A CULTURALLY CONTEXTUALIZED WEB BASED GAME ENVIRONMENT TO SUPPORT MEANINGFUL LEARNING

Alexandre Mello Ferreira[1], Eliane Nascimento Pereira[1], Junia Coutinho Anacleto[1]
Izaura Maria Carelli[2], Marcos Alexandre Rose Silva[1] and Ana Luiza Dias[1]
[1]Computer Department, Federal University of Sao Carlos, Rod Washington Luís, km 235, São Carlos/SP, Brazil

[2]Education and Letters Centre, State University of West Parana
Av. Tarquinio J dos Santos, 1300, Foz do Iguacu/PR Brazil

Keywords: Common sense, Culture sensitive learning, Educational games, Sexual education, Pedagogical issues.

Abstract: The computer game use in education has been growing as a learning facilitator. *What is it?* educational environment allows teachers to be co-author of an online game based on cards which uses a common sense knowledge base. It also allows teachers to choose language according to their students' culture and needs providing them with suitable language. The environment also allows researchers to collect common sense knowledge. Every user interaction in each editor's module and player's module generates a new common sense statement which is stored into Brazilian Open Mind Common Sense (OMCS-BR) project knowledge base. A study case was conducted with teachers and students from two different Brazilian public schools. Results demonstrate there is a large potential of the use of this environment in real classes and the methodology to collect common sense statements naturally through a web game.

1 INTRODUCTION

Nowadays many schools still have difficulty to use the potential of computers for education. In Brazil there are a lot of schools with computer laboratories but they use them only in computer classes or they simply do not use them. Most of schools do not use computers for educational purpose, what could allow teachers to enhance their educational practice, join educational and entertainment aspects. Then, why not to take the computational benefits at education?

In this context this paper described a way to allow teachers to use the computer in their classes, through a game. There are many educational games available, such as: Word Puzzle (www.marista.org.br/arquivos/jogos/85/forca.swf), Secret Word (www.cubagames.com.br/), Crossword Compiler (www.crossword-compiler.com/?lang=en) but most of them have fixed issues, like content or story. Nevertheless if teachers want to use these games, they need to adapt their classes to the game rules. In the game proposed here teachers are co-authors because they can set up, adapt and evolve the game content, according to their educational goals. This game also supports teachers on teaching the transversal themes defined on the Brazilian curriculum: sexual education, ethics, healthcare, environment, cultural diversity, market and consumption (SEF, 1998).

Educational games are able to promote activities that combine fun (playful activity) and seriousness (well defined rules), once they are very popular among children and teenagers. Nevertheless according to Vygotsky (1987), Freire (1996) there are pedagogical issues that should be considered for stimulating the learning process. For example, culture sensitive and contextualized learning considering the student's reality. Then, this game proposes to consider the apprentices' common sense knowledge to promote their learning aiming at: adopting a vocabulary that is familiar to the students; instantiating content and clarifying myths, beliefs and taboos that are cultural heritage. Examples of this kind of knowledge related to sexual education are: teenagers believe that girls don't get pregnant during their first sexual relation, pill has to be taken on the day she is going to have a sexual relation, and AIDS is a homosexual disease. This kind of knowledge can be mapped into the commonsense knowledge and can be clarified by

teachers during classes. The game called "What is it?" ("O que é, O que é?" in Portuguese) aims at helping players to infer a certain secret word related to a certain transversal theme considering a set of clues presented one at a time. The clues are previously defined by the teacher having a common sense knowledge base as a support on reaching such goal.

This paper is structured as follow: section 2 explains the relation between commonsense knowledge and education; section 3 presents the "What is it?" game prototype; section 4 describes the evaluation; section 5 discussion the results obtained; section 6 draw some conclusions and propose suggestions for some future works on related topics.

2 COMMON SENSE KNOWLEDGE & EDUCATION

The Brazilian Open Mind Common Sense Project (OMCS-Br) is a Portuguese version developed by Advanced Interaction Laboratory (LIA) at Federal University of Sao Carlos (UFSCar) from the original English project created by MediaLab of Massachusetts Institute of Technology (MIT) in 2000 (Anacleto et al., 2006).

Available over the Internet since August 2005 at *http://www.sensocomum.ufscar.br* the project aims to create a common sense knowledge base through volunteers' contribution. Any person can contribute with the project, after fulfilling a small form with information, such as: gender, day of birth, city and others.

To collect common sense knowledge, volunteers have to complete some semi-structured statements in natural language in templates. Each template is related to one activity and composed by three different parts: (I) a fixed part which is changed according to activity; (II) a dynamic part which is filled out by a feedback process that uses parts of the statements already stored; and (III) free field, where the user write their piece of knowledge creating a complete statement. Nowadays there are 20 activities about general topics and 6 specific themes (children's universe, colors and objects, colors and emotions, popular beliefs, sexuality and healthcare).

All knowledge typed by volunteers in natural language are processed to create a semantic network, in which, the knowledge is represented as binary relations. This representation, called ConceptNetBr, is formed by four text files which have the relation name, the two concepts, the frequency that this

relation was created by an extraction rule, the frequency that this relation was created by an inference rule, and at least the identification of this relation in the table *entries*, where all statements are stored before have been processed.

Common sense is defined here as knowledge that most people agree within a certain community at a certain period of time related to human experiences, knowledge about social, physical, space, time and psychological aspects of our daily life (Liu et al., 2004). Recent researches (Anacleto et al., 2008) have shown that automatically collected common sense knowledge can be used to culturally map a certain group of people. The importance of the common sense and cultural knowledge to support the learning process is referred by a number of pedagogy researchers. Vygotsky (1987) believes that the individual's mind model can be understood only if the social and cultural processes are considered in his/her context. Paulo Freire (1996) cites that it is necessary to respect knowledge that students already reached when they start at school. Knowledge is acquired in the social relations they participate in their community. According to Freire, teacher should "*discuss with students the origin of some of this knowledge considering the content is being presented*". Such knowledge can help in contextualizing learning process according to the student's reality, which is Freire considers extremely important. Besides, the use of common sense knowledge provides teachers an adequate vocabulary to contextualize and discuss subjects with learners from a certain community (Carvalho et al., 2007). Common sense knowledge also can be taken into account in teaching the called transversal themes from the official school curriculum, defined by the Brazilian Education Secretary, considering that "*the commitment on constructing citizenship which demands a pedagogical approach to reach the comprehension on the social reality, the rights and responsibilities related to the personal and collective life, which leads to the political engagement*" (SEF, 1998).

3 THE "WHAT IS IT?" GAME

The ongoing research aims to make possible the use of common sense knowledge in web educational games, stimulating the introduction, reinforcement and construction of knowledge in the learning process. It also aims at collecting common sense knowledge from whom use the game. The environment is divided in two main modules. The player's module is a quiz game where users should

find out a secret word considering common sense clues given in the game. The game editor's module is used to set up a new game.

"What is it?" has the differential in considering the players' profile, concerning the games presented in the previous section. Since the players have to subscribe themselves in the system before starting to use it, the new statements collected in the interaction can be related to their profile. Taking into account the players' profile collected is especially important for the culture sensitive approach necessary in developing applications for specific groups in a certain region and age, considering their context. In this case, the common sense knowledge can be filtered and the application's designer can consider only knowledge collected from a desired profile in order to contextualize it to the target group.

Figure 1: The player's module main interface.

Figure 1 presents the player's module main interface. To illustrate the game's use, it was developed a game's instance considering the theme "Sexual Education". To start the game the player has to click on the dice, represented by the orange letter "C", whose faces represent topics previously selected during the game edition. Each topic is associated to a letter (see Figure 1, "C" is associated with the topic "Contraceptive Methods") and they are randomly presented, in this way, the player can be in touch with different topics at the same game. For each topic is defined a group of cards and each card has one or more secret words (synonyms). These cards are composed by up to ten clues, which can be extracted from common sense base according to the purpose considered by who has setting up the game. After selecting the topic, the player needs to find out the secret word. To reach their goal, they can select clues clicking on the clue numbers in "Group of clues" and visualizing them at the "Clue balloon". After guessing the word, the player can

continue, either select another topic clicking on the dice and continue playing, or close the game.

As the player tries to find out the secret word, the system collects common sense knowledge storing the relation between the word typed by the player and the clues that were already displayed. This collecting process is interesting (a) to teachers, who can identify possible misunderstanding by analyzing the answers, and therefore, approach those misunderstandings in classroom to clarify them; and (b) to the OMCS-Br knowledge base, which will increase the number of common sense statements. For example, when the player tries the word "condom" after he/she had clicked on three clues, as it is shown in Figure 1; three new relations are created by mapping each displayed clue with the word typed by the player through the relation *ConceptuallyRelatedTo*. Thus, one of these three relations is: (*ConceptuallyRelatedTo*, "it's used to prevent pregnancy and transmission of STD", "condom").

The game's editor module is a seven-step wizard which guides the teacher to create new game's instances, which fit to their pedagogical goals. This module is supported by the common sense knowledge stored in the OMCS-Br knowledge base.

In this way, to create a new game's instance, the teacher must define four items: (1) the target group profile which will be considered during the filter process (2) the game's main theme, which should be chosen from the six transversal themes available; (3) the topics, which are specific subjects related to the transversal theme chosen in order to compose the game dice sides; (4) the cards, which have a secret word related to one of topics defined, an optional secret word's synonym list, and a group of up to ten clues.
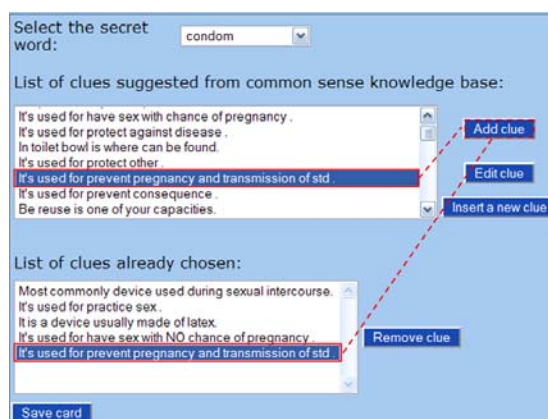

Figure 2: The editor's module.

After the teacher has defined the secret word and the possible synonyms for each card, he/she must

define the clues – at least, one clue for each card. A list of suggested clues is shown came from the common sense knowledge base. To map the binary relations at ConceptNet into these clues the game editor combines some API functions, available to communicate with the ConceptNet. For instance, the relation (*UsedFor*, "prevent pregnancy and transmission of STD", "condom") will be the clue "It's used for prevent pregnancy and transmission of STD" depicted in Figure 2. Besides that, each clue suggested can be modified before selected or new clues can be added. It is important to highlight the *fail-soft* approach adopted, i.e., the statements suggested to teachers can be valid or not (Lieberman et al., 2007).

Even as the player's module, the editor's module also has some engines to collect common sense statements from teachers to OMCS-Br Project. There are seventeen rules to map the user interaction into new statements, and then, new relations in the ConceptNet. For example, when the word "Johnny" as included as a synonym for "condom" one new statement is created "Another way to say condom is Johnny", which will be at ConceptNet, the relation (*DefinedAs*, "Johnny", "condom").

4 EVALUATION

To evaluate *"What is it?"* environment with students and teachers, a study case was conducted in two Brazilian public schools. It was analyzed information about use and collect knowledge process, use facilities and some information regarding to use of computer educational games in schools. We got in touch with schools from two cities, one in São Carlos/SP and another in Foz do Iguaçu/PR. Some characteristics of the participants are depicted in table 1.

Table 1: Evaluation participants.

	SÃO CARLOS	FOZ DO IGUAÇU
TEACHERS	2	4
STUDENTS	4	5
AGE	UNTIL 11	BETWEEN 12 TO 15
GRADE	FIFTH	SEVENTH

Teachers were asked to create a new instance of the game, choosing any of the themes and topics. They used the system for approximately 40 minutes to set up the instance with 2 cards on average. The themes used in these settings were: environment (3 times), healthcare (twice) and sexual education (once). After completion of the new configuration for the game, not even being asked, all teachers themselves wanted to play the newly created instance of the game.

For the students' interaction, the teachers created two interesting instance about healthcare and sexual education and made it available to the students of Foz do Iguaçu and São Carlos respectively. Each player used the environment for about 50 minutes, playing an average of 7 cards.

The methods used to collect data were: direct observation, questionnaires, notes and indirect observation; the latter was obtained through the data stored during interaction between users and system. There were two questionnaires: (I) pre-session, its objective is identify teachers and students profiles; (II) post-session, for teachers about the use of common sense knowledge support, and for students related to use of the game considering the common sense information.

Both post-session questionnaires were inspired at QUIS™ (http://lap.umd.edu/QUIS/).The satisfaction scale was modified to make it easy to the young students; moreover, it is easier to teachers and students to say that the game was very easy to play rather than it was five, for example. Hence, an adjective ranging from a higher to a lower degree was defined based on Likert scale of 5 points, in which "Very hard" represent one point and "Very easy" five points (Evans, 2008; Wainer, 2007). As the students' module stores all the players' interaction, teachers could observe their attempt; the clues presented to them and their answers.

Before starting the evaluation we defined some predictions about the "What is it?"environment regarding to our expectations.

P1: The suggestions of clues coming from the common sense knowledge base help the teacher to create their cards: We believe that the common sense knowledge can provide to the teacher what their students are thinking about something, and therefore help them to direct their class in a better way, as some renowned authors in the educational field say (Carvalho et al., 2007; Freinet, 1993; Freire, 1996; Papert, 1985).

P2: The language used in the game's content is familiar to the student: As the common sense knowledge base provides to the teachers what the students know about something we expected that the type of language used in the game should be familiar to them. According to what was mentioned in previous sections, it can provide a better educational environment for students promoting the new knowledge retention.

P3: A lot of common sense statements can be collected in an easy way: As mentioned before, the "What is it?" environment is also used to collect new

common sense statements from the user interaction. Some rules are used to catch concepts among the user interaction, and to create new common sense statements, which will be part of the knowledge base. We hope with this approach, a faster increase of the common base knowledge base size.

5 RESULTS AND DISCUSSION

Regarding to the editor's module, in the pos-questionnaire there were three questions related to prediction 1 (P1) and in almost all of them the teachers said that the support from common sense knowledge base were helpful and relevant. Nevertheless, only one teacher from São Carlos said that this support was unhelpful or irrelevant, saying "*I thought very unproductive have to read a huge list of clues with many phrases without accordance*" and "*It is hard to find a clue that fit well to the secret word*".

Table 2: Teachers' interaction.

TEACHER	THEME	TOPICS	CARDS	STATEMENTS
A	SEX EDUCATION	2	2	52
B	ENVIRONMENT	1	3	83
C	HEALTH	1	2	80
D	ENVIRONMENT	1	1	38
E	ENVIRONMENT	1	1	34
F	HEALTH	3	6	253

An overview about the information stored regarding to the teachers interaction is given in Table 2, which the columns refer to: (a) the teacher, represented by a letter; (b) the main theme game; (c) the number of topics used; (d) the number of cards created; and (e) the number of new statements generated by the system. It is easy to realize the high number of new common sense statements created (90 on average) through small instances (2,5 cards on average), pointing out the capacity to insert new statements without a huge effort by the user.

Likewise the teachers, the students answered a questionnaire after used the system, in which the questions were about the system aspects and the cards content. From 36 responses received, 26 of them were that they found something known; however, one student from Foz do Iguaçu had many problems to understand the clues and then, many difficulties to discover the secret word. Otherwise, this student was the only one who did not realize anything common to him. The graph on Figure 3 presents the average of student's responses for the prediction 2 (P2).
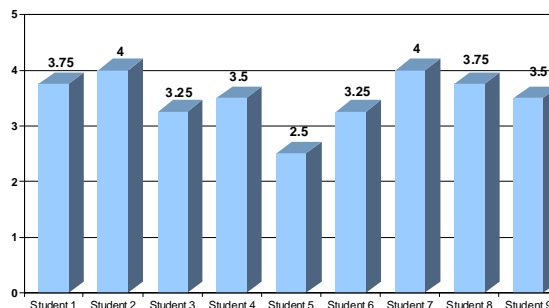

Figure 3: Average of students' responses ref. P2.

All students' interactions were stored to be used to create new statements in OMCS-Br knowledge base. Table 3 depicts some information collected from each student such as: the game theme played, the number of cards played, the total number of tries to guess secret word and the number of new statements created. These new statements are combinations between the words typed by player and each clue requested, i.e., new statements are directly related to the number of tries and the number of clues requested.

Table 3: Students' interaction.

STUDENT	THEME	CARDS	TRIES	STATEMENTS
1	HEALTH	3	4	15
2	HEALTH	5	7	23
3	HEALTH	5	5	20
4	HEALTH	5	8	26
5	HEALTH	2	3	10
6	SEX EDUC	11	13	94
7	SEX EDUC	8	17	145
8	SEX EDUC	8	10	153
9	SEX EDUC	7	12	121

On the Table 3, the first 5 students (Health theme) were from Foz do Iguaçu and the others (Sexual Education theme) were from São Carlos. We noticed a substantial difference between both cities which be explained through the total number of cards within each game, and due to some specific improvements at the collect process of Sexually Transmitted Disease (STD) topic.

The results presented highlight that *"What is it?"* environment provides extra benefits beyond a simple educational game. The teacher's possibility to be the co-author of the game content and, added to that, a contextualized support during this process through a common sense knowledge base is a great feature well accepted by teachers.

Being specific to P1 our experiment show that, except for one teacher, the suggestions from the common sense knowledge base were useful to create the game content in anyway. The critics made by this teacher can be interpreted in two different ways:

(I) due to common sense knowledge base content is created by anyone who access the project site, there are many concepts that do not make sense or that are scientifically wrong. It is a teachers' decision how they could work with this information; (II) the process to create the clue has some problems and can be improved in order to create better sentences. Thinking on the latter interpretation, we are working on with a natural language processing research group to advance this functionality. Concerning to P2, the majority of students said that they found something familiar to them. Of course this not means that it was happened only because of the common sense knowledge support, however, as this support was used by the teachers (mentioned before), we believe that it should helped to achieve this goal. Nevertheless, the student number 5 said the opposite, pointing out that this strategy can be used only to cover the majority people knowledge. We may conclude that P2 was partially confirmed, and we don't have guarantee that the common sense knowledge provided will be known for each student in the group.

The environment also explores a new methodology to collect common sense statements to expand OMCS-Br knowledge base, which was proved to be very efficient – prediction 3. For example, using six game instances within 2.5 cards on average each, 540 new statements into knowledge base were produced. Therefore, as more game will be created in *"What is it?"* environment, more statements will be collected from the players.

6 CONCLUSIONS\FUTURE WORK

"What is it?" educational game environment aims at allowing teachers to configure and/or adapt the game according to their pedagogical goals. Through this game teachers can work on the transversal themes proposed by the Brazilian Ministry of Education, concerning to the students' context and culture through common sense knowledge usage, and promoting a way of learning with fun. As it was discussed in section 2, the adoption of common sense based approaches for education is defended by educators such as Freire (1996) and Freinet (1993). As the design of the interaction considers students' background and culture, it can motivate learners to play since information presented has meaning to them, engaged them in playing and learning. This research also explores a new way to collect common sense statements to enrich the OMCS-Br knowledge

base. To keep the knowledge base quality, we are planning to adapt a spellchecker to validate the sentences generated by the environment before to send it to the OMCS-Br base, avoiding misspelled sentences.

Exploring some web features, this environment can also be incorporated into a Learning Management System that promotes e-learning, like Tidia-Ae, Sakai, Moodle or ATutor.

ACKNOWLEDGEMENTS

REFERENCES

Anacleto, J.C., Carvalho, A.F.P. de, Neris, V.P.A., Godoi, M.S., Zem-Mascarenhas, S., Talarico Neto, A., 2006a. How Can Common Sense Support Instructors with Distance Education? In: *SBIE 2006*, Brasília.

Anacleto, J.C., Carlos, A.J. F., Dias, A. L., 2008. Bridging the gap among cultures: the challenge faced by teachers on producing content for computer-aided education. In *Proc. SIGDOC 2008*, Lisbon.

Carvalho, A.F.P. de, Anacleto, J.C., Lieberman, H., Godoi, M.S., Zem-Mascarenhas, S., 2007. Using Common Sense for Planning Learning Activities. In *Proc. CSIUI 2007*, Honolulu.

Evans, C, 2008. The effectiveness of m-learning in the form of podcast revision lectures in higher education. *Computers & Education.*

Freinet, C., 1993. *Education through work: A model for child centered learning*. Edwin Mellen Press, NY.

Freire, P., 1996. *Pedagogia da autonomia: saberes necessários à prática educativa.* 31ed. RJ: Paz e Terra.

Lieberman, H., Smith, D., Teeters, A., 2007. Common Consensus: a web-based game for collecting commonsense goals. In *Proc. IUI'07*, Hawaii, USA.

Liu, H., Singh P., 2004. ConceptNet: A Pratical Commonsense Reasoning Toolkit. BT T J, v.22, n.4.

Papert, S., 1985. *Logo: computadores e educação.* J A Valente (Trad.). SP: Brasiliense.

Questionnaire for User Interaction Satisfaction. http://lap.umd.edu/QUIS/.

Secretaria de Educação Fundamental, 1998. *Parâmetros curriculares nacionais: terceiro e quarto ciclos: temas transversais.* Brasília: SEF/MEC.

Vygotsky, L., 1987. *A formação social da mente.* São Paulo: Martins Fontes.

Wainer, J., 2007. Métodos de pesquisa quantitativa e qualitativa para a ciência computação. *In: Kowaltowski, T; Breitman, K.* Atualização em informática. SBC e Editora PUC-Rio.