

Being able to accommodate activity's formal purposes as a critical factor when designing for 'location-based learning games' at scale

Over the past few years the use mobile technologies for learning has attracted the interest of practitioners in all phases of education to facilitate informal learning in formal contexts (Bachmair, Cook, & Kress, 2010). Key aspects of such interests are the growing significance of mobile devices in learners' everyday lives (Vinu, Sherimon, & Krishnan, 2011), the increasing portability of these technologies, as well as the reduction in their cost and services. Also, the use of mobile technology in education has led to a new educational paradigm in which students can learn anytime and anywhere (Jones & Jo, 2004; Vinu et al., 2011).

In the context of the research domain of Game-Based Learning (GBL), mobile technologies brings the possibility of creating location-based learning games (Davis, 2002; Jeng, Wu, Huang, Tan, & Yang, 2010). Location-based games represent a new and emerging type of game that draws on the technological resources described as pervasive and ubiquitous computing. These types of games offer several types of educational benefits: extend learning experiences beyond traditional classrooms and interacting with physical items by adding virtual layers of information (e.g., triggered by location-aware events); create fruitful learning experiences that involve exploration and cooperation (Hwang, Tsai, & Yang, 2008); access to contextualized information (Avouris & Yiannoutsou, 2012), communication, analysis and interrelation of real place (Roschelle, 2003); be entertaining and stimulating (Cabrera et al., 2005; Davis, 2002), and effective in terms of increasing the motivation to learn (Yatani, Onuma, Sugimoto, & Kusunoki, 2004).

However, the integration of educational games in formal learning settings at scale is still a challenge that shapes several interdisciplinary research problems in the domain of GBL. One of the main research problems is that for learning games to be relevant in formal education they need to be aligned with the curriculum and adapted to teachers' requirements depending on their particular educational situations. To face this problem, diverse research efforts explore how teachers, who typically do not have programming nor game developing skills, can be involved in the design of the games. However, the existing tools supporting teachers in the design of educational games are still complex and time demanding (Frossard, 2013). We claim that for teachers to be involved in the definition of mobile-learning games, their constituting design elements need to be of feasible customization for teachers while, at the same time, enable rich pedagogical activities. Our approach consists in the adoption of a "puzzle game board" metaphor as a design technique that can offer a conceptual framework for teachers to design their own meaningful location-based games (Melero, Santos, Hernández-Leo, & Blat, 2013).

Indeed, board games have already been considered for designing a rich pool of location-based learning activities (Nicklas, Pfisterer, & Mitschang, 2001; Schlieder, Kiefer, & Matyas, 2006). Contributing to this board games perspective, we have formulated a model to represent puzzle game boards (Melero & Hernández-Leo, accepted). It provides a flexible technique to design location-based learning games that consist of routes containing geolocated questions, including game elements such as hints, feedbacks, bonus, and scoring mechanisms. The model and its derived design techniques have been applied in several case studies. In each case, secondary education teachers become designers of their own location-based games and enact the games with their students.

In this paper we discuss one of the key lessons learnt in the case studies. The lesson learnt has to do with how the teachers accommodated their formal educational purposes in the design of the location-based game. In particular, the possibilities of our model to support assessment purposes was consider critical in two cases when considering the use of this type of games. The designs created in the case studies include: a) an extracurricular learning activity designed by 7 teachers with the purpose of discovering and learning about l'Hospitalet (i.e.

the city where the school is placed); b) a summative assessment activity designed by 1 teacher about the art history of Vic; and c) a formative assessment activity designed by 1 teacher to revise concepts associated to different pictures of a contemporary art museum. Interestingly, teachers' decisions when applying some of the puzzle game board design elements (especially the scoring and feedback mechanisms) varied significantly depending on the formal purposes.

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References

- Avouris, N., & Yiannoutsou, N. (2012). A review of mobile location-based games for learning across physical and virtual spaces. *Journal of Universal Computer Science*, 18(15), 2120–2142.
- Bachmair, B., Cook, J., & Kress, G. R. (2010). *Mobile learning: structures, agency, practices*. Boston, MA.
- Cabrera, J. S., Frutos, H. M., Stoica, A. G., Avouris, N., Dimitriadis, Y., Fiotakis, G., & Liveri, K. D. (2005). Mystery in the Museum: Collaborative learning activities using handheld devices. In *Proceedings of the 7th International Conference on Human Computer Interaction with Mobile Devices and Services* (pp. 315–318). Salzburg, Austria.
- Davis, S. M. (2002). Research to industry. Four years of observations in classrooms using a network of handheld devices. In *Proceedings of the IEEE International Workshop on Wireless and Mobile Technologies in Education* (pp. 31–38). Växjö, Sweden.
- Frossard, F. (2013). *Fostering teachers' creativity through the creation of GBL scenarios*. PhD Thesis. Universidad de Barcelona, Spain.
- Hwang, G., Tsai, C., & Yang, S. J. H. (2008). Criteria, strategies and research issues of context-aware ubiquitous learning. *Educational Technology & Society*, 11(2), 81–91.
- Jeng, Y., Wu, T., Huang, Y., Tan, Q., & Yang, S. J. H. (2010). The add-on impact of mobile applications in learning strategies: A review study. *Educational Technology & Society*, 13(3), 3–11.
- Jones, V., & Jo, H. J. (2004). Ubiquitous learning environment: an adaptive teaching system using ubiquitous Technology. In *Proceedings of the 21st ASCILITE Conference* (pp. 468–474). Perth, Western Australia.
- Melero, J., & Hernández-Leo, D. (accepted). A model for the design of puzzle-based games including virtual and physical objects. *Journal of Educational Technology & Society* (accepted).
- Melero, J., Santos, P., Hernández-Leo, D., & Blat, J. (2013). Puzzle-based games as a metaphor for designing in situ learning activities. In *Proceedings of the 7th European Conference on Games Based Learning* (pp. 674–682). Porto, Portugal.
- Nicklas, D., Pfisterer, C., & Mitschang, B. (2001). Towards location-based games. In *Proceedings of the International Conference on Applications and Development of Computer Games in the 21st Century* (pp. 61–67). Hongkong Special Administrative Region, China.
- Roschelle, J. (2003). Unlocking the learning value of wireless mobile devices. *Journal Computer Assisted Learning*, 19(3), 260–272.
- Schlieder, C., Kiefer, P., & Matyas, S. (2006). Geogames: Designing Location-based games from classic board games. *IEEE Intelligent Systems*, 21(5), 40–46.
- Vinu, P. V., Sherimon, P. C., & Krishnan, R. (2011). Towards pervasive mobile learning - the vision of 21st century. In *Proceedings of the 3rd World Conference on Educational Sciences* (pp. 3067–3073). Istanbul, Turkey.
- Yatani, K., Onuma, M., Sugimoto, M., & Kusunoki, F. (2004). Musex: A system for supporting children's collaborative learning in a museum with PDAs. *Systems and Computers in Japan*, 35(14), 773–782.