Matchballs – a Casual Game for Learning and Domain Ontology Enrichment

Sabrina Ziebarth, Nils Malzahn, H. Ulrich Hoppe, University Duisburg-Essen, Lotharstr. 63, 47048 Duisburg
{ziebarth, malzahn, hoppe}@collide.info

Abstract: Training and continuing education in and for the food industry has to face the challenge of reaching and motivating workers without or with only a low level of formal qualification. We have developed and evaluated a casual game for training knowledge on food safety and hazardous material regulations that provides - in addition to the fun of playing it - several incentives for motivating different types of users.

Introduction

The food industry in Germany is characterized by a high amount of workers without or with only a low level of formal qualification. While these workers are easily found and taught to perform the simple and often physically exhaustive tasks, there is a lack of employees with a higher qualification (e.g. skilled workers), who are able to use and control the complex machines and processes of the food production industry. Thus, the human resource managers try to train some of the lowly qualified to a higher qualification level to close the gap. This is not an easy task since these people often have a migration background and therefore language problems and/or they are not very motivated to learn because of various reasons, e.g. education is not an asset for them or their work is too exhaustive. The project Foodweb2.0 (funded by the German Ministry of Research and Education) aims at training the employees of the German food industry using two basic strategies: motivating employees for vocational training and performing education in collaborative, blended learning using Web2.0 technologies. One of the applications combining both strategies is the use of a collaborative, serious and casual game: Matchballs.

Casual games are known to be small games with a high potential for frequent gaming by people of various social and educational background. These games are characterized by simple and easy to learn rules (Kuittinen, Kultima, Niemelä & Paavilainen, 2007) and either by a slowly increasing difficulty or a time limit combined with a high score list. Serious games are games that have a serious context. Serious games are often used to virtually train situational behavior like conflict resolution or firemen training or to implicitly transport some knowledge that would not be transferred easily otherwise, because it is too abstract (e.g. nutritional education for young diabetes patients) (Michael & Chen, 2006). They have been established in vocational and advanced training over the last years and have a big potential for informal further vocational training.

To be flexible concerning the learning domain we decided to use an ontology-based approach. The ontology may be easily exchanged to adapt the game to another domain. Furthermore, the ontology principally offers the opportunity to encode specific feedback for common misconceptions like it is often done in intelligent tutoring systems. Ontologies are usually incomplete, since it is nearly impossible to represent even a limited domain in full detail. Accordingly, relations created by the players that do not occur in the knowledge base are not necessarily wrong, but possibly just missing, especially if a significant amount of players creates them. Therefore, frequently occurring relations are very interesting, because either they can be used by knowledge engineers to enhance the ontology or they are typically misconceptions to be resolved by the teachers.

Thus, apart from teachers being interested in getting information about common misconceptions to correct these, it is possible to use the so called "wisdom of the crowd" of the game players to enrich a pre-built ontology. In this way the game presented here is also a game with a purpose (cf. von Ahn, 2006). Games with a purpose (gwap) are often used for human computing, i.e. by exploiting the human intelligence to facilitate tasks that are otherwise difficult or impossible to reach by computational means. There already are gwap approaches for building, maintaining and aligning semantic web vocabularies (e.g. Siorpaes & Hepp, 2008).

Matchballs

Matchballs is designed as a simple allocation game, in which the player creates statements by linking ("*matching"*) concepts displayed as *balls* (see Figure 1). A statement consists of two concepts linked by a relation. The game can be played either as two player game or as single player game with a bot. Each pair of players sees the same game field (concepts) and the goal is to agree with the teammate on as many relations as possible in a given time. To agree on a relation both players have to create it. If they agree on a relation, they score points and get time bonuses. Players may see the relations of their teammates, but not the relation types.

As knowledge domain we use the domain of food safety and hazardous material regulations, which is an important topic of further education in the German food industry. The considered concepts are specific situations, actions, dangerous substances and edibles, which can be linked by using the four semantic relations "is similar to", "is more general than", "results in" and "then you may not".

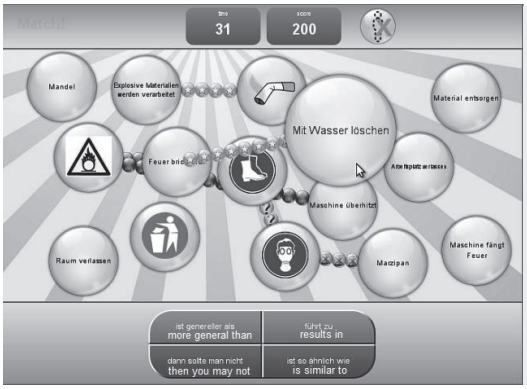

Figure 1. Matchballs user interface.

Figure 2. Display of achievements.

The initial ontology was hand-crafted by our knowledge engineers. Feasible statements are for example "machine overheats results in fire danger" or "if oil starts burning then you may not extinguish the fire with water".

There are several incentives for playing the game considering different types of players: For competitive players there are high scores and time bonuses, which are a well-known and often used incentive since early arcade games. Furthermore, players can collect "achievements", which are trophies for solving certain predefined tasks, e.g. for playing a given number of games with another player or with the bot (see Figure 2). Achievements are a more recent kind of incentive often used in modern console games. They not only address competitive players, but also people with a collector's passion, who want to unlock the full set of obtainable awards. While competitive players will tend to play against the bot to be not dependent on the teammate, for team players the possibility to play together with another human is an incentive of its own.

Discussion

The Matchballs game has been evaluated with a class of 18 students at the Academy of Sweets in Solingen, Germany. The evaluation results show that the Matchballs game was perceived as a casual game that is addictive enough to encourage the learners to try another game to improve their score. Based on the data generated during the game sessions we were able to identify 17 relevant associations that were not represented in the initial ontology. These associations were integrated into the ontology by our knowledge engineers. Thus, we could also prove that our approach of using a learning game also as "game with a purpose" is feasible. In this way the game may be seen as self-extending with respect to closing gaps in the ontology.

In a way the game may be viewed as a concept map creation game when used as a multiplayer game, where the players create a shared concept map. Concept maps are successfully used as learning tool for linking existing and new knowledge as well as for evaluation and identifying valid and invalid ideas of students (Novak & Canãs, 2006). If the game is played in single player mode, the game may still be used as an advanced vocabulary trainer. In spite of playing the game individually the students still collaborate indirectly. Accordingly, teachers can apply the game to get an overview of typical misconceptions of the group but also of single students.

In the context of the Foodweb2.0 project there have already been several requests by teachers and students for transferring the game to further knowledge domains. We will try to incorporate these domains and enhance these ontologies with specific feedback on the relations made by students. The feedback will be given at the end of the game. For the multi-player scenario there will be a feedback about the existence of their relation in the ontology. In single-player scenarios the feedback hints at possible misconceptions automatically based on information directly represented in the ontology for particular error types and exploiting the semantic ontology structure for the generation of generic feedbacks following an intelligent tutoring approach.

References

Kuittinen, J.; Kultima, A.; Niemelä, J., & Paavilainen, J. (2007). Casual games discussion. In *Proceedings of the 2007 conference on Future Play* (pp. 105-112), New York: ACM.

Michael, D., & Chen, S. (2006). *Serious Games: Games that educate, train, and inform.* Boston: Thomson Course Technology PTR.

Novak, J. D., & Canãs, A. J. (2006). *The theory underlying concept maps and how to construct them*. Technical Report IHMC CmapTools 2006-01 Rev 01-2008, Florida Institute for Human and Machine Cognition, available at: http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf.

Siorpaes, K., & Hepp, M. (2008). Games with a Purpose for the Semantic Web. *Journal IEEE Intelligent Systems,* 23(3), 50-60.

von Ahn, L. (2006). Games with a Purpose. *Journal Computer*, 39(6), 96-98.