

Integrating culture into digital learning environments: studies using cultural educational games

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The research presented in this paper focuses on the importance of culture as a design feature in educational learning environments. The significance, benefits and barriers of adopting culturally-oriented approaches are discussed together with recommendations from the literature for overcoming challenges. In this paper, we describe the details of an exploratory study and an experimental study undertaken using culturally-oriented educational games built in accordance with the recommendations for enculturated learning systems. The results and findings of both studies are outlined, and evidence is presented in support of the viability and utility of cultural inclusivity in educational game-based learning environments.

Keywords: cultural inclusivity, digital educational games, e-learning, software design, student engagement

Introduction

Increasing numbers of mobile devices capable of accessing the Internet have propelled e-Learning forward such that deficiencies in cultural-awareness can no longer remain unattended. Originally, e-Learning content and online tools were considered to be more usable if they were designed without any culture-specific features. However, developing culturally neutral content and tools is virtually impossible since cultural tendencies pervade every design choice. The design of user interfaces, the selection of teaching strategies, the format and content of the educational material all vary depending on the cultural background of the developers (McLoughlin & Oliver, 2000). Subtle cultural influences seep into the final product and this can be counter-productive to learning when these effects clash with the practices and beliefs of the students. So, by internationalizing or localizing e-Learning products (Young, 2007), certain users may be included and others left out thereby working against the e-Learning goal of providing individualized instruction to any learner at any time. This happens largely because the cultural background of a learner plays a significant role in shaping his/her learning habits, and cultural appropriateness can no longer be treated as an optional personalization factor.

The influence of culture on learning experiences

What constitutes culture?

According to Savard, Bourdeau, and Paquette (2008), a person's culture can be considered as individual and collective. Here, individual culture concerns the "set of general knowledge acquired by an individual" (Savard, Bourdeau, & Paquette, 2008, p. 84) whereas collective culture refers to the "set of usages, customs, artistic, religious, and intellectual expressions that define and differentiate a group, and a society" (Savard, Bourdeau, & Paquette, 2008, p. 84). Therefore a student's individual culture, formed by his/her typical interests, peculiar beliefs, misconceptions, and specific inclinations, is

biased by his/her collective culture which is in turn dependant on his/her ethnic identity, religious and societal practices, regional history, and geographic location. These inherent influences give rise to an understanding of the factors that can motivate a student to learn.

Significance of culturally-oriented instruction

Based on the arguments made earlier, culture is of great importance because of its impact on the learning style of a student (Subramony, 2004). Since a learning style typifies an approach to learning, the cultural heritage of a student would certainly affect which approaches he/she tends to prefer. Work done in the area of cultural inclusivity and culturally-oriented instruction reveals that students are more motivated and they exhibit increased self-regulated learning when elements of their culture are reflected in their curriculum and used in their learning experiences (McLoughlin & Oliver, 2000; Robbins, 2006).

A student's cultural background also has an effect on what type of instructional method the student is more comfortable with. Zhu, Valcke and Schellens (2008) report that Chinese culture is exceedingly teacher-centered and consequently Chinese students in their study did not favour a social constructivist e-Learning environment since there was very little teacher-presence compared to their Flemish counterparts who were accustomed to blended learning approaches.

Expectations concerning instructional feedback are also defined by one's cultural background. For example, Hudley and Daoud (2007) found that students with a Latino background were more receptive when a positive interpersonal relationship was formed with their teachers compared to students with an Anglo background who valued academic validation more than a warm relationship. Assessment modes also differ across cultures because different cognitive styles are often adopted. Flear (1989) shows that Aboriginal learning cultivates strong skills in visual, spatial, and long-term learning whereas the test procedures in educational software available to students are not designed to test these skills. Consequently, Aboriginal students are considered to be underperformers and this is solely because of the inappropriate test procedures. These dimensions of learning style, teaching approaches, reward allocation, and feedback requirements show that cultural influences cannot be separated from the learning process since culture is an integral part of the identity of an individual.

Barriers to developing culturally-oriented e-learning environments

Despite the compelling connections between culture and learning, culturally-oriented e-Learning environments are limited in practice. This is due to several factors, such as the fact that current instructional designs may not pay attention to issues of cultural sensitivity (Young, 2007), because of the perceived decrease in reusability of content and tools that are culture specific (McLoughlin & Oliver, 2000) but mostly because of the difficulty in representing culture computationally (Blanchard & Mizoguchi, 2008).

Culture is an ill-defined domain; this means that it is difficult to define what comprises culture, since culture is shared by members of a group or society and very often members vary in their embodiment and expressions of aspects of their culture (Blanchard & Mizoguchi, 2008). E-Learning environments are in essence pieces of software and therefore application features and desired software functionality must be expressed in a well-defined, unambiguous manner. As a result, many developers have shied away from cultural representations because of the complexity in reliably representing various aspects

of a particular culture. In addition, developer partiality towards stereotypes and personal interpretations compromises the authenticity of any cultural representation. This can be detrimental to learning if it is offensive to the learners hence it has been avoided altogether by many developers. Young (2007) points out that the dearth of culturally-oriented ICT systems can also be attributed to the lack of guidance regarding the integration of culture-specific elements into present-day instructional design.

Above all, e-Learning has as one of its advantages, the possibilities for reuse of content and tools and resources; hence by meeting the cultural needs of one user, another user's needs may not be met unless the design of the content or tool is reworked. This is costly and time-consuming. All of these reasons contribute to the general notion that paying attention to culture may be a challenge in the development of e-Learning environments.

Recommendations for representing and using culture

Different recommendations for representing culture in software systems appear in the literature. These range from simple user interface design guidelines to learner profiling and inclusion of tangible cultural elements. The most common recommendation made by researchers is the consideration of the learner's background from a pedagogical perspective. Young (2007) and Flear (1989) suggest examining the dependency between a learner's cultural background and his/her skill and ability levels. McLoughlin and Oliver (2000) prescribe the use of instructional techniques that compliment the learning style(s) dominant to a particular culture. Economides (2008) advocates all of the above and argues for the use of a learner cultural profile based on mainstream cultural models, however no implementation details are given.

Another common recommendation involves the use of symbols, familiar contexts, customs and traditions belonging to the culture that one wishes to integrate into the e-Learning environment. For example, Flear (1989) uses illustrations of flora and fauna indigenous to Australia, and incorporates examples of the local beliefs, life experiences and symbols native to Aboriginal culture in an educational (reading and writing) software package called *Tinja* developed for Aboriginal students. Robbins (2006) makes use of analogies and local metaphors in a collaborative digital scrapbook built for South Pacific students, and goes a step further by giving the users the power to customise the tool with their own content and cultural elements.

By having a person native to the culture provide cultural content, the authenticity of cultural representation is greater and more recognisable. This point was also stressed by many of the researchers as a means of addressing the stereotypical and biased viewpoints that may be introduced by developers who are not native to the culture for which the tool or content is being developed. Interesting work is being done by Blanchard and Mizoguchi (2008), and Savard, Bourdeau and Paquette (2008) on the development of holistic cultural learner models that are represented computationally and that can be shared by e-Learning tools. These models incorporate the pedagogical and cultural aspects of the learner and show great promise for bolstering the spread of culturally-oriented e-Learning.

Experimental studies using culturally-oriented software: digital educational games

Background to the studies

The recommendations outlined in the previous section can be accommodated through digital game-based learning (DGBL) environments (Mohammed & Mohan, 2008). Educational games have been shown to be suitable learning environments because of the many

learning approaches that are intrinsically accommodated (Gee, 2007) such as problem-solving, collaborative learning, constructivism, and situated learning. Incidentally, these instructional strategies have been regularly mentioned by proponents of culturally-sensitive instruction (Economides, 2008; Fler, 1989; Henderson, 2007; McLoughlin & Oliver, 2000; Young, 2007) owing to the easier integration of cultural elements through context. Tangible representations of culture through images, dialogue, game-feedback, storylines, character designs and so on have been proposed by Mohammed and Mohan (2008) because of the fundamental use of graphics, audio, and textual content in games. Educational games that aim for balanced, principled pedagogy must provide some form of student modeling (Mohammed & Mohan, 2007) which consequently provides a suitable integration point for cultural learner models. Blanchard and Frasson (2006) give further support for the integration of cultural backgrounds into intelligent learning environments such as games, adding that it is useful for stimulating student motivation through self-directed learning.

Two studies were conducted using cultural educational games at The University of the West Indies (UWI), St. Augustine campus. The first study was exploratory and investigated student attitudes towards student-developed games which featured some of the cultural recommendations expressed earlier. The second study focused on evaluating a cultural game prototype that advanced the findings of the exploratory study and incorporated more of the cultural recommendations expressed earlier. The details of each study are described below. The vernacular used in the games is formally referred to as Trinidadian English Creole (TEC) by linguists and historians involved in the study of Caribbean people and their languages. When TEC is used to describe the customs and everyday events characteristic to Trinidad, the local culture can be represented as a narrative that has comedic appeal. Rich story-based scenarios can be easily put together by describing simple events using TEC phrases and by including Trinidadian cultural twists related to these events.

Exploratory Study of Student Attitudes towards Cultural Educational Games

An exploratory study was conducted at UWI, St. Augustine campus, which focused on using humorous aspects of Trinidad and Tobago culture in an attempt to improve undergraduate student attitudes towards their introductory programming course (Mohammed & Mohan, 2009). Students from the third-year game programming course COMP 3000 produced educational programming games for their coursework assignment based on cultural game designs, described in Mohammed and Mohan (2009), including the use of comical phrases expressed in TEC language and references to local events and items which have amusing names. Two of the games produced by the students were used as the basis for the exploratory study. These games were Caribbean Conquest and Lazy Jim.

Caribbean Conquest is a single-player, turn-based game, which features two islands of the Caribbean, where the player (representing Trinidad and Tobago) must conquer unsettled islands before the enemy (Barbados), by sending people to settle the island within a specific time. Players must solve the programming problems during the game and if they succeed, their island defenses are strengthened, otherwise the enemy gets a boost in defense. The problems test the player's skill in error detection and correction of C code where the player must select the line of code with an error and then type in the correction.

Lazy Jim is a single-player game where players pose questions to shopkeepers in the market, the grocery and the hardware store in order to get items on a shopping list. In the game, questions are asked when the player wants an item, wants to know where

to find an item, or wants to know the price of an item. TEC language features strongly in this game, together with images of local food items as per the requirements given to the COMP 3000 students. The learning exercises in Lazy Jim are similar to those of Caribbean Conquest, where the player must identify the line of code with an error and then suggest the correct substitution.

Twenty four students evaluated the two games. Questionnaires were administered to gauge their interest in digital game based learning, to find out what they thought about using culture and games, and to get their opinion concerning the effectiveness and utility of the culturally-oriented game prototypes. Demographic data and details about the students' gaming behaviour were also collected.

Twenty three students indicated that they played games several times monthly confirming the digital native prevalence among our students. When asked about using educational games in their programming courses, 25% did not want to use games at all, 50% opted for games as a supplement to lectures and tutorials, 21% wanted to use games to replace everything, and 4% gave no response. Over 80% of the students appreciated the use of culture in the games, and they were especially engaged when humour was involved. Enriching learning experiences, national pride, and humour were the top reasons cited by students for which they would use a culturally-oriented educational game. Mohammed and Mohan (2009) found that the local culture did play an important role in promoting a positive student attitude towards learning, and had an impact on student motivation and interest in the subject.

Trinbago Adventures of L. Macawell (TALM): a cultural educational game for increasing programming proficiency

Based on the encouraging results of the exploratory study, an advanced culturally-oriented educational programming game was built in accordance with principled game design guidelines. These included believable game physics, understandable gameplay, entertaining characters, proper saving mechanisms, well-defined game goals and achievable challenges (Oxland, 2004). The game, Trinbago Adventures of L. Macawell (TALM), is a two-dimensional, single-player adventure game set in the context of typical scenarios in Trinidad and Tobago. Dillon (2004) and Gee (2007) advocate an adventure genre for educational games because of the range of learning styles and activities that are supported particularly problem-solving and experiential learning through storytelling. TALM is based on an adventure game theme for these reasons however more so because it promotes meaningful use of cultural elements through narrative devices such as engaging characters and interesting plots. Furthermore, we believe that situated learning, bolstered using concrete cultural references, has the potential to create greater interest in abstract subject areas such as computer programming. As such TALM focuses on developing deeper analytical programming proficiency in students, a necessary and severely underdeveloped computer science skill (Gray, Edwards, Lewandowski, & Shende, 2005).

Appelman (2007) comments that educational games should have more reusable content than entertainment games. TALM was designed with reusability at its core so that the educational activities—programming exercises in this case—were not coupled tightly to the game's implementation. New exercises can be exchanged with old ones without affecting the game as long as the exercises match the context of the storyline. A student model was used to direct instructional events such as changing an exercise, recording student activity such as time spent on an exercise, and for evaluating student progress. A tutoring component was used to evaluate the student's answers and change the learning

activities while coordinating to match the game plot. Cultural elements were showcased through game objects, character dialogue and the storyline. Trinidad English Creole (TEC) was used in the character dialogue, game feedback and game object design.

Figure 1 shows screenshots of TALM. In the game there are two phones as shown in Figure 1(b), one belonging to the main character/hero and the other belonging to a non-player character (NPC). The storyline involves a lazy, technologically-savvy young boy, L. Macawell, who has to go shopping for his mother (the main NPC). His mother has stored the shopping list on her phone in an attempt to encourage the boy using technology.

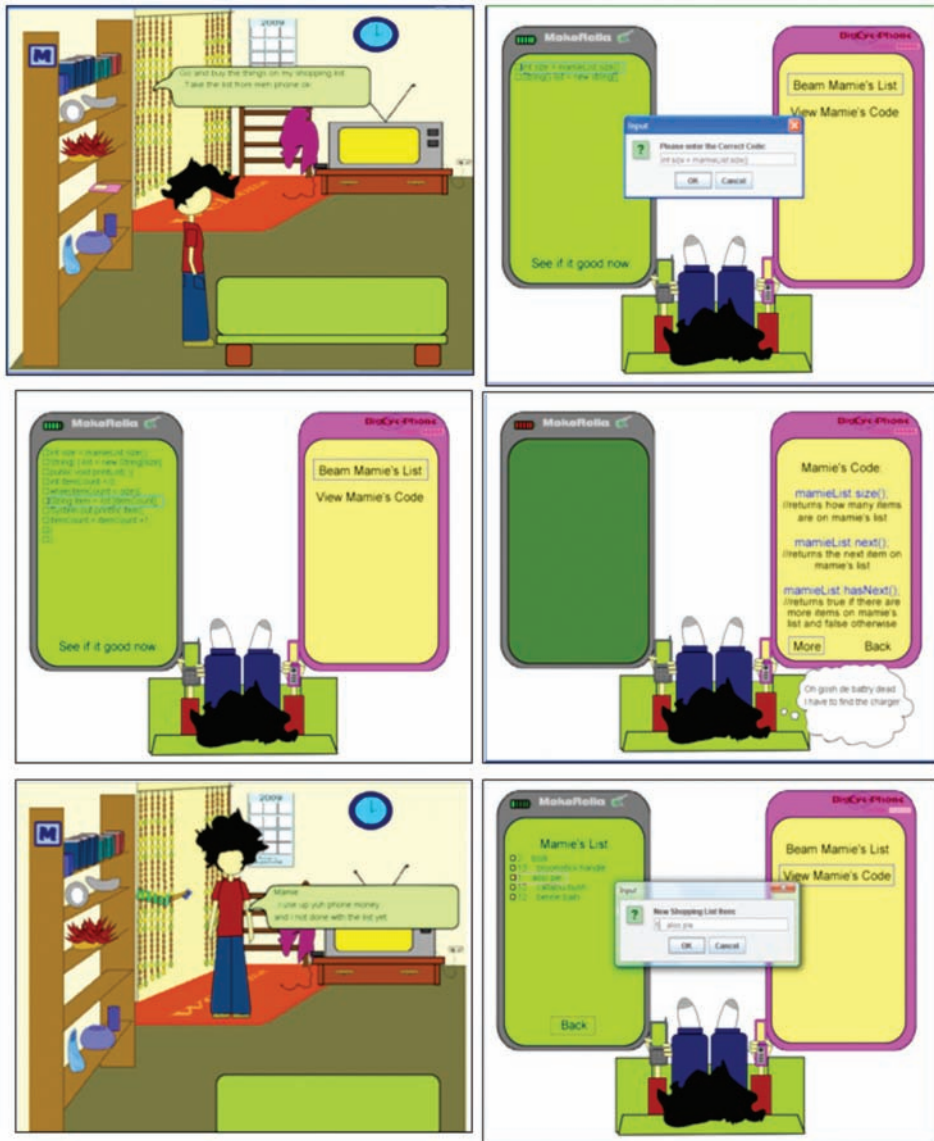


Figure 1. Screenshots of TALM: (a) Opening scene (b) Programming exercise scene showing the two phones and the player's attempt at fixing the code on the hero's phone (c) Programming exercises becoming more difficult as the game progresses (d) Scene where the hero's phone battery is depleted and the phone screen goes blank (e) Hero searching for a top-up card from the NPC (f) Reward scene showing the editable shopping list.

Unfortunately, the boy's phone does not work properly because of faulty computer code and he has to repair the code on his phone in order to receive the list through a successful data transfer. At the start of the game, players have to locate the NPC phone as shown in Figure 1(a), and then they must figure out how to send the shopping list located on the NPC phone to the hero's phone. Controls for initiating the transfer and receipt of the list are on the NPC phone and the hero's phone. Transfers cost money and when the NPC phone credits are used up, players have to search for a top-up card for the phone before another transfer can be done. This is shown in Figure 1(e) where the NPC presents the hero with a card from behind the beaded curtain when he steps on the welcome mat. There are a limited number of top-up cards available in the game.

The programming code controlling the hero's phone contains errors which prevent the receipt of the list and players have to detect, repair the errors and check for code correctness – these are essentially the programming exercises. Incrementally, the code snippet increases in functionality and difficulty as the player corrects the errors until the functionality required for sending the list is completed as shown in Figure 1(b) and (c). Parts of the list are displayed on the hero's phone as the code snippet expands thereby giving the players feedback on their progress. Using the features of the hero's phone drains the battery as shown in Figure 1(d), and when the battery is depleted players have to locate the charger and recharge the phone battery since the screen goes blank. Throughout the game, players are teased with TEC cultural idioms and expressions when different events occur such as the hero thinking “pressure does buss pipe¹” in frustration when the phone discharges. At the end of a successful game, the player is rewarded with the completed shopping list and they are allowed to add on something of their choice as shown in Figure 1(f). The shopping list is generated randomly and consists of local objects and items. Figure 1(f) shows an example of such a list with items such as “aloo pies²” and “callaloo bush³”. High scores are displayed with the number of chargers used and the number of top-up cards used.

Experiment design and results: TALM prototype evaluation

TALM was evaluated to determine whether usage results in any increase in analytical programming skill, and to gauge student opinion and interest in the culturally-enhanced approach taken. Student awareness of cultural expressions commonly used in Trinidad and Tobago was assessed as well. Thirty-five (35) students, 21 males and 14 females, enrolled in the second year object-oriented programming course at UWI voluntarily participated in the experiment. Aged between 20 and 35 years (mean=21.9, s.d.= 5.262), 56% were of African descent, 26% were of East-Indian descent, and 18% were of mixed ethnicities. Three of the students were native to St. Lucia, and St. Vincent and the Grenadines while the remaining majority was from Trinidad and Tobago.

Research method

The students were given a ‘cultural’ questionnaire, i.e. a questionnaire containing a series of cultural expressions common to Trinidad and Tobago and they were asked to indicate their familiarity with the expressions. Next, a timed pre-test was administered to the

¹TEC saying (High pressure can burst pipes) used when problems or hard work become intolerable (Mendes 2007)

²Local East Indian delicacy of fried soft dough filled with potato and curried chick peas (Mendes 2007)

³TEC name for either Amaranth (spinach) or the leaves of the Taro plant. It is used in a popular Caribbean soup dish called callaloo (Mendes 2007)

students after which they were allowed to play with the TALM game for 20 minutes in the Computer Science laboratory at U.W.I. An equivalently timed post-test was subsequently administered, followed by an evaluation questionnaire and demographic survey. At the end of the experiment, gameplay logs were retrieved from the student machines. The educational materials used in TALM and for the pre- and post-tests were based on part of the programming curriculum for the object-oriented course.

Results

The cultural questionnaire was used to find out whether students in the sample were familiar with the cultural expressions and examples used. The expressions supplied in the questionnaire ranged from local names for everyday objects and foods such as “baylna” and “crocus bag” to common TEC idioms such as “to try all how”. Two participants failed to complete their questionnaires and were omitted from the results. 330 responses were collected and the breakdown of the responses based on student familiarity is shown in Figure 2. The large majority of students were very familiar with the expressions.

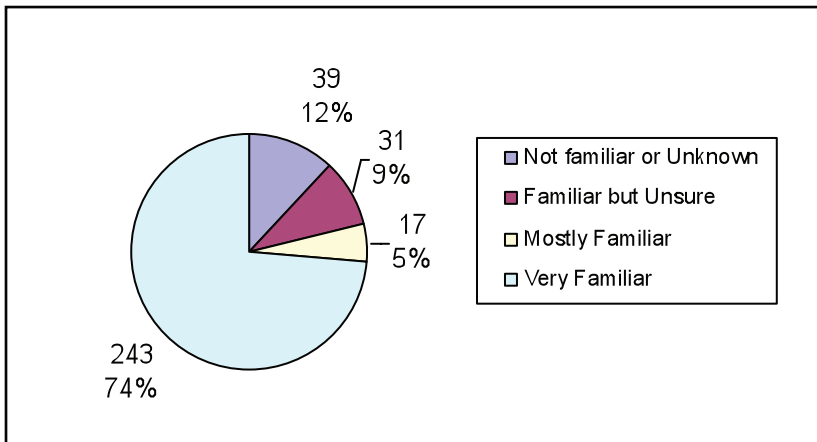


Figure 2. Student familiarity with cultural Trinidad English Creole expressions.

The students spent an average of 11.17 minutes playing the game, and an average of 9.14 minutes time-on-task with the programming exercises. Initial examination of the pre- and post-test scores indicated a positive change in the post-game performance of 77% of the students as illustrated in the graph in Figure 3 below. The average pre-test score was 3.286, the average post-test score was 4.943 and the average difference between the pre- and post-test scores was 1.657. It should be noted however, that the difference is modest and not statistically significant ($p=0.3920$).

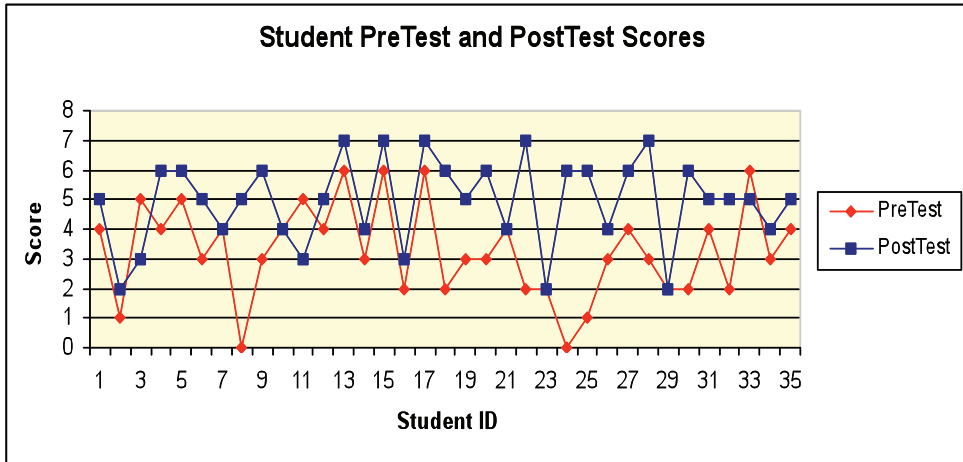


Figure 3. Graph showing modest increases in student test scores after playing TALM.

In the subjective assessment survey, 60% of the students rated the game as ‘really good’ and ‘pretty good’. The remaining 40% rated it as ‘good’ and ‘ok’. The most popular reasons for liking the game were the use of cultural slang, the humour of the character dialogues, the gameplay – specifically the depletion of the battery and phone credit, interesting problem-solving context, and the storyline. The most common reasons for disliking the game included poor usability, bugs in the game, insufficient gameplay instructions, and lack of hints for the programming exercises. It is interesting to note that use of culture was not mentioned by any of the students as being an impediment or irritating but rather an incentive. The difficulty of the exercises received mixed reviews: 38% of students found them fairly or very easy, 31% were neutral and 31% described the exercises as challenging. In spite of this, 50% of the students indicated that they enjoyed solving the problems using TALM, 34% were neutral, and only 16% did not enjoy the problems.

TALM was built to reinforce analytical skills and the students became aware of this after playing the game. 40% felt that their skills improved and singled out specific strengths such as error detection and syntax precision, and specific topics related to the course such as array declaration, string handling, objects and constructors. 40% felt that there was little or no improvement and 17% were neutral. With respect to their proficiency in object-oriented programming 34% of the students rated themselves as very or somewhat strong, 49% considered themselves neither weak nor strong, and 17% indicated that they were weak. Logged gameplay data revealed positive correlations between the time spent on the programming exercises in the game and the increases in student post-test scores. Table 1 shows that these correlations became stronger as the student’s proficiency weakened. Weak positive correlations were also found between time spent on programming exercises and increases in post-test scores for female students ($r=0.0925$) and male students ($r=0.0476$) However, these relationships were not statistically significant ($p>0.1$).

Table 1. Correlation between time spent on programming exercises and increases in post-test scores for students categorized by programming proficiency.

Programming Proficiency	Correlation Coefficient
Weak	0.5253
Weak to Average	0.2689
Average	0.1857
Strong	-0.2242

Note: $p > 0.1$ for all values

Significant positive correlations were found between several other variables and these are summarised in Table 2 below. All of the parameters with the exception of the number of cultural elements seen in the game were extracted from close-ended questions patterned as five-point Likert items in the evaluation questionnaire.

Table 2. Relationships between various parameters extracted from the evaluation questionnaire and game logs

Parameters		Correlation Coefficient
Game Rating (ok to especially good)	Enjoyment of Programming Exercises (Not at all to very much)	0.553**
Perceived skill improvement (none to quite a lot)	Enjoyment of Programming Exercises (Not at all to very much)	0.422*
Programming proficiency (very strong to very weak)	Challenge of Exercises (very easy to very challenging)	0.313*
Challenge of Exercises (very easy to very challenging)	Number of cultural elements seen in game	-0.384*
Perceived skill improvement (none to quite a lot)	Number of cultural elements seen in game	0.383*

Notes: ** $p < 0.001$; * $p < 0.01$

Analysis of results

The increases in test scores were minimal largely because of issues with the usability of the game, insufficient instructional guidance, and limited playtime with the game. Matters related to meagre clues in the game for solving the puzzles and locating items, counter-intuitive navigational and help menus, bugs due to inadequate testing prior to deployment, and obscure feedback were understandably frustrating for the participants. We believe that these prevented larger learning gains and will be addressed in the upcoming version of TALM because important game design principles are at stake. In spite of this, the novel storyline and cultural approach were appealing enough for most students to persist beyond these impediments. Although the average time played was 11 minutes, approximately one third of the participants played well-beyond 15 minutes and were disappointed when their 20 minute limit expired.

Overall, the students liked the cultural gameplay primarily because of the reasons outlined in the exploratory study: enriching learning experiences and humour. The use of culture created a familiar setting and it was done in a way that was relevant to the course

content. The results of the TALM experiment confirm the effectiveness of specific types of cultural humour as an incentive for learning and the game's design illustrates how to effectively incorporate these types of cultural humour into a classical game design. Based on Neulip's (1991) humour classification, untargeted humour (cultural jokes, puns, expressions), non-verbal humour (game character's lazy movement) and external humour sources (funny names for objects on shopping list, and phones) were successfully used to create a contextualised learning scenario. Subtle examples were used in the game such as a spoof on a popular phone name, 'Mokorolla' (Moko is a local name for a variety of plaintain) and these created memorable experiences for the students who enjoyed discovering the understated jokes. This enhanced the significance and realism of the educational content and consequently increased the students' confidence by diffusing frustration and providing hidden rewards. Support for this claim comes from the strong, very significant positive correlation between the student's rating of TALM and their enjoyment of the programming exercises ($r=0.553$). Greater enjoyment of the exercises led to higher game ratings.

Habgood (2007) points out that when the most interesting parts of a game are used as the base for instructional activities, players will be engaged and play longer. Although not statistically significant due to the small sample sizes, interesting results came from a fine-grained analysis of the relationships between the time students spent on the programming exercises in TALM and the proportionate increases in their post-test scores. Table 1 shows a trend where greater time spent on the exercises led to better post-test increases as the student's proficiency weakened. This implies that weaker students benefited more from the time they spent on the game's exercises while stronger students benefited less and in some cases worsened. Certain students can benefit from educational games and these results hint towards the weaker and average students as the main beneficiaries. The weaker relationship for male students ($r=0.0476$) compared to female students ($r=0.0925$) for the same parameters suggests that females may reap greater learning benefits over males for the time spent with this type of game. These relationships need to be investigated further before concrete claims can be made but they allude to interesting trends for future research.

As expected, there was a linear relationship between students' programming proficiency and their ratings of the challenge of the programming exercises ($r=0.42195$). The exercises seemed to be more challenging to students with lower programming proficiencies. A greater enjoyment of the exercises led to a perception amongst the students that their programming skills had increased ($r=0.42195$). In addition, more cultural elements seen while playing TALM made the programming exercises seem easier ($r=-0.384$) and increased the perception of skill improvement ($r=0.383$). As the number of elements seen increased, the students rated the exercises as less difficult and felt as though their skills were improving. These relationships indicate that the cultural design of the game was successful in promoting positive student attitude not only towards the programming exercises but also instilled a sense of confidence and created a more relaxed atmosphere. This evidence empirically supports the many statements made throughout the literature that advocate a culturally-sensitive approach (Economides, 2008; Henderson, 2007; McLoughlin & Oliver, 2000; Young, 2007) and confirms the viability and utility of culture in educational game-based learning environments.

Conclusion and future work

Culture is rapidly becoming an important consideration in the design of eLearning software firstly because of the increase in the number of users accessing software over the Internet, and secondly because of the sheer diversity in the cultural backgrounds of these users. Conventional learning has often taken place in a localized setting with a teacher guiding one or more students in their search for knowledge. With the advent of the Internet, this traditional setting has changed drastically since students now have access to teachers and educational material from over wide distances. Consequently, these students are exposed to a variety of educational tools, teaching strategies and learning materials which were not developed with their own personal needs in mind. This has dramatic usability implications especially when the mainstream culture for which e-Learning materials are designed clashes with that of the users.

The research discussed in this paper focused on the value of culture in e-Learning environments. An investigation of how culturally-oriented learning environments impact upon student learning experiences was carried out through two studies. The exploratory study revealed that undergraduate programming students at UWI are receptive and interested in the use of culturally-oriented games for practicing and gaining skill in programming. The students appreciated the use of culture and were especially engaged when humour was involved. Subtle, careful use of cultural semiotics, specifically familiar language and cultural names of objects and foods were used in an advanced educational programming game, *Trinibago Adventures of L. Macawell (TALM)* which was evaluated following the exploratory study. The game adopted a contextualised approach towards strengthening analytical programming skills in computer science undergraduate students and leveraged the most interesting and attractive parts of the gameplay mechanics with cultural humour that was relevant to the course content and familiar to the students. Modest learning gains in the analytical programming skills of students who evaluated TALM were reported in the experimental study which provides empirical evidence in support of the viability and utility of culture in educational game-based learning environments.

Further refinement, extension and improvements are planned for TALM. Work on a more sophisticated tutoring component which caters for the analytical skill level of the player is currently in progress along with the creation of a larger variety of cultural and instructional assets. Additional features such as cultural player profiling and extended gameplay levels are also part of the plans intended for this research. Future tests include longitudinal studies with larger sample sizes which would give more fine-grained evidence relating specific aspects of culture to any development of positive student attitude and learning gains resulting from the use of a culturally-oriented gaming environment.

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