AI & Soc (2011) 26:35–47
DOI 10.1007/s00146-010-0282-6

ORIGINAL ARTICLE

The significance of the Culture Based Model in designing culturally aware tutoring systems

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Received: 18 December 2009 / Accepted: 18 April 2010 / Published online: 11 June 2010

Abstract Designing for culture through intelligent tutoring systems is on the rise. The needs of military personnel to communicate and understand cultures other than their own in deployments, missions, and work-related assignments have strongly encouraged the creation of culturally aware tutoring systems (CATS) that teach about other cultures. This paper critically analyzes three systems (i.e., ELECT-BiLAT, Tactical Iraqi, and VECTOR) and the frameworks that guided the design and development process. The examination reveals that there is a need for comprehensive guidelines to build CATS. Therefore, the Culture Based Model is offered as a framework to guide the design of culture-based information and communication technologies.

Keywords Culturally aware tutoring systems · Framework · The Culture Based Model · Artificial intelligence · Military

1 Introduction

The design of culturally aware tutoring systems (CATS) has come of age. Recent examples of intelligent tutoring systems (ITS) reveal a culture-specific platform supported by the latest technology. Some of these systems include Tactical Iraqi, SABRE, VECTOR, ELECT-BILAT, and ATL (Hussain and Feurzeig 2008). These American born cultural learning systems seek to aid military personnel nationally and internationally with learning the culture of their allies and enemies. In this sense, meeting the needs of a few has become more important than meeting those of the many.

Trends related to the design of CATS have been sporadically documented in the literature. Within this paper, all CATS are considered culture-based; however, some are more culture-neutral (generic) and others culture-specific (specialized) Young (2008a, c, 2009). In 1986, Mitter asked whether artificial intelligence should take culture into consideration. In this essay, Mitter concluded with an affirmative response. Mitter argued that there is "no universality in human needs (p. 102)." By this, Mitter meant that there is great diversity within cultures and across cultures. Given human beings commonalities and universalities, there needed to be considerations that were more culture-specific. Mitter (1986) realized that to transfer knowledge within or across groups, culture must be considered.

Researchers agree that the design of technologies requires culture-based considerations. Verma (1986) argues that the design of educational technological tools should consider social and cultural contexts of the learner. Heaton (2004) agrees that culture is important in the design of technologies. Payr (2004) asked what is culture-specific in "embodied agents" and concluded that there cannot be an "agent without culture" (p. xiii, xxi). That is, culture is always present.

More recent examples of trends include the research identified with CATS that promote cultural considerations in e-learning, ITS, and future technologies. This research advocates that culture influences how learners learn and how content should be taught; culture minimizes misunderstandings, allows for individualized instruction, brings flexibility to systems, and promotes the extensive use of CATS. Further, given the growing diversity of societies,

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there is a need to better understand culture (Blanchard and Allard 2008; Blanchard et al. 2009).

There are a limited number of guidelines that describe how to design technologies for an ethnically and culturally diverse audience (Eugene and Gilbert 2010; Eugene et al. 2009; Gregor and Newell 2001; Hengeveld et al. 2007). Moreover, applying culture to technologies is not a simple task. However, if we are too truly design for humans, then design considerations based on culture is the nexus of this journey.

This paper begins with a sampling of culture-based frameworks in artificial intelligence (AI) to provide an overview of existing guidelines to design virtual humans, products, and systems. Then, several CATS are researched and evaluated by providing a brief description of the system, a critical examination of the framework used to develop the system, and a critique of the systems components. Last, the Culture Based Model (CBM) is presented as a comprehensive framework for the design of CATS (Young 2009).

2 Culture-based frameworks in artificial intelligence

Frameworks in AI seem to serve a set of actions, steps or stages in the design process. These frameworks may describe ways to design through a technical procedure, detailed process, single variable, or set of ideologies.

Ruttkay's (2009) framework outlines four stages needed in designing culturally sensitive facial expressions for virtual humans. The four stages include the following: (1) Select the facial expression; (2) Analyze the facial expression in real life situations; (3) Generate the facial expression; and (4) Evaluate perceptions of the facial expression. Ruttkay's framework is minute in that it narrowly defines one aspect of human behavior—that is, the facial expression. The question is whether a single variable should define a framework.

Maldonado and Hayes-Roth (2004) propose a framework consisting of ten key qualities to animate agents; these qualities provide a blueprint to design culture-specific virtual humans. They include (1) Identity, (2) Backstory, (3) Appearance, (4) Content of speech, (5) Manner of speaking, (6) Manner of gesturing, (7) Emotional dynamics, (8) Social interaction patterns, (9) Role, and (10) Role dynamics. These ten key qualities are defined and exemplified. This framework is viable in the creation of virtual humans; however, it provides only a surface layer to the building of a virtual human. Further, the degree of cultural specificity is questionable. There is a need to provide greater depth in agent development. By example, additional key qualities might include more human characteristics such as identity, values, ethics, and thinking patterns embedded in the human psyche. Without this depth, the virtual human remains more culture-neutral than culture-specific. That is, within a framework there is a need to make explicit those qualities that are culture-specific.

Designing From the Interaction Out is Raybourn's (2004) framework that guides the design of intercultural virtual humans. The framework seeks to build "dynamic multicultural communication patterns in virtual settings and online communities" (p. 274) through a focus on the 4 phases—Interaction, Narrative, Place, and Emergent Culture. Considerations for the kinds of "communication instances" the system will support are made during the Interaction phase (p. 275). In the Narrative phase, considerations are made for the kinds of narratives between intercultural agent and users. The Place phase makes considerations for discourses that generate from interactions and narratives that form multicultural and cross-cultural places. In the final phase of Emergent Culture, considerations are made for the role of virtual humans in community-based systems (i.e., intranets or portals). *Designing From the Interaction Out* focuses on competence through intercultural communication; although the discipline of intercultural communication has been a place for designers to begin, it limits the range of design. If agents simulate human beings, then human existence is more than interactions, communicating, and input/output. Can the single discipline of intercultural communication define all that culture is and should be in the virtual and physical worlds?

Eugene et al.'s (2009) *Cultural Relevance Design Framework* proposes a culturally relevant framework to design software. Culture is defined as "what we do" and "who we are," and it is depicted through four themes: Practices, Ontology, Representation, and Tasks (p. 22). The Practices theme refers to the identification of target audiences shared social and cultural practices and norms. Ontology is the shared "organizational structure of knowledge" that exists and is understood by the target audience (p. 23); this includes language, vocabulary, and other cultural knowledge. Representations focus on the physical and visual appearances that characterize the target audience or culture. The Tasks theme consists of the behavioral actions indicative of the target audience. The framework provides a set of investigative questions and criteria for further design considerations. The *Cultural Relevance Design Framework* is limited in breadth and depth. When describing aspects of a culture, breadth is needed for designers to pick and choose design specifications; there is a need to broaden, not narrow, design possibilities. Depth is needed to authentically represent human beings as virtual characters in a virtual world; this means there is a need to understand and replicate human beings anthropologically and psychologically.

Meaning in Mediated Action (MIMA) is Bourges-Waldegg and Scrivener's (2000) design framework or approach for culturally diverse groups. MIMA consists of four cycled steps: Observation, Evaluation, Analysis, and Design. Within MIMA, Observation is conducted through observing the interactions of users with the interface system; this mediated activity is monitored for disconnects between the system and user. Evaluation entails questioning users about their perceptions of representations as it relates to the interface context. The Analysis step assesses the context in which culturally diverse users understand representations; this analysis influences decisions to design and redesign. The Design step included identifying redesigns based on "culturally determined usability problems" and "shared contexts" for additional representations (p. 116). MIMA should be considered an evaluation approach more so than a design approach because designers would typically use MIMA after the product is substantially developed. Further, the premise of a culturally diverse user is a neutral term that does not clearly define a user in terms of ethnicity, race, age, sex, etc. Therefore, a culturally diverse user can be as generic as the product itself.

To begin, a framework for the design of AI needs to provide the flexibility for designers to build culture-neutral or culture-specific virtual humans, products, and systems. The framework must include both breadth and depth, considerations for the ideologies of the user or learner, options for how to design, variation in procedures, multiple path ways to culture-based designs, and the inclusion of the anthropological and psychological. This range of design specifications means that there is a much broader palette in which to design (Young 2008a, 2009).

3 Frameworks of CATS

In the midst of a prolonged war and establishing relations with Middle Eastern countries, US military and their allies need training to prepare them to interact with people and cultures different than their own. ELECT-BILAT, Tactical Iraqi, and VECTOR provide authentic examples of CATS that meet this concern. Overall, these systems are more culture-specific than culture-neutral (Young 2008c). This means that (1) culture-specific systems can be successfully built; (2) culture-specific systems are specialized to the needs of the learner or user; (3) the content of culture-specific systems focuses on a particular society, culture, and/or target audience, and (4) culture-specific systems promote the human aspects of design and technology.

When building these systems, the designers followed a framework to guide the production process. These frameworks became integral to the structure of the systems.

3.1 ELECT-BILAT

ELECT-BILAT (Enhanced Learning Environments with Creative Technologies for Bi-lateral negotiations) is a serious game-based simulation that teaches military forces how to conduct business negotiations and meetings in a cultural context. BiLAT stands for bilateral engagements that describe the deliberate events required in the meeting of two parties (Hill et al. 2006; Lane and Hays 2008). A thorough overview of the ELECT-BILAT system and its functionality can be found in the research of Hill et al. (2006).

ELECT-BILAT used a 5 phase approach compiled by Hill et al. (2006); this approach provided a "pedagogical structure" to the training objectives. Hill et al's. (2006) 5 phase approach is a compilation of best practices used in the training and development community. In phase 1, a task analysis is performed on data that includes interviews, field manuals, research reports, and articles. These data became the primary sources for developing the training objectives. In phase 2, a storyboard prototype is developed based on the task analysis results. The storyboard serves as a preliminary tool to develop the content. In phase 3, a computer version is developed from the paper prototype. In phase 4, training objectives are connected to the content. These objectives provide on-going assessments of the learner's acquisition of content knowledge. By phase 5, supplemental materials are developed to support learners, instructors, and trainers. These materials serve as a printed version of the training system and an individualized training module.

According to Hill et al. (2006), the 5 phase approach is an "explicit framework for developing training objectives and refining them as the training application is built" (p. 2). The 5 phase approach, as presented by the authors, is a hodgepodge of ideas about the process of design, development, and training. Although Hill et al. (2006) propose the 5 phase approach as a process that can be used by "training system developers" who have interests in "producing pedagogically structured, immersive training environments" (p. 5), this approach might be difficult to replicate given the cornucopia of ideas. Information is pulled from military manuals, assorted documents, and interviews with subject matter experts; customers; and other military personnel to articulate Phase 1. Task analysis, as a pedagogical structure, is based on DuBois and Shalin's (2000) research on cognitive oriented task analysis and Hackos and Redish's (1998) research on task analysis for interface design. Phases 2 through 5 do not provide enough guidance in the narrative for the novice or expert to follow. The 5 phase approach is specific to the needs of ELECT-BILAT not the building of other training systems.

As presented, the 5 phase approach is not a framework but an isolated plan of action.

3.2 Tactical Iraqi

Tactical Language and Culture Training Systems (TLCTS) is a serious game platform that teaches a foreign language and culture through interactive 3D video game simulations. TLCTS has developed other language courses such as Tactical Iraqi (2006), Tactical Pashto (2007), Tactical French (2007), and Tactical Dari (2008) (Alelo 2009). These are ITS integrated with serious game technology. Tactical Iraqi focuses on a dialect called Arabic Iraqi (Johnson et al. 2007). Military forces use this training to develop cultural competency. A thorough overview of the Tactical Iraqi system and its functionality can be found in the research of Alelo (2009) and Johnson et al. (2007).

Tactical Language and Culture Training Systems (TLCTS) implemented a task-based approach to the design of learning systems like Tactical Iraqi (Johnson et al. 2004a, b). The task-based approach is derived from Doughty and Long's (2003) research that proposes 10 methodological principles of Task-Based Language Teaching (TBLT). TBLT principles aid in the production of courses that tailor to learner's communicative competencies, functional proficiency in a foreign language, and pedagogical practices specific to second language acquisition. These principles are specific to the development of distance learning foreign language and computer-assisted language learning programs. The 10 TBLT principles consist of (1) use tasks, not text, as the unit of analysis; (2) promote learning by doing; (3) elaborate input; (4) provide rich input; (5) encourage inductive learning; (6) focus on form; (7) provide negative feedback; (8) respect developmental processes and learner syllabuses; (9) promote cooperative/collaborative learning; and (10) individualize instruction.

Task-Based Language Teaching (TBLT) is a basic framework for designing language learning technologies. Its adaptation into TLCTS is embedded throughout the systems design. There is task oriented language learning that consists of conversations, feedback to correct errors, and scaffolding of language learning. The limitation of TBLT is its single focus on language, and language alone cannot define a society, culture, or target audience. TBLT requires designers to figure out all the other aspects of a society, culture, or target audience that need to be integrated into CATS. This process can be 'hit or miss' without a more elaborate framework. As intended by Doughty and Long (2003), TBLT is one approach to a single cultural variable (i.e., language).

3.3 VECTOR

Virtual Environment Cultural Training for Operational Readiness (VECTOR) is a training program that provides experience-based cultural familiarity through a virtual serious game environment. VECTOR was first piloted with a focus on the Kurdish culture in Iraq (Deaton et al. 2005). Military personnel use this training to develop cultural sensitivity as it relates to cultures other than their own. A thorough overview of the VECTOR system and functionality can be found in the research of Barba et al. (2006a, b) and Deaton et al. (2005).

VECTOR follows a framework that aids in the construction of training scripts and scenarios (Deaton et al. 2005). Deaton et al. (2005) adapted parts of Wise et al.'s (1998) Cultural Communications Skills Template (CCST) that offers a taxonomy to organize elements of a culture. This template provides criteria specific to a culture and focuses on the identification of behaviors within this culture. The three major areas and subsequent criteria of CCST are as follows: (1) The Psychological Profile focuses on a distinct set of attitudes through criteria such as: cultural values, motivation, and relationships; (2) The Shared History encompasses a distinct set of attitudes through criteria such as: culinary tradition, ethnic, or minority groups; historical tradition, hygiene, linguistic characteristics, manners/protocol, science and technology, social structures, sports, recreation and leisure, the arts, and vice; and (3) The National/Regional Characteristics attends to a shared history through criteria such as: buying/leasing/selling goods, communications, geography, economic structure, educational system, finance, health, housing, legal system, military institutions, polity, services, and transportation. This basic template is applied to a distinct culture. Data are gathered from and about the target culture based on the template areas. This process manifests a culture-specific template. The culture-specific template is then compared to mission templates, and these data are used to design training courses.

Cultural Communications Skills Template (CCST) is a basic framework for defining, designing, and analyzing a culture, and more specifically, identifying cultural communications skills within a culture. CCST's template consists of 27 cultural elements, and some of these cultural elements became integrated into the design process of VECTOR. CCST served as a "cultural model" for VECTOR by identifying a large set of "cultural variables" applicable across cultures; further, CCST identified "cultural behavioral rules" that aided in the development of interaction scripts and training scenarios (Deaton et al. 2005, p. 162). CCST is a broad framework that provides the cultural elements needed to build CATS. The

framework, as with any framework, requires some adaptation. CCST was designed by the military for the military; therefore, access to all its components are not readily available to the public. The main limitation of CCST is that it focuses only on the design of a project; designing CATS requires culture-based thinking throughout project management and design.

4 Critiquing CATS

The conscientious effort to consider culture makes these 3 systems culturally aware (Blanchard and Mizoguchi 2008). Table 1 provides an overview of ELECT-BILAT, Tactical Iraqi, and VECTOR. The table specifically highlights some important components to the design of CATS. In these cases, the types or genres are serious games. These serious games provide a venue to integrate game technology, military training information, and cultural content. They combine the visual excitement of entertainment games with the instructional content of training curriculum.

These systems support the teaching of skills and content directly related to the Middle Eastern culture. Given this focus on Middle Eastern culture, future CATS, specific to a target audience or culture, could benefit those in business, education, and industry. Specifically, there is great potential for working with global partners, marketing to world nations, and educating across international waters. In these cases, global partners would be very knowledgeable of each others language, culture, and business acumen. Products could be precisely built and accurately marketed to specific target audiences. E-learning would move beyond the generic to more culture-specific interfaces, interactions, and content.

As indicated in Table 1, there is a focus on the learner or user of the system; this focus is carried throughout the design process. CATS require an investment in the needs of the user or learner that is embedded throughout the design

Table 1 Culturally aware tutoring systems

Product	ELECT-BILAT (Middle Eastern)	TACTICAL IRAQI	VECTOR (Kurdish)
Genre/type	Serious game	Serious game	Serious game
Goal	Teach skills for conducting business negotiations and meetings in a cultural context	Teach Arabic language and culture	Teach skills needed to interact in a variety of cultural contexts
Learner/user	Military forces	US military, Australian Defense Force	Military personnel
Culture/society	Middle Eastern	Iraqi	Kurdish
Culture-target audience	Middle Eastern people	Iraqi people	Kurdish people
Technologies	Integrating architecture	Automated speech recognition	Lithtech Jupiter Game engine
	SmartBody	Enabling learning objectives	iGEN intelligent agents
	PsychSim		
Teaching strategy	Skills-based learning	Task-based learning	Case-based learning
Learning	Individualized instruction	Individualized instruction	Individualized instruction
			Cognitive apprenticeship
Framework	5 phase approach	Task-based language teaching	Cultural communications skills template
Data collection	Bilateral materials	Live simulation training exercises	Arabic language
	Interviews of subject matter experts	Iraqi people role play in mock-up Iraqi towns	Kurdish culture
	Analyzed transcripts of Iraqi-American role-playing scenarios	Sources: field manuals, research reports, and articles from military personnel	Sources: books, articles, pamphlets, military reports, cultural information about Iraq and other cultures
Cultural elements	Behaviors, norms, values, social interactions	Communication (verbal and non-verbal), cultural knowledge, language, social interactions	Attitudes, behaviors, cultural, emotions, gender, interaction, knowledge, language, perceptions, personality, predispositions, religion, social, space, status
Supplemental materials	Printed version of training system	Online and hardcopies of reference materials	Do's and don't booklet

Data gathered from Alelo (2009), Barba et al. (2006a), Deaton et al. (2005), Hill et al. (2006), Johnson et al. (2007) and Lane and Hays (2008)

and development process. Specifically, the lens through which decisions are made is through the user or learner. This focused lens is what makes CATS culture-specific.

The 3 systems focus on the Middle Eastern culture and a specific target audience (e.g., Iraqi people, Kurdish people). This means that in building CATS there should be a cultural context for the target audience. That is, the target audience exists within a society or culture. This society or culture and the target audience must be explored, evaluated, and integrated as a whole. The design of CATS requires a holistic representation of people, cultures, or societies to remain authentic.

In building CATS for the future, it will take the collective efforts of multiple forms of technologies. By example, ELECT-BILAT, Tactical Iraqi, and VECTOR integrated several technological formats to achieve the desired functionality, aesthetics, and content. Innovation of this type requires thinking outside the box.

CATS, that seek to educate, require teaching or instructional strategies through which learning happens. In these systems, three best practices in teaching and learning were implemented—skills-based, task-based, and case-based learning. The problem with assigning a pre-determined teaching strategy is to assume that all learners learn best through this methodology. Further, it does not allow the learner the intellectual freedom to choose their most appropriate instructional strategy.

Learning is delivered through methods such as individualized instruction and cognitive apprenticeship. Individualized instruction is used as a method of managing instruction such as the pace or amount of time allotted to learning, content of material learned, instructional materials, and instructional technology. VECTOR also incorporated cognitive apprenticeship as a learning methodology. In this method, learners are enculturated into authentic activities and practices that involve social interaction (Brown et al. 1989). The problem with assigning pre-determined learning methodologies is to assume that all learners learn best through these methodologies. Further, it does not allow the learner the intellectual freedom to choose their appropriate learning method or for the adaptive technology to adapt to learner's preferences.

Consistent across ELECT-BILAT, Tactical Iraqi, and VECTOR, the development of these systems is guided by an approach or framework. The 5 Phase Approach, TBLT, and CCST are the culture-based frameworks guiding these systems. These frameworks come from the fields of training and development, language learning and behavioral and social science, respectively. This borrowing of pieces of frameworks to build CATS is a 'hit or miss' strategy. There is no systematic path to design that can be successfully replicated by other designers. This returns to the need for a framework specific to the building of technologies like CATS.

The investigative work that needs to be done in creating CATS maybe referred to as ethnographic research, because there must be a collection of data through participant observations, interviews, and in-depth field work (Ferraro 2004). According to Forsythe (1993, 1999), the collection of ethnographic data requires an objective observer and should not be performed by insiders. Insiders fail to detect tacit knowledge; it becomes invisible to them because of their proximity to the setting. Further, these tacit assumptions become part of the system. Systems are likely to reflect the infusion of tacit assumptions and "fall off the knowledge cliff" (Forsythe 1993, p. 463). Data collection by ELECT-BILAT and Tactical Iraqi included role playing. However, role-playing and re-enactments of human behavior may not provide reliable data to build systems. In particular, the language communicated during the role play is usually simple and interactions flat; thereby creating an inauthentic example of human to human interaction. Systems built on role-playing data have led to "systems based on simplistic assumptions that have been unable to accommodate the needs of real users in unpredictable situations" (Forsythe 1993, 1999, p. 135). Ethnographic data collection is very much needed in building systems; however, this process must be monitored and evaluated by insiders and outsiders (e.g., ethnographers or anthropologists).

Broadly defined, cultural elements refer to those criteria used to identify a particular society, culture, or target audience (Young 2009). As exemplified by Table 1, cultural elements are needed to identify aspects that underlie the core culture. Cultural elements may identify the anthropological (e.g., behaviors, norms), psychological (e.g., attitudes, emotions) or scientific (e.g., space) aspects of a society, culture, or target audience (Hall 1966; Kroeber and Kluckhohn 1966; Young 2009). The building of CATS requires a comprehensive set of cultural elements inclusive of the anthropological, psychological, and scientific if needed.

Supplemental materials serve to provide learners or users of these systems alternative ways to acquire the content, meet multiple learning modalities, and reinforce content knowledge. These materials should reinforce, extend, and replicate a systems content knowledge. With supplemental materials, learning is supported through multiple forms of instructional technologies, and learners are provided a variety of instructional methods to master content.

These data suggest that CATS can serve the needs of the few and the many. If this technology were brought into the public arena, the needs of all learners could be met. In public education, academic achievement in science and

mathematics could move from a chore to child's play. Healthcare practitioners could become more informed about how culture impacts health and wellness. Businesses could hone in on their target markets, train employees about cultures far and near, and better meet the needs of their clients. CATS have global implications for bringing worlds and people together or to at least find some common ground.

5 The Culture Based Model and CATS

Frameworks provide solutions or guidelines to design (van den Akker 1999). The 5 phase approach provides a limited number of project management and design features, and the cultural elements are not explicit in the approach. TBLT does not focus on project management, and design is limited with this approach. Also, TBLT does not contain any cultural elements to guide the design process. CCST does not focus on project management; it is more focused on design. The review of literature and these frameworks speak to the need to have guidelines that aid in project management and the design of CATS. Given this, CBM is offered as a comprehensive framework to guide the management and design process.

CBM is a basic framework; it qualifies as a model of culture. In this sense, CBM works with other frameworks, models, approaches, templates, ontologies, etc. It could be seen as a bridge that connects one discipline to another or as a foundation in building systems or products. CBM defines cultures. The framework does not label cultures with terms such as individualistic or high context, because there is too much differentiation within societies, cultures, and people. CBM can be applied to more than one culture. The framework supports the creation of culture-neutral and culture-specific products and services.

CBM's framework enables the building of information and communication technologies (ICTs). In this context, the term ICT is used to define the various forms of technologies including AI. CBM has 8 areas aligned with the acronym ID-TABLET (Inquiry, Development, Team, Assessments, Brainstorming, Learners, Elements, Training). Inquiry and Elements focus on project design; all other areas focus on project management. There are a total of 70 design factors with additional subfactors not included in this total.

CBM can aid designers of CATS in creating content for domain models; capturing attitudes, emotions, and behavior (Woolf 2008); building cultural profiles of learners (Blanchard and Mizoguchi 2008), collecting the necessary data to build systems, and more. Building CATS through CBM's ID-TABLET requires making cultural considerations during the management and design process or from beginning to end. It is a conscientious effort on the part of the designer, team, client, and all stakeholders to develop an authentic product.

CBM begins with getting stakeholders to identify design goals. These goals can be classified in one of the following categories: C: Custom development; A: Add-on; R: Re-engineer; or D: Diagnostic evaluation. Custom development is building a project from scratch. An add-on means adding onto an existing product. Re-engineering requires revamping the existing product in terms of making changes to the software codes, restructuring, or rebuilding. Diagnostic evaluations serve as a measurement tool.

Given the direction of the project, corresponding areas of CBM's ID-TABLET are selected, and a database or knowledge management system is built. This database serves as a "culture guide" for building programs, products, and systems. Extensive details on CBM can be found in Young (2009).

The next sections briefly outline how CBM works, presents the areas of the ID-TABLET, and offers connections to CATS. Where applicable, connections are made to ELECT-BiLAT, Tactical Iraqi, and VECTOR.

5.1 Inquiry

Inquiry monitors development, automates the internal flow of the design process, and functions as internal sensors. This area offers a series of questions to be asked and answered before, during and after the products development. These questions are meant to guide the designers or teams conceptualizing and keep everyone focused on the society, culture, or target audience. There are six Inquiry design factors: I1. Genre, I2. Framing, I3. Omission, I4. Backgrounding, I5. Foregrounding, and I6. Visual representations. Each design factor serves a different function in the design process.

5.1.1 Genre

Genre assists in selection of ICTs, considers affordability, and determines other influences on the product's design. The first question asks What ICTs are being used and why (Young 2008b, c, 2009)? In selecting technologies for CATS, there should be a focus on issues such as access and equity. Genre questions get at whether the learner can access the technology and whether there have been considerations to provide an accessible technology. With ELECT-BiLAT, Tactical Iraqi, and VECTOR, access is granted and restricted to military and government personnel.

5.1.2 Framing

Framing assists in maintaining the target audience's perspective. These questions align the project to the target audience with a focus on content. For example one question asks How is the content presented to the target audience (Young 2008b, c, 2009)? In designing for CATS, there should be considerations for whose perspective is being presented and how is the content delivered. The presentation of content can be different based on the technology platform (web based vs. software) or where objects are placed (text on left or right of screen).

5.1.3 Omission

Omission helps in assessing the design; these questions determine what has been omitted intentionally or unintentionally. An omission question asks What has been intentionally omitted and why (Young 2008b, c, 2009)? In designing for CATS, considerations as to why content, ideas, and people were omitted needs to be evaluated. The personal ideologies of the team should be intentionally omitted from the design. There should be more focus on the target audience or culture rather than one's own beliefs and values; thereby, bias is minimized. Payr (2004) argues that the cultural background of designers is implicit in agent architecture. Through the questions in the Inquiry area, the hope is to minimize the designer's own cultural influences and make explicit the society, culture, or target audience.

5.1.4 Backgrounding

Backgrounding helps to provide a balanced design. A balanced design is assessed by determining what content has been backgrounded intentionally or unintentionally and whether this backgrounding is detrimental to the project. A backgrounding question asks Is the backgrounding intentional or unintentional and why (Young 2008b, c, 2009)? In designing for CATS, considerations whether backgrounded items are implicit (implied) or explicit (clear) needs to be discussed and discovered. A community representative or cultural expert may readily notice a backgrounded item as being appropriate or offensive.

5.1.5 Foregrounding

Foregrounding assists in providing an objective design. This objectivity is determined through an analysis of what and why something is emphasized. A foregrounding question asks What is emphasized and why (Young 2008b, c, 2009)? In designing for CATS, considerations for foregrounded items should be consistent with the expectations of all stakeholders. Foregrounded items could include color, icons, text, objects, etc.

5.1.6 Visual representations

Visual representations assist in conveying meaning to the design. Meaning maybe conveyed related to purpose, process, product, selection, and placement of images. A visual representations question asks Who is portrayed in these visual representations (Young 2008b, c, 2009)? In designing for CATS, determine whether the images portrayed are those stakeholders wanted to communicate.

5.2 Development

Development provides the management structure for problem solving. It considers those features that are important in the overall development of the product. There are ten Development design factors: D1. Consider technical, aesthetic, content, culture-based, and target audience (TACCT) design specifications, D2. Mass distribution formats, D3. Effective technology to produce the product, D4. Diversify ICT format, D5. Understand target audience, D6. Explore environmental and individual/group cultures, D7. Quality design, D8. Authenticate product, D9. Control for interference, and D10. Model the product or process (Young 2008b, c, 2009).

In terms of CATS, providing a management structure to the design process is needed. D1 offers TACCT as a preliminary assessment tool to evaluate pre-existing technologies. D2 helps the designer consider issues of access to the technology and equity in the number of equal chances learners have to engage the technology. D3 assists the designer in considering whether the technology is effective in delivering content; that is, the human to machine interaction is considered. ELECT-BiLAT, Tactical Iraqi, and VECTOR, as indicated in Table 1, also provided supplemental materials that were online and print based. This is consistent with D4 that suggests diversifying the ICT format to better meet learners learning modality. In the research, there is much concern about understanding the learner (Woolf 2008), D5 gets the team focused on the target audience throughout the design. Later, this translates into "Acquisition-Oriented CATS (systems trying to teach intercultural skills to learners)" such as Tactical Iraqi or "Adaptation-Oriented CATS (systems trying to understand the cultural profile of learners and adapt to it)" (Blanchard and Mizoguchi 2008, p. 24), D6 begins the discussion to consider the multiple perspectives of societies, cultures, and target audiences. D7 looks at the quality of the product and the possibility that others might emulate its design. D8 begins the ongoing discussion of accurately representing the society, culture, or target audience; this is balanced by the

collection of authentic data in CBM Elements. In Heaton's (2004) research on computer-supported cooperative work in Japan, she found authentic agent embodiments were preferred over iconic depictions. D9 focuses on minimizing bias, attitudes and prejudice throughout the management and design process and minimizing interference related to humans, machines, and the environment. Phase 2 of the 5 phase approach (Hill et al. 2006) (see Table 1) requires the development of a storyboard prototype. This is consistent with D10 to model a product or process through some form of visual language (Botturi and Stubbs 2008).

5.3 Team

Team focuses on the recruitment of a culturally sensitive design team; this is where much of the decision making happens. The three Team design factors include T1. Cultural expert(s), T2. Enlist educators, and T3. Culturally informed team (Young 2008b, c, 2009). Creating any type of artificial intelligence is a team effort; however, in creating CATS, there must be cultural experts as indicated in T1 (Blanchard and Mizoguchi 2008; Wise et al. 1998). Like most educational products, there is a need for subject matter experts as indicated by T2. In Table 1 under data collection, ELECT-BiLAT used subject matter experts as a resource for content. Last, T3 suggests that team members are educated about the society or culture and accept the various racial, ethnic, linguistic, and other diversities of the target audience. By example, team members of ELECT-BiLAT, Tactical Iraqi, and VECTOR would receive training about the Middle Eastern culture and its people. CBM requires that team members positively accept and respect the target culture to be part of the team.

5.4 Assessments

The area of Assessments covers multiple evaluation options. These evaluations provide evidence of the products effectiveness and evaluate the goals set for the target audience. There are four Assessments design factors: A1. Multiple evaluation options, A2. Assess the assessment, A3. External review, and A4. Culture-specific assessments (Young 2008b, c, 2009). ELECT-BiLAT, Tactical Iraqi, and VECTOR each have some type of assessment tool. A1 suggests that the assessment be internal and external. In the case of the 3 CATS, this would mean that ITS have internal assessments and that the assessments match the content delivered via the ITS. External evaluations might be field tests, instructor made exams, pilot studies, prepackaged exams, or standardized tests. A2 provides an internal monitoring of the system to determine whether learning outcomes are being properly measured and whether the testing methods (e.g., fill-in or multiple choice questions) are effective. A3 suggests hiring external reviewers to evaluate the product; the goal is to provide an objective evaluation of the system. A4 recommends the development of culture-specific assessments that culturally align with the needs of the target audience and content.

5.5 Brainstorming

Brainstorming determines the direction to proceed and serves as an initial review of the management and design process. It is the first step in planning the project. There are ten Brainstorming design factors: B1. Financial support, B2. Pilot studies/field tests of product, B3. Assess community's response, B4. Community representative on team, B5. Investigate target audience to authenticate product, B6. Reflect and assess learning goals, B7. Affordable design, B8. Meet needs of target audience, B9. Discuss and consider cultural context, and B10. Present and consider outcomes (Young 2008b, c, 2009).

ELECT-BiLAT, Tactical Iraqi, and VECTOR received financial support from the United States government. B1 advocates that financial funding be secured for the duration of the project because culture-specific projects require more initial upfront monies. TLCTS engages in ongoing pilot studies of its ITS (Johnson and Valente 2008). B2 suggests that pilot studies or field tests be conducted throughout the development process. These ongoing evaluations reduce victimization of learners/users from failed products. B3 promotes an assessment of public opinion to the products development; this might be carried out through opinion polls or focus groups. Similar to the cultural expert, B4 suggests a community representative who is versed in the racial, ethnic, social class, and economic conditions of the target audience; this person may have lived or still lives in the target community. Discussions about the level of ethnographic data collected begin in B5; the collection of data might include interviews from cultural informants, observations, artifact collection, commissioned reports, and articles. In Table 1, preparation for ELECT-BiLAT, Tactical Iraqi, and VECTOR included data collection consistent with that suggested in B5. B6 suggests that there be ongoing reflections and assessments of learning goals throughout the products development. In meeting the needs of the many and the few, B7 advocates for an affordable design that the target audience can afford or obtain free through some other means of accessibility. B8 begins discussions on how the product meets the instructional or cultural needs of the target audience. The design of nonbiased products requires conversations about the target audience in terms of their economic status, history, social interactions, politics, religious affiliations, and other factors in CBM Elements; discussions about these topics begin in

B9. B10 suggests formalizing expectations for achieving learner outcomes or meeting the user goals.

5.6 Learners

Learners centers on the needs of learners and learning. These design factors assist in building a learning environment that supports the learner's cultural frame of reference. There are ten Learners design factors: L1. Extend learning, L2. Differentiate opportunities to learn, L3. Empower and engage learners, L4. Teach proactive learning, L5. Identify educational objectives, L6. Culture-specific instructional strategies, L7. Enrich instructional content, L8. Adapt instruction to learner, L9. Plan for instruction, and L10. Enculturate the learner (Young 2008b, c, 2009).

L1 suggests the need to extend learning opportunities by building adaptive designs that meet learners where they are in terms of knowing and understanding; these opportunities should extend or advance instruction as needed. Much research in AI promotes the building of adaptive learning environments (Woolf 2008). L2 promotes differentiated instruction that provides learners with options in instruction (Dewey 1897; Gagne 1962), and applying these ideas more broadly to the design of CATS means that there can be differentiation in hardware, software, teaching and instruction, and learning. L3 suggests that learners be empowered by and engaged in the content. By example, ELECT-BiLAT, Tactical Iraqi, and VECTOR provide an engaging learning environment through the use of game technology. L4 suggests proactive learning requires building mechanisms into CATS that provide incentives to learners to improve their learning; this can be achieved by creating multiple pathways for the learner to improve, build, or develop skills, abilities, and experiences. When building any e-learning system or product the educational or learning objectives should be identified first—as suggested in L5; this means that the learning outcomes are known to the designer and the learner. L6 advocates for consideration of culture-specific instructional strategies that are specialized to a particular individual or group. These instructional strategies take into consideration how the target audience learns and the best way of approaching this learning. Instead of applying the learning theory or instructional strategy to the system, assessments are made to determine the best learning strategies that work for the learner. For example, cognitive apprenticeship would not be integrated into the ITS as with VECTOR (see Table 1); the ITS would determine the best instructional strategy based on the needs of the learner. Then the most appropriate learning theory or instructional strategy is applied by the system and thereby transferred to the learner. L7 proposes that instructional content can be enriched by expanding the content to culture-specific elements of learners such as: politics, morality, ethics, beliefs, language, identity, and social actions. L8 recommends an adaptive instruction that is not too grade level or age level specific but focuses more on cognitive ability. ITS can account for diverse adaptations in their designs (Gill 1986). L9 suggests that the long- and short-term instructional needs of the learner be considered; this means how knowledge is acquired over a span of time. Finally, L10 proposes that the product can enculturate the learner into a culture. Enculturation into the Middle Eastern culture seems to be the goal of ELECT-BiLAT, Tactical Iraqi, and VECTOR.

5.7 Elements

Elements facilitate content development. These Elements seek to be comprehensive in providing the fundamental total of which all culture is composed. There are 25 Elements divided into 3 sections.

5.7.1 Section I

The Anthropology of Culture covers design factors E1–E13. This section draws from key concepts in the fields of anthropology, communications, demography, economics, language, history, and the physical and environmental sciences to explore the depth of culture. The design factors include E1. Cultural aesthetics, E2. Cultural artifacts, E3. Cultural capital, E4. Cultural classification, E5. Cultural communications, E6. Cultural demographics, E7. Cultural environment, E8. Cultural history, E9. Cultural knowledge, E10. Cultural language, E11. Cultural physiology, E12. Cultural relations, and E13. Cultural resources.

5.7.2 Section II

The Psychology of Culture covers design factors E14–E20. This section draws from the fields of cognitive anthropology and cultural psychology that focus on cognitive, psychological, and social realms. The design factors include E14. Cultural beliefs and values, E15. Cultural experiences, E16. Cultural ideas, E17. Cultural identity, E18. Cultural interests, E19. Cultural misconceptions, and E20. Cultural ways.

5.7.3 Section III

The Science of Culture covers design factors E21–E25. This section draws from key concepts in the fields of biological science, earth science, ecology, physical science, futures research, and cross-cultural studies to explore the scientific nature of humanity and the possibilities of cultural futures. The design factors include E21. Cultural

anomalies, E22. Cultural cultures, E23. Cultural futures, E24. Cultural infinities, and E25. Cultural nature (Young 2008b, c, 2009).

Information about the society, culture, or target audience is built from the Elements; these data are collected in the applicable areas of the Elements. These data become a culture guide, housed in a database, to the particular society, culture, or target audience. Once the database is built, multiple ITS could be developed based on these data. By example, a comprehensive database of information on the Middle Eastern culture could have aided in building the 3 systems: ELECT-BiLAT, Tactical Iraqi, and VECTOR.

Through Elements the human aspect is brought to design. The design factors under Section I: The Anthropology of Culture could benefit the development of CATS in the following ways. (Of note, the references cited behind the design factors, support the need for these types of design considerations in AI or Human Centered Computing).

1. guides the collection of data from informants and documentation of sources (Forsythe 1999);
2. builds a comprehensive taxonomy of a society, culture, or target audience;
3. aids in the development of content for domain models (Woolf 2008);
4. aids in understanding the cultural knowledge of a society, culture, or target audience (Carpenter and Wisecarver 2006);
5. offers options to consider multiple parameters about a society, culture, or target audience;
6. aids in building an authentic cultural profile of learners or users (Blanchard and Mizoguchi 2008);
7. allows for the development of new cultural models to generate training modules or interaction scripts (Weiland et al. 2003);
8. allows for intercultural analysis;
9. assists in determining cross-cultural clashes; and
10. assists in designing for diverse users (Gregor and Newell 2001).

The design factors under Section 2: The Psychology of Culture could benefit the development of CATS in the following ways:

1. builds a comprehensive taxonomy of the human being;
2. aids in capturing attitudes, emotions (Woolf 2008), beliefs, values, and identity;
3. assists in understanding human behavior;
4. aids in understanding communication (nonverbal and verbal) and language issues (Karkaletsis et al. 1998);
5. allows for an understanding of reasoning specific to culture (Blanchard and Mizoguchi 2008); and
6. assists in the design of racially and ethnically appropriate virtual humans (Lee and Nass 1998).

The design factors under Section 3: The Science of Culture could benefit the development of CATS in the following ways:

1. builds a scientific taxonomy of what is and what could be;
2. allows for considerations based on cultural diffusion (borrowing, acculturation, and appropriation);
3. considers how the environment impacts humans and other species;
4. considers the future of humanity; and
5. makes considerations for the science of humanity.

5.8 Training

Training is the education of individuals. This is another area in providing full management of a project. There are two design factors for training: Tr1. Product training and Tr2. Culture-based training. Most of the information for this training is gleamed from the data gathered through CBM Elements. Tr1 suggests training instructors, practitioners, and others about the product. Tr2 recommends culture-based training of team members; this provides comprehensive educational coverage of the society, culture, or target audience (Young 2008b, c, 2009).

6 Conclusion

Frameworks provide solutions or guidelines to design (van den Akker 1999). The implementation of the 5 Phase Approach, TBLT, and CCST in the design of CATS suggests that (1) there is a need for a broad framework to guide the project management and design of CATS and (2) the building of CATS should not be isolated to military only initiatives.

Empirical studies suggest that CATS can improve learning, motivate learners, and teach information to learners. An empirical study of BiLAT reports that the system aids learners in acquiring content material; this is due to the interactivity of the system and interactions with the virtual human characters (Lane and Hays 2008). Preliminary studies of Tactical Iraqi indicate that students gained knowledge, increased their understanding of the Arabic language, improved job performance, and enhanced "organizational outcomes" (Johnson et al. 2008). The games, in general, motivate learners and motivated learners leads to a successful learning experience (Johnson and Wu 2008). Continued empirical research is needed to provide more conclusive measures of learning gains, strengths, and weaknesses of CATS, the impact of cultural content on teaching and learning, and future areas of improvement.

Several questions still need to be asked: (1) Why is there such resistance in doing the work needed to build CATS and (2) What will it take for CATS and other culture-specific technologies to be valued as global technological necessities?

Designing CATS is a deliberate effort to integrate culture into design. This review demonstrates that there is a process to design. This process should be guided by a framework that provides assistance in project management and design. The development of culture-specific products will eventually move beyond those focused only on language or a few localization features. Therefore, a culture-based model like CBM provides the comprehensive framework needed in building CATS. The inclusion of culture-based design specifications is the future of building innovative technological products and systems.

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