a 2-inch overlap. 3) paper cutting- Eyeball the wrapping paper at the ends of the box. Trim away any extra paper so that the remaining flaps are long enough to cover the box but short enough to fold over smoothly into flaps. 4) edge folding- Position the gift box so that one short end is facing you. Grasp the left and right edges of the wrapping paper and push the sides in so that top and bottom flaps are formed. Make sure the edges are pushed in as far as they will go without ripping the paper. Tape the edges to the box. 5) tape placement- Bring one lengthwise edge of the wrapping paper to the center of the box and secure it with tape. Turn the opposite edge of the paper under approximately 1 inch and bring this to the center of the box as well so that it overlaps the first edge, and tape it down. 6) bow/ribbon tying- Wrap a long piece of ribbon around the gift box lengthwise, then twist the ribbon at the lengthwise seam to wrap it around the box width-wise. 7) gift labeling- If you have a card, slide it under the ribbon and secure it with tape on the underside. If you have a gift tag, use the loose ends of the ribbon to secure the gift tag (if it has a hole in it), or adhere it directly to the gift (if it has adhesive on it.) So now you each pick a comfortable spot, a wrapping paper pattern that you prefer and you get started. The lines quickly form and you all start wrapping away pre-cautiously wrapping as you learned in your briefing.

dinnerFamily	objects	You have just sat down at the table of your family holiday dinner, and you quickly scan the table. The table is filled with all your favorites, mac and cheese, mash potatoes, gravy, greens, etc. You are ready to dig in. So you sip on your drink as you wait for everyone to take their seats, and the host to enter to begin the festivities.
familyTogether	objects	You are at your family get together and seeing family you haven't seen in a long time. As they start to arrive you are trying to remember the names of all of your first cousins, aunts and uncles based on your childhood memories. So you start making a list of names and some details that you remember about them (like height, size,) and some random memories (your aunt that makes your favorite pie or your cousin wet the bed when you were kids). You are quickly forming your list as the family starts pouring in, and heading your way. Now to put your memory to the test.
church	functions	It is a nice day, you are headed to church. Once at church, the church greeter asks you to assist her in seating people as they enter, because you are expecting a lot of guests today. She explains a detailed process of greeting, seating, and then giving each guest a flier. Finally you are ready to help seat the guests. Now all we have to do is wait, for them to arrive.
music	objects	Its a nice day and you just got some new music to add your computer. You figured this would be a good time to create a new playlist. So you sort all your music by title and gather your favorite tracks that will give you the sound you are seeking for this playlist. Then you sort your music by rhythm and search through and see what other songs in your collection would be a good fit. You want one more short song to add your playlist so then you search through your list of songs my time periods. Your playlist is just about done. Now its time to put it to the test.

charity	objects	Its a nice day and a wealthy philanthropist has asked you to recommend several nonprofit/charitable organizations to donate, to based on your background and experience in working with charities. So you start to think about the best way to differentiate between the charities. As you start to create your list, to simplify things, for each charity that you recommend you provide the name, the description and its purpose, so that the philanthropist can be well informed of the charity that they are donating to. You've done a pretty good job, so now you send your list to the philanthropist so now you sit and wait.
tcomm	variables	Picture this, you are working for a telecommunication company and have been charged with the task of getting some new communication equipment to reduce cost. There are some products that you have in mind. Your mission today is to figure out the product information so you can get the right products. For starters you realize that you at least need the make, the model, and the product ID number for each product. Now the hunt is on.
movies	objects	Its a nice day and you finally got some time to relax and catch a movie. First you have to decide what kind of movie you are in the mood to see. You start off by sorting them by category/genre (comedy, action, drama, family, etc) to narrow down your movie choices. Then you sort the available movies by leading actors (any of your favorite actors?) and then plots (what's the subject of the movie). You are down to your final two movies and you use the movie length as the deciding factor. Now its time to start the movie.
server	functions	Its a nice day and you are heading into work at the restaurant today, they just hired a new server and asked you to train him. You carefully explain and demonstrate the detailed process of a servers responsibility of explaining the menu to the customer, taking the customer's order, and delivering the customer's meal from the chef. Finally the training session is over, and the new server seems to be ready to start serving the customers. Now all we have to do is wait, for them to arrive.

healthcare	objects	Its another great day at work in the healthcare world, and your supervisor has just requested the medical history of several patients. Your supervisor is in a meeting and has asked you to get some information together on patients. You scan the patients chart, picking out the key information for the patient (such as patient name, medical condition,medication, etc.) and quickly send over the necessary information.
golf	objects	Its a great day for golf, and a friend has asked you to help them learn the basics. As you make your way across the green you start off by explaining some basic golf fundamentals the difference in golf clubs, golf balls, varying golf holes, while using examples that include known golf players and commonly known golf concepts. You make it over to the first hole, after a couple of demonstrations, you guide them through their first swing.
training	functions	Its a nice day and a friend is in need of your expertise to help him prepare to present his first training class. You carefully explain and demonstrate the detailed process of preparing the lesson, gathering and sorting the material, creating handouts, and creating visual aids. Finally, you are done, and your friend seems to be ready to start his first training class. Now, its training day, and all we have to do is wait, for the trainee's to arrive.

Appendix F: Object and Function Analyzers Definition

Objects

What is an object? In computing, they say an object commonly means a data structure consisting of data fields and procedures (methods) that can manipulate those fields. But really, object is just the way computing world defines a THING. So any THING, PERSON, OR PLACE can be an object.

For example, in the story you just saw, almost every noun can be defined as objects: <<*removed: cultural example*>> Defining objects, then putting them together to construct a computer program to solve problems is called Object-Oriented Programming.

An object usually contains two parts - Attributes, and Methods.

Earlier we said that objects are what we in the computing world call THINGS.

Attributes describe the 'thing' characteristics. So attributes can be a name, size, style, type, etc

Methods describe what the 'thing' can do, the behavior. . So methods can be actions that the 'thing' can do, or that can be done on it

Functions

What is a Function? A Function is a portion of a program that independently performs when you tell it to, its the behaviors or actions of a program. For example a song can be played, an alarm can get or set time, and a dog can bark. A Function can be thought of as the steps or the instructions of a portion of a program that you can repeat.

<<removed: cultural example>>

Earlier we said that a Function is a portion of a program that independently performs when you tell it to. A function is designed so that it can be coded to be started ("called") several times and/or from several places within one execution of a program, including from other functions.

A Functions can also be designed so that it can obtain a specific set of data values from the program that called it (its parameters), and eventually provide a specific set of values to it (its return values).