

# Using Culture to Motivate Learning in a Digital Game Based Learning Environment

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**Abstract.** The educational game described in this paper, *Trinbago Adventures*, is being developed with the intention of addressing the following research question: whether culture can be used to motivate learning and create appeal in an educational gaming environment such that determinate learning objectives are achieved by the players. In particular, this game targets undergraduate university students native to the Caribbean region, and who are enrolled in computer science degree programs at the University of the West Indies. The components which make up the game's architecture, and the activities and strategies employed to motivate and measure learning are described along with the enhancements Caribbean culture brings to the learning experience when used. The paper also reports on two successful examples of game based learning environments which augment motivation by using culture, and outlines the challenges to be faced with the development of *Trinbago Adventures*.

**Keywords:** educational game, culture, humour, learning, motivation.

## 1 Introduction

*"It have any pommerac around here?" "Reverse back down the road until you see a man selling coconut on the side in ah dead out old truck. Sometimes it does have a lady selling near there." Dass followed the man's instructions when suddenly 'badam!' the car hit a pothole. Unfazed, he continued back up the road when as the car turned the corner, he had to mash brakes ...a pothong was sprawled off in the middle of the road. After the animal cheups and slowly moved out of the way at the last minute, Dass found the lady. The lady approached the window as the car stopped, "Yes doux-doux, the pommerac sweet too bad. Ten dollars ah heap." Dass replied, "Ah go take that heap there tants." He collected the fruit, added it to his cache, and consulted his map for the next direction."*

The narrative given above describes a typical scenario within an educational game designed using the sociolinguistic context of a Caribbean island setting for motivating learning. The interaction models common to the Caribbean region are a complex interplay of social and cultural elements, heavily influenced by a heritage of English, Dutch, Portuguese, French and Spanish vernacular. As such, the narrative above

would cause some confusion and possible discomfort to readers who are unfamiliar with the dialect since there are many instances of incorrect grammar and words which sound like gibberish (see Appendix for a glossary of terms used). The opposite would be true for readers who are aware of the colloquial speech used in the Caribbean (West Indies) by either being native to the region themselves or through interactions with West Indian speakers.

The educational game described in this paper, *Trinbago Adventures*, targets undergraduate students enrolled in the computer science degree program at the University of the West Indies which is a multiple-campus university distributed across Jamaica, Barbados, and Trinidad and Tobago. Of the three locations, the game has been designed for computer science students enrolled at the Trinidad and Tobago campus (hereafter referred to as U.W.I.), and therefore features the culture, unique scenery, and diverse fauna of the Caribbean twin-island nation. The game derives its name from ‘Trinbago’, a common expression used to refer to the single statehood of both islands [1]. At U.W.I., the majority of the computer science students are familiar with the Trinbagonian culture either being citizens or native to the Caribbean region. The inspiration for the game emerged after several interesting observations were made by the authors in and out of computer science programming classes. Generally, they are able to understand abstract concepts after observing the execution of actual code but they require a lot of programming practice as a result; this is rarely pursued by the students out of class. In addition, the students’ inclinations towards technology (evident by their constant preoccupation with online tools and mobile devices) and present lack of motivation in attending lectures strengthens the prospects of using digitally enhanced learning environments. Furthermore, the students often respond positively to instruction laced with local stories and language since it creates an encouraging, familiar setting for discussion.

These observations prompted the research question that *Trinbago Adventures* intends to address: whether culture can be used to motivate learning and create appeal in an educational gaming environment such that determinate learning objectives are achieved by the players. The paper is organised as follows: Section 2 describes the general design of *Trinbago Adventures*, the components which make up the game’s architecture, and the activities and strategies employed to motivate and measure learning. Section 3 discusses the value of incorporating cultural context into learning environments, and particularly highlights how Caribbean culture enhances the learning experience when used. Section 4 reports on successful examples of learning environments which augment motivation by using culture and by being game-based. Section 5 goes on to outline the challenges to be faced with the development of our educational game. The paper concludes in Section 6 with the current status of the game and plans for future work.

## **2 Game Design: Trinbago Adventures**

A citizen of Trinidad and Tobago is sometimes referred to as a ‘Trinbagonian’, however, residents of Trinidad are referred to as ‘Trinis’. These terms will be used

throughout the paper. In addition, students and learners are referred to as players in the remainder of the paper.

## 2.1 Game Description

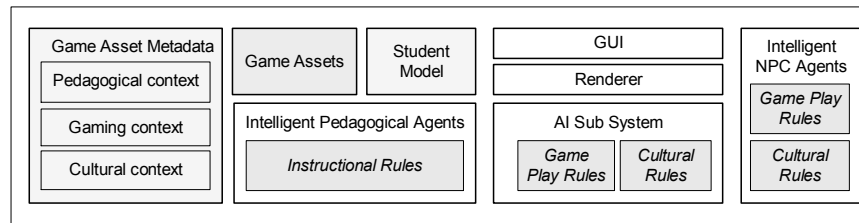
*Trinbago Adventures* is an adventure/driving game and offers two modes of game play: players may either embark on treasure hunt rallies, or go on free form exploration of the island landscape. In the treasure hunt rallies, players must race (long distance) across the country within a certain time frame while collecting unusual items or treasures located along the driving course. They have to interpret a navigational rally map in order to find the checkpoints stationed at unknown locations. The second mode, free form exploration, does not have a time limit so players can travel around the country going to places of interest, sightseeing, or exploring new routes and streets. They must obey the traffic laws at all times while being wary of the 'Trini' driving culture. Hazards such as potholes, road construction, 'badjohn' drivers (a local term for motorists who drive inconsiderately and recklessly [2]), and occasional crossing animals are common in the game, and players need to find ways of overcoming these obstacles. These and other examples of local culture are widespread throughout the game so players are exposed to the more humorous elements of a typical Trinbagonian way of life as depicted in the scenario at the start of the paper. For instance, a 'pothong' is a dog of mixed or uncertain breed, generally keen on eating and sleeping rather than pursuing trespassers in spite of their fierce nature. These dogs often enjoy the warmth of sitting in the roads oblivious of the annoyance they cause to motorists, and are a common sight in Trinidadian villages and towns.

*Trinibago Adventures* is an educational game and as such there are learning objectives in the game. Drivers must be able to configure their vehicles' operational features prior to use and during use since things often go wrong during the game. Features such as starting, braking, accelerating, engaging the autopilot, cruise control and navigational guidance system require knowledge of computer science concepts since players are essentially programming the functionality into their vehicles. These features are required in both the treasure hunt rallies and free form exploration. Participating in the treasure hunt rallies however requires additional functionality such as keeping a digital record of treasures collected, and decoding the rally map. Players can also seek guidance from locals or auto mechanic garages when in difficulty.

## 2.2 Game Components

One of the research objectives of *Trinbago Adventures* is to analyse the impact of culture on motivation to play and learn using digital game based learning environments. Consequently, the game must be able to represent elements of Trinbagonian culture such that the player's interest in the cultural representation can be captured and analysed. Additionally, the game must be able track and measure the player's learning progression resulting directly from motivation to interact with the cultural elements of the game. Figure 1 shows the architecture of the game which has been designed with

these requirements in mind. Intelligent Tutoring Systems have a long history of modelling and assessing a learner’s knowledge during electronic tuition. Accordingly, the game architecture is composed of major ITS components (student model, instructional rules, intelligent agents) for these purposes along with several other components critical for a gaming environment (renderer, AI sub-system, game rules). These will now be explained in more detail.



**Fig. 1.** Game Architecture of Trinbago Adventures

The student model serves the traditional purpose of recording the player’s knowledge levels, learning achievements, and learning goals. It stores logs of the pedagogical events in the game such as the player’s successful and failed attempts at learning activities, time taken to give answers, suggested hints and instructional guidance given to the player. In addition, the model tracks the player’s interaction with the game, and records information related to how the game is being played. This includes player dwell time on game objects, game branches followed during game play, number of interactions with non-player characters (NPCs), rewards collected, and penalties earned. It is essentially a snapshot of the player’s educational and gaming experiences. Intelligent pedagogical agents constantly access and update the student model in response to messages from the game’s AI sub-system. Whenever a game event occurs, the AI sub-system forwards information such as input data and event type to these agents. Subsequently, instructional rules are used by the agents for decision making relevant to the event with the end result of scaffolding the learning activities and determining appropriate feedback for the player. Any feedback given is stored in the student model so that the records of the player’s experiences are kept up to date.

Another type of agent featured in the *Trinbago Adventures* architecture is the NPC agent. These are essential because they emulate the verbal and non-verbal culture in the NPCs featured throughout the game. Cultural rules are used by these agents for expressing typical ‘Trini’ behaviour, and add cultural intelligence to the game. For example, the dog in the scenario is an NPC in the game, and would have rules governing its behaviour which embody how a local ‘pothong’ reacts when a vehicle approaches. The use of culturally intelligent agents follows the methodology laid out by Blanchard, Razaki, and Frasson [3] for making Intelligent Tutoring Systems (and by extension this game) culturally aware. These cultural rules are closely related to the game play rules which govern how the game works, dictate how and when audio and visual feedback is given, and control the transition of the game scenes. The AI Sub System and the renderer are mandatory components of any game since they form part

of the game engine. Together, they control the execution and appearance of the game using these game play rules.

One of the most important components in the architecture is the repository of game assets. This repository holds the educational material in the form of game images, audio clips, and animations. Each game asset is described by metadata which specifies the cultural, pedagogical, and gaming context relevant to the asset. Consider the dog again; the game assets for the dog would be a collection of image files and audio files. The cultural context would describe the assets as those of a 'pothong', the gaming context would describe the assets as being those of an NPC which obstructs the player, and the pedagogical context would describe the assets as being generic precursor events for initiating learning activities. These descriptions are cursory for the purposes of the paper as there would be more metadata associated with the assets particularly related to emotive perspectives. Games assets are selected by the game play, instructional, and cultural rules based on the changing state of the game (mirrored in the student model and in the intelligent agents) and presented to the player by the renderer in a continuous game loop.

### 2.3 Game Play

*Trinbago Adventures* is a driving game and as such players need to control basic features of a vehicle related to guiding its movement. These involve starting the engine, stopping or slowing the vehicle's progression, altering the direction of the vehicle's movement, and shifting gears in vehicles with manual transmission. In addition, players need to configure the instrument display panel in the vehicle which reflects important state such as fuel level, rate of travel, and engine speed for example. Secondary features such as the windshield wipers, windows, and indicator lights, can also be controlled by the player. All of the vehicle's features and functions are linked to specific learning activities and computer science topics as shown in Table 1. Players therefore need to program the feature's functionality into their vehicles by writing code before they are able to use the feature. Depending on the vehicle chosen by the player, the basic functionality (and by extension the difficulty of the learning activity) varies. Throughout the game, these exercises are administered so that their delivery is integrated into the storyline using cultural elements.

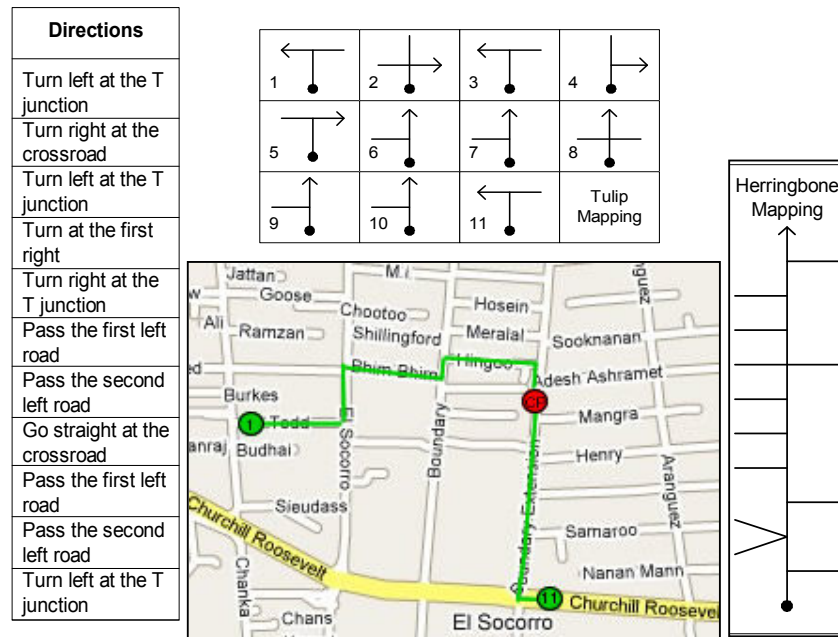
So for example, in the scenario when the player, Dass, drove into a pothole the car would have jolted on impact. Consequently, the indicator lights could have stopped working properly as a result; at this point a learning exercise related to conditional statements could be introduced so that the player has to re-configure the light control. Here, the player has to understand the computer science concepts designated in the learning exercise (as determined by the pedagogical agents based on the student's mastery of conditional statements) and be able to apply the necessary skills required to complete the exercise. If for instance, the player has weak debugging skills then the game activity would require the player to spot and fix the error in the code controlling the indicator lights. On the other hand, if the player has weak coding skills then the exercise may be to write the code from scratch (implying a more severe jolt and a significantly larger pothole). A successful attempt at the exercise yields a game reward

to the player such as being able to use the functionality in the game or being able to advance along the roads in the game and find a treasure easily.

**Table 1.** Table of computer science concept/topics corresponding to learning activities linked to the vehicle features. Each feature is available in either one or both of the game modes

Vehicle Feature	Computer Science Concept/Topic	Game Mode
Starting Engine	Object Oriented Programming	Free Form; Rally
Moving/ Stopping Vehicle	Variables, Control Structures	Free Form; Rally
Instrument Display Panel	Object Oriented Programming	Free Form; Rally
Secondary Features	Variables, Conditional Statements	Free Form; Rally
Autopilot	Algorithms (searching, insertion), Data Structures (graphs)	Free Form
Navigation: Road Map	Algorithms (searching, display), Data Structures (graphs)	Free Form
Navigation: Rally Map	Algorithms (parsing, display), Data Structures (queue, list)	Rally
Treasure Screen	Algorithms (searching, sorting), Data Structures (binary tree)	Rally

Figure 2 shows a road map<sup>1</sup> (lower center) of part of San Juan, a town in Trinidad. The green circles represent the starting and ending locations of the player's vehicle, the red circle (labeled CP) represents a check point, and the green line shows the pathway taken by the driver. Players are given a rally map for the treasure hunt (rally) mode of the game and this map can take one of two forms of mapping: Tulip Mapping or Herringbone Mapping. Examples of these are also shown in Figure 2. On both rally maps the vehicle is represented by a filled circle or ball and the direction in which the driver must head is shown by the arrow. The Tulip mapping is simpler than the Herringbone mapping because each box on the Tulip map grid represents a road that is either taken (indicated by an arrowhead) or ignored (indicated by the absence of an arrowhead). This can be observed in Figure 2 where the eleven boxes shown in the Tulip map grid correspond to the eleven driving directions shown on the extreme left of Figure 2. The Herringbone mapping only shows ten symbols (or lines) since the fourth driving direction is not explicit on the map. After turning left at the T junction (third direction), the driver encounters a road on the right and since it is not shown on the Herringbone map grid, the driver has to turn down that road. The Herringbone mapping only shows the roads which are to be ignored and it is more time consuming to interpret as result (more difficult game level). Note also that the location of the checkpoint is not revealed on either of the navigational rally maps however after the driver has passed the checkpoint it appears on the road map.



**Fig. 2.** The *directions* (extreme left), road map<sup>1</sup> (lower center) and two examples of corresponding navigational rally maps: *Tulip mapping* (top center) and *Herringbone mapping* (extreme right) corresponding to a player's driving path (green line) starting from point 1 and ending at point 11 (green circles). This shows a figure consisting of two different types of rally maps and the corresponding pathway on the road map.

Throughout the game, as players move along the course (in either game mode) they will encounter and be able to interact with characters and objects which reflect the culture of Trinidad and Tobago. These will be placed at strategic points in the game in order to motivate the players so that the learning exercises would have to be completed before these elements of interest are revealed to the players. Any interaction (cultural or game related) that the player initiates with these characters or objects will be recorded in the student model as a measurement of interest.

### 3 Empowering Learning through Humour and Culture

The vernacular used in the game is formally referred to as Trinidadian English Creole (TEC) by linguists and historians involved in the study of Caribbean people and their languages. During the latter half of the nineteenth century, complex changes in Trinidad such as colonisation, indentureship, and emancipation greatly influenced the development of TEC such that the lexical and grammatical contributions of many languages are evident [2]. Influences from the language and culture of East Indian, Chi-

<sup>1</sup> Image from Google Maps

nese, African, Spanish, French, Amerindian, and British populations have been integrated to form a unique language which sounds comical and is often satirical in a humorous way. The phonology of TEC adds even more dimension to language since the pronunciation of a word can change its meaning. When TEC used to describe the customs and everyday events characteristic to Trinidad, the local culture can be represented as a narrative that has comedic appeal as in the scenario.

Humour plays an important role in learning environments because it promotes a lighthearted and memorable learning experience. According to Dormann and Biddle [4], humour is a valuable tool because it not only enhances a student's mood through affective learning but also commands the student's attention and encourages retention of material as a result of comical moments. Humour also promotes greater student interaction and social discussion of amusing anecdotes used in the learning process. Dormann and Biddle [4] go on to add that humour can be used to diffuse frustration and hostility because it decreases the pressure (on the student) to learn and perform. Again, this is valuable in disciplines where academic competition is stressful or where the material being learnt is difficult or abstract. In computer science some of the topics have the potential to be highly theoretical until they are applied to examples/situations that students are able to relate to. Humour is intrinsic in *Trinbago Adventures* because of the sociolinguistic context and cultural idiosyncrasies. Furthermore, rich story-based scenarios can be easily put together by describing simple events (such as waiting in traffic for example) using TEC phrases and by including Trinidadian cultural twists related to these events. Blanchard and Frasson [5] give further support for the integration of cultural backgrounds into ITS and eLearning environments adding that it is useful for stimulating student motivation through self-directed learning.

In the game, culture therefore plays several roles. Firstly, it is used to instill curiosity by being a natural source of humour. This provokes interest so that players must complete the learning exercises in the game if they want to explore and experience more of the entertaining moments/interactions. Secondly, local events are being represented as game events and game challenges. Culture is therefore being used both as a reward and as a challenge. Lastly, cultural elements are being used to create an educational environment that gives players a sense of belonging, ownership, and familiarity. This is important because the game instills pride in the students since it acknowledges, represents, and integrates their cultural background into a tool for learning computer science.

#### **4 Boosting Motivation Using Educational Games**

Strategies for inspiring and upholding student motivation have been prescribed in several instructional design models. Bixler [6] examined several of these models and found that they all overlapped and emphasized four conditions in particular. The conditions, which form the core of the ARCS model of motivation [7], are: attention, relevance, confidence, and satisfaction. Keller [7] explains that these elements can be used to systematically predict and influence motivation when matched with the students' characteristics and needs. The work of Malone and Lepper [8] provide greater



elaboration on how these elements can be implemented in a digital game based learning environment. For example, they recommend that challenge should be maintained in a game in a manner that produces uncertain outcomes and builds the player's self esteem through social relevance; this relates to all of Keller's motivational elements. In *Trinbago Adventures* the use of culture inspires learning since many of the challenges are graded to suit the player's knowledge and skill levels so that the feedback given not only helps the player to gain proficiency in computer science but it instills curiosity. Furthermore, the constant feedback and clear instructional goals delivered using the local sociolinguistic context aligns with many of the design guidelines laid out in [8]. By following these principles, the culturally aware strategies used in the game increase the appeal of the instructional activities even more because the learning experience is perceived as more enjoyable by students.

The Tactical Language and Culture Training System (TLCTS) [9] developed for teaching communication skills and foreign culture illustrates the viability of using a cultural context in a game based learning environment. One of the TLCTS Arabic language courses, Tactical Iraqi, was tested by several members of the Marine Corps where the majority of the participants had no substantial knowledge of Arabic. Johnson [9] states that the participants who were familiar with the Iraqi culture (after having been deployed to Iraq) were able to appreciate the cultural context of game, and consequently they picked up on the language faster and performed better than their peers (who were unfamiliar with the Iraqi culture). This observation supports the decision made in *Trinbago Adventures* to target students native to the Caribbean region since appreciable knowledge of the sociocultural context aids in the overall success of the learning experience. In addition, Johnson [10] comments that a game based approach attracts students with 'little initial motivation to study' and allows more effort to be focused on the quality of instruction being provided.

MOCAS (MOtivational and Culturally Aware System) [5] is another example of a game-based learning environment which augments culture and motivation. Adventure games, role playing games and strategy games have been popular game genre choices among instructional technologists because of their suitability to specific learning situations. MOCAS adopts many characteristics of a role-playing game (particularly the collaborative and interactive aspects) while adapting the instructional strategies and content used according to the player's culture. Heavy use of cultural rules and pedagogical agents gives this system the cultural intelligence needed for guiding the learner and for facilitating free-form exploration. The motivational strategy of building confidence is shown in MOCAS since it encourages players to discover and explore the gaming environment which changes based on their cultural background. This game targets a wider audience than *Trinbago Adventures* and as such it requires cultural profiling.

The adventure game genre setting is ideal for encouraging reflective thinking (by solving educational puzzles in the form of game challenges) and for expressing culture (through interaction with NPCs). Because of the extensive use of narrative, this genre offers greater motivational benefits because it immerses students in a controllable fantasy world which stimulates curiosity through mystery and challenge. Unlike most learning environments, adventure games tend to put less pressure on players and are often non-confrontational; this supports player versatility by being more inclusive

from gender and instructional perspectives. Furthermore, this genre is more conducive for integrating the motivational strategies discussed earlier since the cultural expressions of Trinidad and Tobago have a story-telling bias. These characteristics essentially predisposed the design of *Trinbago Adventures* towards an adventure game theme.

## 5 Challenges and Future Work

The preliminary design and research motivation for an educational driving/adventure game, *Trinbago Adventures*, have been described in this paper. Presently, the game is in the design stages where the content and rules are being developed to work with the game play and motivational strategies outlined earlier. However, several challenges remain to be tackled in this work. Firstly, the design is an ambitious one which will involve considerable development time and expertise from both an ITS perspective and a game development perspective. Secondly, in order for the game to be taken seriously by students, the use of Trinbagonian culture must mimic real life events, characters, and behaviour with an acceptable degree of plausibility. Thirdly, the amount and type of cultural expressions used in the game must be carefully chosen and limited to a certain extent. This is necessary because when too much vernacular is used to reflect the phonology of the Trinbagonian language it becomes difficult to understand. Also, owing to the humorous nature of the culture used in the game, too much usage can become distracting to students. Lastly, since the game is being developed to investigate how culture affects motivation, the game must be able to represent cultural elements in a computationally measurable model.

In order to address these challenges, the plans for additional work include following up on research that has been done along similar lines. For instance, the work done in [11] on assessing intercultural competence is useful for informing how to integrate and measure the impact of culture on player motivation. Also, the cultural profiling conducted in [3] is valuable for determining how to select the right amount of cultural expression for students playing *Trinbago Adventures* so as not to be distracting or confusing. Future work that will also be undertaken includes the selection of development tools and the conversion of these designs into a working game prototype which will be used in empirical studies to validate the research objectives stated in the paper. Possible tests include tracking the player's in-game interactions so that dwell time and access patterns are linked to game characters, objects, and events so that overall the player experiences could be assessed such that the cultural source of motivation (interactions, language, or events) can be identified. By isolating specific elements of Caribbean language and culture and incorporating them into a game-based learning environment, this research holds promise for motivating students to learn computer science concepts using an engaging tool that offers a humorous take on everyday experiences and events.

## References

1. Mendes, J.: Côté ci Côté la: Trinidad and Tobago Dictionary. 2nd Edition. John Mendes, Trinidad and Tobago. (2007)
2. Winer, L.: Badjohns, Bhaaji Banknote Blue: Essays on the Social History of Language in Trinidad and Tobago. The University of the West Indies, Trinidad and Tobago. (2007)
3. Blanchard, E., Razaki, R., Frasson C.: Cross-Cultural Adaptation of e-Learning Contents: a Methodology. In: Richards, G. (ed.): ELearn 2005. 1895-1902. AACE, Chesapeake. (2005)
4. Dormann, C., Biddle, R.: Humour: Why are Serious Games so Serious? In: Taisch, M., Cassina, J.(eds.): Learning with Games, Sophia Antipolis, France. 449-456. (2007)
5. Blanchard, E., Frasson, C.: Easy Creation of Game-Like Virtual Learning Environments. In: Workshop on Teaching with Agents, Robots, and NLP at ITS 2006. (2006)
6. Bixler, B.: Motivation and its Relationship to the Design of Educational Games. Available online: [<http://archive.nmc.org/events/2006summerconf/materials/Bixler/m&g.pdf>] (2006)
7. Keller, J.: How to Integrate Learner Motivation Planning into Lesson Planning: The ARCS Model Approach. Paper presented at VII Semanario, Santiago, Cuba. (2000)
8. Malone, T. W., Lepper, M. R.: Making Learning Fun: A Taxonomy of Intrinsic Motivations for Learning. In Snow, R. E., Farr, M. J. (eds.): Aptitude, Learning and Instruction: III. Conative and Affective Process Analyses. 223-253. Hillsdale, NJ, Erlbaum. (1987)
9. Johnson, W.L.: Serious Use of a Serious Game for Language Learning. In: Luckin, R., Koedinger, K. R., Greer, J. (eds.): AIED 2007. vol. 158, IOS Press, Amsterdam (2007)
10. Johnson, W.L., Vilhjalmsson, H., Marsella, S.: Serious Games for Language Learning: How Much Game? How Much AI? In: Looi, C.-K., McCalla, G., Bredeweg, B., Breuker, J. (eds.): AIED 2005. vol. 125, IOS Press, Amsterdam. (2005)
11. Ogan, A., Aleven, V., Jones, C.: Culture in the Classroom: Challenges for Assessment in Ill-Defined Domains. In: Aleven, V., Ashley, K., Lynch, C., Pinkwart, N. (eds.): Workshop on Intelligent Tutoring Systems for Ill-Defined Domains at ITS 2006. 92-100. (2006)

## Appendix

Glossary of terms used in the scenario

Word/Phrase	English Meaning
It have...	Are there any...
Pommerac	Pear shaped red fruit with white fleshy insides. Also known as Malay Apple and Mountain Apple
Reverse back	Reverse (a vehicle)
Dead out	Past its prime
Mash brakes	Press the brake pedal
Pothong	Dog of mixed or unknown breed
Cheups	Express annoyance
Doux-doux	Expression of endearment. Derived from the French for sweet.
Sweet too bad	Tasty; enjoyable experience
Ten dollars ah heap	Ten dollars for one heap
Ah go...	I will...
Tants	Aunt, or any person who is like an aunt