Learning Design for a Successful Blended E-learning Environment: Cultural Dimensions

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Abstract. Blended e-learning is becoming an educational issue especially with the new development of e-learning technology and globalization. This paper presents a new framework for delivery environment in blended e-learning. In addition, new concepts related to the learning strategies and multimedia design in blended e-learning are introduced. The work focuses on the critical cultural factors that affect a blended elearning system. Since it is common that good systems may fail due to cultural issues, this research work highlights these issues and how to utilize them to create a successful blended elearning. It introduces a new blended e-learning model that accommodates different cultural groups and various learning strategies.

Keywords: Blended elearning, cultural factors, interactive components, graphical interface.

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1 Introduction

We are witnessing an enormous advancement in multimedia technologies such as audio/video conferencing, interactive elements, and live video streaming, to name a few [11]. Benefiting from networking and communication technologies and advances, these multimedia applications reshaped the learning and educational system. The conventional learning systems, that mainly depend on textual material, are dramatically changing to a blended learning system where it utilizes the elearning as a crucial component of learning process. Recent years witnessed several works to build solid theory for elearning that incorporates the emerging and rapidly changing multimedia, networking, and educational technologies [20]. The main concern here is to develop an efficient blended elearning that combines the conventional education and the online distance based elearning [4].

E-learning can be defined as any form of learning that utilizes a network for delivery, interaction, or facilitation. The network could be the Internet, a University Local Area Network or even a corporate Wide Area Network. The learning could take place individually (guided or instructed by a computer) or as part of a class. The NCSA e-learning group defined the elearning as [32]:

> e-learning is the acquisition and use of knowledge distributed and facilitated primarily by electronic means. This form of learning currently depends on networks and computers

but will likely evolve into systems consisting of a variety of channels (e.g., wireless, satellite), and technologies (e.g., cellular phones, PDAs) as they are developed and adopted. e-learning can take the form of courses as well as modules and smaller learning objects. elearning may incorporate synchronous or asynchronous access and may be distributed geographically with varied limits of time.

2 Blended E-learning

Blended e-learning, on the other hand, merges aspects of e-learning such as: web-based instruction, streaming video, audio, synchronous and asynchronous communication, etc; with traditional "face-to-face" learning. Valathian described Blended Learning as: "a solution, which includes face-to-face, live elearning and self paced learning"[29].

The benefits of blended e-learning is that it allows students from different cultures the ability to select the delivery format of their learning content, hence improving their interaction with the environment. There are two main areas associated with blended learning environment. The first is the blending of traditional classroom learning and e-learning. This is the most recognized form of blending that looks at combining the theories and practice from instructor-centered and student-centered learning. The second type of blending is that of synchronous and asynchronous e-learning technologies. This blend of technologies will provide students with access to both synchronous and asynchronous communication and information. This is very beneficial when we consider the number of international off-campus students studying course at the tertiary level and the geographical and access issues associated, and to create an environment which is accommodating to cross-cultural learners.

Designing an efficient elearning system is influenced by several issues and critical factors such as pedagogical, technological, management support, and cultural issues; to name few. Among these issues, the cultural issues play a critical role in deploying a successful elearning system. Hence, it is crucial to understand the cultural issues related to the learners, instructors and the online content in order to utilize them as attraction factors.

It is worth defining culture at this point. Culture is a complex and broad concept, which can be defined in many ways. Boldley [5] stated that culture involves what people think, what they do, and the material products they produce. Culture touches members of a society in which it shapes their value, assumptions, perceptions, and behavior. We believe that there is a need for unified educational access to culturally diverse populations. Educators often hear about the positive effects of e-learning systems that is being used somewhere and wonder if it would be useful in their own setting. When such a transfer of electronic learning occurs across different countries and cultures, there is a problem of portability.

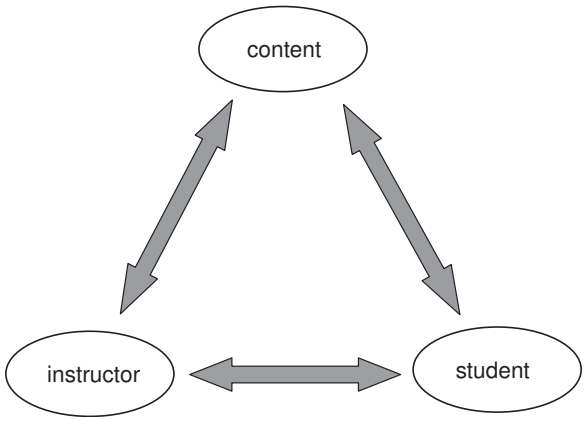

Figure 1: Learning Model

Gujar and Sonone [13] mentioned in their study that the adaption of educational and training to multicultural settings requires a new paradigm that includes an understanding of the deeper psychology of culture and the unique differences culture brings to a global workplace. The question is: How does culture impact the design and development of educational software especially for blended e-learning approach? There is a need for research on culture and its impact on information seeking, user interface design, usability, interactivity, access, delivery, learning style, and content.

Several cultural factors that may be affecting low attraction of elearning systems are identified in this work. The objective is to highlight the problems related to these issues in order to create an efficient blended elearning. The rest of the paper is organized as follows: section 3 presents a learning model that depicts a blended elearning system. Section 4 discusses the different cultural elements that affect blended e-learning on different levels. The learning design strategy for blended e-learning is presented in section 5. In section 6, the authors discuss several issues related to the multimedia interface design for blended e-learning environment. The paper concludes with several recommendations and future direction in section 7

3 The Learning Model and Framework

Blended learning programs may include several forms of delivery and interactions. According to Khan [14], "Blended learning programs may include several forms of learning tools, such as real-time virtual/ collaboration software, self-paced Web-based courses, electronic performance support systems (EPSS) embedded within the job-task environment, and knowledge management systems". In this work, blended elearning means a combination of conventional teaching and online content in its different formats.

A learning model is depicted in Figure 1. It is evident that the model is based on the interaction between the instructors, the learners and the content. This pedagogical model is derived from the Cognitive Flexibility Theory. According to Spiro, et al [26] , cognitive flexibility is the "ability to spontaneously restructure one's knowledge in many ways, in adaptive response to radically changing situational demands" In complex environments, learners generally cannot retrieve an intact hierarchical learning structure from memory; instead the mind combines, recombines, and reinvents structural components to meet the requirements of each particular situation. Cognitive flexibility theory focuses on learning processes in ill-structured, context-dependent learning environments

A framework for elearning is developed by Badrul Khan (http://BooksToRead.com/framework). The main outline of the framework does not include a main group of cultural factors. However, it presents the cultural diversity under the Ethics group. We strongly believe that the cultural diversity is one element of the critical cultural factors of a successful blended elearning. The above framework can be dramatically enhanced by adding a group of "cultural factors"

3.1 Delivery Model for Blended E-learning

By the delivery environment we mean the medium where the learning and teaching process are taking place. The elements of the environment are the learning management system, multimedia equipped classrooms (smart classrooms), and network or the Internet. Here, we propose a new framework for the delivery environment in blended e-learning. Using the proposed framework, the learning activities in blended elearning process can be summarized as follows: *students meet with instructor in smart classrooms. The instructor guides the learning process by utilizing the online content where students access the content via the network (Internet). The LMS tracks the learning activities and provides the instructor with performance report about the learning process.* Figure 2, depicts this model.

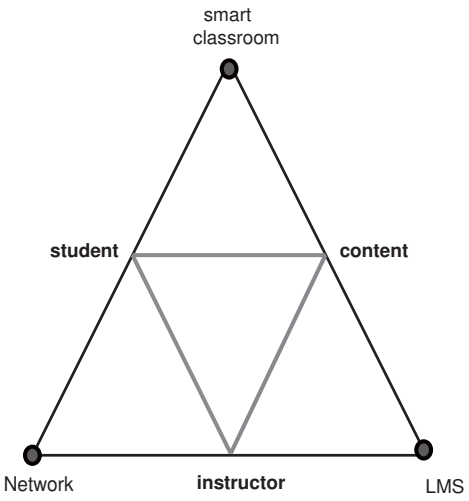

Figure 2: Delivery Environment Framework

It is worth mentioning here that this new delivery framework can be mapped to the Activity Theory [19]. This theory focuses on people activities and their social and contextual relationships of collaboration. It incorporates six elements; primary elements (subject, the object, and community) and mediators (instruments, rules and roles). "An activity is undertaken by a human agent (subject) who is motivated toward the solution of a problem or purpose (object), and mediated by tools (artifacts) in collaboration with others (community). The structure of the activity is constrained by cultural factors including conventions (rules) and social strata (division of labor)". Activity theory offers the possible integration of many human computer instruction theories and concepts. For more information about the activity theory, the reader may refer to [25].

It is evident that the proposed model depicts the relation between students (subject), learning objects or content (object) and the role of the instructor as facilitator (role). The interaction is mediated by the Internet and the LMS (tools) and the collaboration s taken place between students online or in the smart classroom (community). In this environment, cultural issues and phenomenons play a key role in creating a successful collaborative environment. In such an environment, it is obvious that there is a cultural phenomenon controls the environment; i.e., cultural activities [22]. These activities forms the foundation in which individuals interact with objects, people, and tools. Hence, studying the cultural factors related to these cultural activities is of a paramount importance for creating a successful blended e-learning environment. Examples of these factors include communica-

tion langauge, technical factors and social, political, economical, and religious factors.

In the above framework, the medium of delivery is the network and usually it is the Internet. The Internet becomes the natural choice as a delivery medium. Research shows that university students are heavy and frequent users of the Internet [31] Success factors related to the medium of delivery are mainly related to network efficiency. In other words, these factors are related to the bandwidth, strong wireless coverage, application architecture and network's security. The delivery medium requires many-to-many communication (i.e., multicasting). Hence, sufficient bandwidth plays a key role in ensuring smooth delivery. Another important factor is a good wireless coverage and up-to-date tools and protocols in the smart classrooms. In addition to the tools and technologies provided in a smart classroom [23] , every student has his/her laptop and have an access to the content via the wireless network inside the class. Smooth and fast delivery via the network motivates the students and avoids frustrating waiting time to complete the content download. It is worth mentioning here that these issues are tackled in the delivery framework as high level factors and not from the perspective of technical and low-level design. For example, readers that are interested in the technical low-level design may refer to [27].

Another main factor in the delivery environment is the Learning Management System (LMS). There are several LMSs by different vendors. Blended elearning adopters should select the LMS that support the delivery environment. The LMS should support transparently a number of features:

- easy and smooth navigation through system and learning content.
- monitors and tracks of learner performance.
- allows the communication with the instructor and peers.
- provides a wide variety of reports.
- the system should allow the learner to go through assessment material.
- user-friendly interface.
- enables the usability of the learning objects and contents.

In addition to these general features, the LMS should empower instructors to manage the learning content by adding, removing and updating learning objects. Moreover, instructors can manage the classes and courses, and determining students progression and assessing their performance.

4 Cultural Elements & Blended e-learning

This section discusses the critical cultural factors that affect a blended system. In this work we concentrate on factors related to language, technical issues, and social, political, economical, and religious issues.

4.1 Language

Language is a critical issue in global e-learning. Language is a cultural tool, as well as culture itself, it includes not only its most obvious meaning, but also the usage variations within a language that set one group apart from another. Language is one of the most important constraints on portability of educational software. Unless instructors and learners understand the language, the program has no value. It is not just a matter of substituting words. One has to be aware of the meaning, the inferences and connotations.

Dunbar [9] believes that most computer-related material such as manuals, keyboards, software is designed for English speakers and lack features that add symbols, punctuation and accents easily. Even though keyboards have been designed for some languages, this does not solve the problem. Testing and development would constantly require the developers to change keyboards and software environments. This issue cannot be resolved unless there is an international standards effort in the area of technological innovations. One solution to this may be to use visual programming methods and icons to represent various features of the program; however, even icons are sometimes culturally dependent. The challenge is how to turn English-language training materials into culturally sensitive, intellectually stimulating, knowledge- and skill-transferring materials in a different language. Blended e-learning can bring solutions with local instructors who can facilitate learning with proper translation of the learning materials.

4.2 Social, Political, Economical, and Religious Issues

Traditions, political, economical, and values all play an important part in every society. A society's physical and geographical locations may further promote the extent to which these socio-cultural factors become significant in educational matters. National and cultural identities play an important role in interaction with computer-based learning materials. If people from

both cultures are to identify with the software, the content should be carefully written so that there are no clashes of cultural identity. Dunbar [9] stated that technology is encoded with the characteristics of the culture that developed it. For example, individualistic values are implicit in software developed in the United States, whereas these techniques may be totally inappropriate for Arabic students, because they are extremely heteronomous by nature.

Religion and politics both are sensitive issues that instructors and instructional designers who adapt global e-learning, should be mindful of. In Asia, religion, history, economics, class systems, and politics have a deep impact on how life and work issues are perceived and programmed. In addition, political relationships between countries play an important role in cooperation on the academic front. Some countries do not trade with others, and may refuse to buy computers or software made in certain countries based on political ideology. For example, there is a ban on trade between Israel and some arabic and Islamic countries.

Arabic countries have some rich cultures and religious beliefs, which may be violated seriously in the light of the current trends in virtual learning. Akinyemi [2] examined the perspectives of some Arab students on Web-based learning and possible cultural interference. He stated that Interactions between learners and instructors seem to be the bedrock of web-based or online education. Interaction in the virtual realm is faceless and knows no restrictions in terms of race, color, sex, religion etc. A cultural conflict may thus emerge as the interaction patterns cannot be easily controlled between the male and female students. Further, the religious barriers collapse in the virtual realm. He also raised some questions, should or can there be an "Arabised E-learning System"? Will a unique practice in virtual learning not affect the quality and universality of global education?

Localization of educational resources is very important. One of the factors that has made the Cisco Networking Academy program so successful, as discussed by Selinger [24], is that it was taught to nearly half a million students in over 10,000 academies in 152 countries worldwide. The program is a blended e-learning model in which students are locally taught by instructors in face to face settings, using web based teaching materials and hands on labs. The local instructors make the Academy program relevant and accessible to students because they understand the cultural preferences (language, social, political, and religious issues)

4.3 Technical Issues

Technology has a cultural dimension, Pernici et al [21] believe that being aware of cultural differences in technology can help instructional designers and instructors to design more culturally sensitive learning materials. Hardware and software selection is one of the most critical factors affecting portability of educational software As well as the Authoring languages which allow developers to easily change screens that they have developed, whereas programming languages are a little more complicated to manipulate. Countries have various computer systems that are popular in the school system. For example, the BBC microcomputer and Commodore systems are popular in England, where as the Macintosh systems are popular in the United States. Software must naturally be compatible with both systems. In addition, access to technology is an important factor. The gap between the use of learning technology and their application in the social reality of the culture must be reduced. What about teaching learners to surf the web and collaboration using email or chatting without providing them access to the internet. Blended e-learning plays an important role with access to technology in which instructors can facilitate, provide, control the provision and access to technology for learners.

5 Learning Design For Blended E-learning

Learning design is one of the most important aspect in regard to the development of educational software. Designers should consider the following issues when designing program for different cultures with blended e-learning considerations:

5.1 Learner Characteristics

Designers of educational software must realize how people should conduct their thinking, their actions, their rituals, and their businesses. Triandis [28] determines dimensions of cultural variation as individualism- collectivism. He states that Asian countries represent the collectivism culture, while the United States and European industrial countries are characterized by individualism. He also describes collectivist cultures are interdependence, group identity, self-restraint, and hierarchical control. Individual matters are usually subordinated to the goals and benefits of a collective, such as the family, the tribe, the nation etc. Individualism, in contrast, highly values individuality and freedom. The belief in human rights, freedom, and individual equality underline Western social philosophy. These

basic cultural characteristics strongly shape the social systems, lifestyles, and values of each society.

In the case of instructor-centered learning as stated by Conlan [8], the instructor is responsible for conveying the information or knowledge to be taught, and then focus on encouraging the students to use this knowledge and practice it by completing set activities. In this type of learning students rely purely on the feedback given by the instructor in order to gauge their progress. It is acknowledged in [8] that this approach is preferred by students with Asian backgrounds, including Arabic students. In student-centered learning, the responsibility lays purely on the student to complete the set work. Lanham and Zhou [16] argue that the emergence of cross-cultural classrooms has been steadily increasing in Australian tertiary institutions, thus signifying a change in the student demographics. This change has acknowledged that a more flexible approach is needed in the way that the unit content is conveyed to the learner. Studies have indicated that students from different cultures responded variably in different learning environments. They add that to ensure that all students are able to participate in this new learning domain, preparations have to be made to accommodate all cultural types. Instructors are embodiments of knowledge in certain cultures and students do not contradict what the instructor says. Students in some cultures are not used to working independently, therefore, software that is designed for these cultures needs to be adapted to enable students to participate in a manner that is not contradictory to their culture. Hence, with the importance on creating flexible learning environments for all students the blended learning approach can be selected for application. The researchers believe that blended learning could provide online students with the right combination of student-centered learning and the more traditional approaches of instructor-centered learning. As education seems to be expanding towards the online environment it lies with the instructor to provide environments which can be used by multi-cultural users.

In the above sense, it is crucial that instructional designers, developers and instructors understand learners cultural background to ensure the online content are culturally conflict free. In addition, and by nature, learners are different and have different paces. As such, it is very important that the online content contains the learning elements that match the abilities of different learners in order to keep them attracted to the system [30].

5.2 Communications and Interaction Styles

There are substantial cross-cultural differences in interaction and communication. Woolliams and Gee [33] stated that any social group or organizational setting develops its own culture, with norms and expectations relating to aspects such as the degree of formality and centrality in communication patterns. Communication / interaction style appropriate in one country may be totally inappropriate in another country. Originating from the respect for authority and harmony, Asian people generally prefer formality and indirectness in requesting and criticizing, especially when the authority in presence. The pattern can be found in some small things such as, addressing people by family name with title, to general communication patterns. Not being aware of these, westerns may feel confused and uncomfortable when communicating. On another hand, the westerns are used to informality, directness, and less central communication patterns. If a western instructor/trainer brings this type of interaction into Asian countries, he/she may be perceived as rude and disrespectful of learners/trainees. It is very important to acknowledge the differences in communication and interaction styles and adapt them where necessary.

Boriarsky [6] mentioned that for the most common used communication applications, such as email and text chat, some culture members have higher expectations to communicate, which may impose burdens on participants, for example, many Chinese Internet users have higher expectation to communicate than American counterparts according to a recent Chinese online survey. Thus, Chinese learners will potentially face more distractions when they go online to receive training. Hyper linked text is one of extensively studied computer-mediated learning tools. According to Ayserman and Minden [3], many studies indicated that a hyper linked environment emphasizing user choice might not be consistent with a hierarchically oriented culture.

When doing collaborative projects, the cultural variations in understanding of task sharing and context affect the effectiveness of collaboration. Some groups may have a relationship focus while others have a task goal. As a result, different groups perceive on-line tasks differently. Expectations that the course is fixed or static and that the instructor decides the essential resources. We must realize the needs of students from other countries and cultures and recognize that at times the lack of shared meaning can make communication difficult for people of different cultures. Instructional designers must recognize and provide appropriate interface for these learners. In addition, it is important

to create flexible learning environment to facilitate and enhance the interaction styles between learners, learning materials, and instructors through blended e-learning approach.

5.3 Learning Strategies

E-learning is not just about web based content, it can involve simulations, modeling, and remote lab access as well as construction and collaboration tools that engage students in a range of tasks and learning environments. Instructors work with designers of online courses can select the technology that is most appropriate to the domain and the content being taught. In vocational subjects such as information technology, and, to some extent, mathematics and science, cultural relevance is not as pronounced as it is in disciplines like history, social studies, or music where the focus and bias will depend on the location of learners. This does not imply that cultural relevance is not important in scientific domains, but, by and large, the subject content here differs little between countries, and it is only the context in which problems are set and the images used that vary considerably.

E-learning materials can be customized for different cultures particularly with e-learning tools that make use of reusable learning objects so that different approaches can consider cultural differences when teaching the same content. These cultural differences also have implications for how locally based instructors support students, and any advice ought to consider such differences and not advocate one approach.

Khakhar et al [7] report that experience has shown that materials and delivery methods transferred from one place to another may interfere with peoples' cultures and values. Materials used in web education need to be relevant, appropriate and in conformity with cultures and values of the citizenry of many nation. With blended e-learning approach, various learning strategies can be included so that relationship between learners and instructors are strong determinants of the interactions that take place, and any technology-facilitated interventions. Also the adaptation that need to be made for culture in both scientific and humanities can be considered.

We stress here that blended e-learning provides a complementary balance between new and traditional education environments. It will be through the blending process that we will be able to provide students regardless of the location and culture, with a dynamic learning environment. This dynamic learning environment can empower students with the ability to cater the unit learning content to fit their individual learning styles.

6 Multimedia interface Design For Blended E-learning

There are many principles relating to interface design that should be developed. Importantly, as course designers of subjects that includes interface design, we must provide cross-cultural design considerations. Learners need to be aware of the role of visual communication and the impact on the learner. A successful on-line course, web page or educational multi-media package needs to bring together all the elements, including cultural learning objects of successful interface.

6.1 Graphical Interfaces

Graphics and images are the visual language of a culture. When people in one culture recognize an image, people in another cultures may have little or no meaning of it. Yeo [34] demonstrates some graphical issues that mirror the "feel and look" of the learning package. He believes that cultural user interfaces can be created for each culture taking advantage of the knowledge of a target culture.

The cultural differences make designing effective icons and symbols challenging. Today, multimedia programs rely heavily on icons and symbols, as they are very important to communicate with users. Marcus [17] identifies icons as signs that are familiar and easy to understand, and often concrete representations of objects or people. He stresses that icons and symbols should be designed and used to represent the environment of the users' culture. He adds that icons and symbols can replace the national verbal languages and contribute to user interfaces that are international in design and comprehension. Uren et al [10] on the other hand, introduced some examples of symbols like hammer and sickle, rising sun, crosses, stars, and so on which may represent political or religious forces that people from other cultures find objectionable. If western designers are intending to design for Moslem countries, care must be taken, knowing that some people in those countries appear to take offence at things that are quite innocuous in the west.

Fernandes [12] believes that culture is something in which people take pride, and that it must be considered and respected in the user interface. While AlHunaiyyan, et al [1], contend that culture is a discernible variable in interface acceptance and interfaces should be designed to accommodate users' cultures. According to Marcus and Gould [18], current user interface design is based on psychological and social models

drawn from European and American research traditions, while recently, cultural psychologists, cultural anthropologists, cultural sociologists and designers have begun reconsidering the applicability of these models by identifying cultural preferences and value orientations more prevalent in Asia, Latin America, the Islamic world and Africa.

As a designer of multi-media instruction, the basics of interaction, such as use of metaphors, manipulation, consistency, control, simplicity, support, accomplishment, satisfaction and visual design (aesthetic integrity) are worthy principles to strive for. Cultural considerations increase the complexity of designing multimedia interfaces because more variables are added. As graphical interfaces reduce the amount of knowledge users have to remember, metaphors within these interfaces play an important role in creating meaningful and memorable environments for users. However, these metaphors should combine familiar domains with objects and elements that represent a users' culture.

6.2 Cultural Learning Objects (CLO)

Learning Objects (LOs) are reusable components in knowledge databases that provide flexibility in virtual learning environments for reusability, adaptability, generativity, and scalability. In respect to the previous theories of cultural-based and blended learning, the designing of LOs can be enriched by information about the target culture by using artifacts, music, films, and everything that refers to the way that people of the target language live their lives. For example, students can be presented with and be given background information about art objects (jewelry, crafts, embroideries, paintings, etc.) in a particular cultural context.

In an efficient blended e-learning environment, building interesting Cultural Learning Objects (CLOs) is a matter of a great importance. Instead of having to deal with one parameter as with all LOs produced up to now, we are dealing with two, the cultural and the grammatical and structural phenomena. So, the use of interacting properties with text, image and sound might be a better solution. As such, a multimedia CLO, technically speaking, needs an html environment to be integrated.

The researchers think that blended cultural -based learning could provide solutions for increasing interest in teaching and learning. Lambropoulos [15] used cultural-based learning objects to teach Greek language in a way that it could enhance learners' interests and motivation. The suggested proposal might need further development since it is the first attempt to construct cultural learning objects for teaching Greek as second/foreign language. For the design and construction of CLOs it is firstly needed an inquiry into students' needs and common difficulties in learning and secondly a cooperation and collaboration of researchers, teachers, curriculum developers, artists, and multimedia designers in order to produce high quality CLOs.

7 Conclusion and Future Directions

The computer human interaction (CHI) environment regularly researches factors that affect the success or failure in interaction with computers. Designers need to construct meaningful frameworks for making appropriate decisions regarding visual design and user interaction. It is important that we can provide these learners with an environment that they feel comfortable learning in. This is where the blended learning provides instructors with the ability to incorporate both traditional and e-learning design and strategies.

It could be seen that to achieve a truly successfully e-learning environment we need a blend of both the new technology and traditional learning. This does not mean that we simply recreate the classroom material in electronic form and then offer it in an online environment. However, if we utilize the teaching and learning principles of traditional learning that have produced successful results in the past and apply them in the e-learning arena, we will begin the process of creating blended learning technology.

Blended e-learning provides a complementary balance between new and traditional education environments. It will be through the blending process that we will be able to provide students regardless of the location and culture, with a dynamic learning environment. This dynamic learning environment will empower students with the ability to cater the unit learning content to fit their individual learning styles. Some reasons that make blended e-learning a successful approach are:

- Satisfies both instructor-centered and student-centered learning approach.
- Creates flexible learning environment.
- Enhances curriculum relevance.
- Stresses on cultural expectations and learning traditions.
- Provides easy to use cultural interfaces.
- Coordinates and facilitates access to technology.
- Enhances communication and interaction styles.
- Decreases language difficulties.

- Minimizes the load on teachers.
- Allows for more effective and highly satisfactory learning/teaching.
- Enhances self-learning, self-motivation and independence.
- Reduces learning and training costs.
- Supports various learning styles and strategies.
- Provide a balance between new and traditional education environment.

Issues such as: the variations in access to technology; learning traditions; cultural expectations; instructors and learners, all must be considered and analyzed with blended e-learning approach. management awareness of the potential of technology; curriculum relevance; and the level of expertise of the users.

This research introduces a new model for a successful blended e-learning and the influence of the cultural factors on the learning environment. The work, however, does not allow the identification of a comprehensive and reasonably definitive set of design guidelines for interactive multimedia blended e-learning programs which accommodate a users' culture, and a good deal of research will be required to develop guidelines for designing multimedia educational programs that accommodate different cultures. This may encourage researchers to explore further into this field of cross-cultural differences in using multimedia computer-based applications.

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