Open 3D Environments for Competitive and Collaborative Educational Games

Roland Klemke[1], Milos Kravcik[2]

[1] CELSTEC, Valkenburgerweg 177, Heerlen, The Netherlands
roland.klemke@ou.nl
[2] Advanced Community Information Systems (ACIS), Informatik 5,
RWTH Aachen University, Germany
kravcik@dbis.rwth-aachen.de

Abstract. Educational games have a lot of potential to raise students' motivation and improve the quality of education when applied properly. But finding a suitable game for a particular learning objective is not easy and development of a new one is expensive. In our university course a group of students developed a prototype of a serious gaming tool for architectural design, which is based on the Google Street View environment. With this tool teams can model 3D buildings, place them in real world images, share their results, and rate them. The solution provides a better contextualization of the model and paves a way towards integration with a full 3D environment, which should even more improve the serious gaming experience in the architectural design.

Keywords: game based learning, 3D worlds, open platforms, competitive, collaborative

1. Introduction

Despite the long tradition of games for education and training, their uptake in higher education is very limited - especially, when compared to the boost in the games market [1][2]. The reasons for this are manifold: high technical demands are in conflict with available budgets [3]. Educational games often do not fit in the educational context or they are hard to tailor [4]. It is hard for teachers to support educational games within their educational processes [5]. In a previous paper, we explored and reported on an approach to address the *high technical demands* and *the limited familiarity of teachers* with games based on freely available tools and open platforms [6]. In this paper, we will build on this work and explore an extension of one of the approaches towards 3D-modelling embedded in open environments.

By extending its range of openly accessible productivity tools with open APIs (Application Programmer's Interfaces) that can be used by developers to create services and tools based on Google's suite of technologies, Google simplifies the process of developing specialised applications and services that rely on well tested user interfaces and back-end technologies. Google Street View is one of these tools, offered by Google as an add-on to the popular Google Maps. Street View offers navigable, 3D-like visualisations of the environment, displayed from a user point-of-view. A user can navigate through Street View as if moving around the actual scenery.

Based on Street View as a front-end component, the *StreetLearn* game engine [6] is designed as a simulated location-based game combining locations, objects, players, and tasks in a 3D-environment representing the real world. Players as well as all objects and tasks are associated with a specific location on the map. The game starts at a specific location, where players are confronted with an initial task description. Typical tasks comprise finding locations, finding/taking objects, retrieving information, and answering questions. Solving a task leads to scores and usually a follow-up task. Players can be organised in competing teams that share tasks. Teams gain a team score, but individual players also score individually. Typical examples for StreetLearn games comprise scavenger hunt games, location-based quiz-rallies, or exploration games.

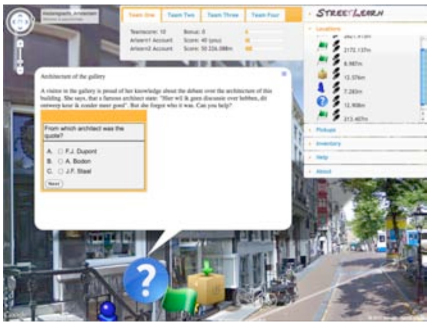

Fig. 1 StreetLearn user interface

Looking at gaming processes and learning processes from a more pedagogical perspective, StreetLearn is designed with the learning process being controlled by the gaming process [7].

2. Pedagogical and technological approach

Using Street View as game platform has a specific drawback in educational situations, where real 3D-models offer an additional benefit, such as architectural education: the Street View-based user interface only shows the 2D surface of the environment. Consequently, it is our aim to combine existing 3D models with the StreetLearn interface to provide an in depth experience.

In the course of a student development project at RWTH, a group of computer science students participating in the course Hightech Entrepreneurship and New Media (HENM'11) consequently got the task to enhance the StreetLearn environment with a 3D visualisation add-on that allows visualising 3D models within the StreetLearn environment. This way, the photographic environment of StreetLearn can be extended with explorable 3D models of existing or planned buildings. The add-on allows extending the game play of StreetLearn: while previously, the existing world serves as a playground, where players could navigate and interact, now it is possible to enhance the environment with virtual entities.

This idea has been taken to a competitive architectural game: several student teams compete in an architectural competition game. Each team represents an architectural firm, which tries to win several projects. Each of these projects is represented by a virtual construction site, represented on the map. The game process introduces the game goal and guides the team around these different sites in order to receive information, retrieve hints, and solve architectural tasks by creating 3D models, which they place in the StreetLearn environment. After completion of the tasks, participants of competing groups can rate the other group’s outcomes. This way, the game offers two motivating and pedagogically important principles: collaboration (applied within a group of students) and competition (applied across groups). Collaborative learning [9] fosters engagement of students, who can capitalize on one another’s competences. The competitive aspect stimulates the performance of groups. Moreover, the design dimension emphasizes also constructivistic learning principles [10], including active [11], experiential [12], and problem-based learning [13]. This type of learning is an active process of interpreting and constructing individual knowledge representations. It aims at complex problems that do not have a single correct answer and is based on concrete experience. Thus the proposed pedagogical approach cultivates a whole spectrum of cognitive skills from the revised Bloom’s taxonomy [10], including the highest ones – analysis, synthesis, and evaluation.

Technically, the students built on the existing StreetLearn object model as described in [6] and extend its MapItem entity, which serves as a general purpose location-based object. As shown in fig. 2, ConstructionItem, representing a construction site on the map, extends MapItem. ConstructionItem can contain a number of BuildingItems, which represent alternative designs created by competing teams. The BuildingStatus allows associating a simple process model to buildings in order to represent several design and construction phases.

This approach allows building on the existing gaming infrastructure of StreetLearn (game process, team play, scoring mechanism) while concentrating on the novel aspects (3D model visualisation, architectural process representation).

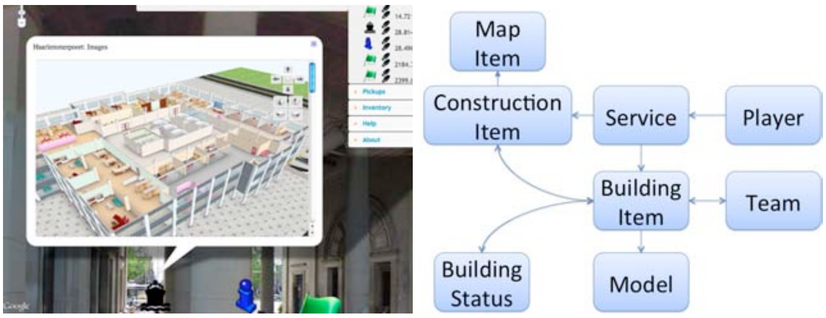

Fig. 2 StreetLearn with embedded 3D model (left) and Extension of StreetLearn object model (right)

3. Results and conclusion

Within the student project, we were able to demonstrate the development of a prototypical StreetLearn add-on, which was capable of visualizing uploaded 3D-models on top of the StreetLearn user interface. Also, the collaboration and competition features have been realised within the StreetLearn architecture.

The work presented here is in preliminary status, a full evaluation of the extended StreetLearn module has not yet been performed. First feedback gathered by presenting the prototype to architectural students indicates two main messages: (1) The integration of 3D models in their “natural” environment such as provided by

StreetLearn gives a better contextualisation of the model and the surrounding it may be realised in. (2) The user interface integration of StreetLearn and the 3D-models however feels a bit unnatural, due to the non-3D behaviour of the underlying Street View technology. For a future version of this approach, we consequently think of integration with a full 3D environment such as Google Earth.

Acknowledgments. We want to thank the participating Students of the HENM'11 course for their contributions. Part of the work presented here was co-funded by SURFnet/Kennisnet in their programme 'Innovation of Higher Education 2011'.

References

1. PWC (2010) Global Entertainment and Media Outlook: 2010-2014. http://www.pwc.com/
2. National Gaming Survey (2009) Detailed data of gaming in the Netherlands. Newzo, TNS-NIPO. [Online], www.nationaalgamingonderzoek.nl
3. Westera, W., Nadolski, R., Hummel, H. and Wopereis, I. (2008) 'Serious Games for Higher Education: a Framework for Reducing Design Complexity', *Journal of Computer-Assisted Learning*, vol. 24, no. 5, pp. 420-432.
4. Klopfer, E., Osterweil, S. and Salen, K. (2009) *Moving Learning Games Forward, Obstacles Opportunities & Openness*, Cambridge MA: MIT/The Education Arcade,Available: http://education.mit.edu/papers/MovingLearningGamesForward_EdArcade.pdf [2 April 2011]
5. Van Rosmalen, P., Sloep, P., Kester, L., Brouns, F., de Croock, M., and Pannekeet, K. (2008) 'A learner support model based on peer tutor selection', *Journal of Computer Assisted Learning*, vol. 24, pp. 74-86.
6. Van Rosmalen, P., Klemke, R., & Westera, W. (2011) Alleviating the Entrance to Serious Games by Exploring the Use of Commonly Available Tools. In *Proceedings of the 5th European Conference on Games Based Learning*, 20-21 October, Athens, pp. 613-619.
7. Kelle, S., Klemke, R., Gruber, M. and Specht, M. (2011) 'Standardization of Game Based Learning Design', *Proceedings of the International Conference on Computational Science and Applications*. Heidelberg, Berlin, New York: Springer. June 20-23, 2011, Santander, Spain.
8. Dillenbourg, P. (1999). Collaborative Learning: Cognitive and Computational Approaches. *Advances in Learning and Instruction Series*. New York, NY: Elsevier Science, Inc.
9. Anderson, L. & Krathwohl, D. A. (2001) Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives New York: Longman.
10. Jonassen, D. (1991). Objectivism vs. constructivism. Educational Technology. *Research and Development*, 39(3), 5–14.
11. Bonwell, C.; Eison, J. (1991). Active Learning: Creating Excitement in the Classroom. *AEHE-ERIC Higher Education Report* No. 1. Washington, D.C.: Jossey-Bass.
12. Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. *Journal of Organizational Behavior* (Vol. 8). Prentice-Hall.
13. Hmelo-Silver, C.E. (2004). Problem-based learning: What and How Do Students Learn?. *Educational Psychology Review*, 16(3), 235-266. Springer Netherlands.