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A Modular Approach for Learning Support on Different Levels in Educational Games

Alexander NUSSBAUMER[a*], Christina M. STEINER[a], Matthias MAURER[a], & Dietrich ALBERT[a,b]
[a]*Knowlege Technologies Institute, Graz University of Technology, Austria*
[b]*Department of Psychology, University of Graz, Austria*
*alexander.nussbaumer@tugraz.at

Abstract: In this paper we present a modular approach for learning support in game environments. In applied or educational games both aspects are important – the fun to play and a topic to learn. While traditional games or leisure games only focus on the enjoyment and entertainment of the player, educational games also aim to convey knowledge and competences. However, in order to fulfill this goal, an applied game should take care that the player actually learns something. The software components of our approach specifically support the learning aspects in a game in different and balanced ways. This includes competence development, maintaining motivation, support in problem solving tasks, support for meta-cognition and reflection, and adaptation of the game based to players' personality.

Keywords: Educational games, adaptation, competences, motivation, reflection support

1. Introduction

Digital learning games represent an e-learning technology that is increasingly recognized by educational practitioners (Johnson, 2014). With their highly engaging and motivating character games constitute effective educational tools for creating authentic learning tasks and meaningful, situated learning (De Freitas, 2013). One main reason why games can be so effective for learning is their ability to induce a "flow experience" - a positively perceived experience and state of full immersion in an activity that typically goes along with a loss of sense of time (Csikszentmihalyi & LeFevre, 1989).

Psychological research has targeted many aspect of leisure and educational games, such as engagement, challenge, motivation, and achievement. Starks (2014) proposes a cognitive-behavioural game design model that incorporates a wide range of psychological constructs and relates them with game design elements. In this three-tier model cognitive elements (e.g. knowledge, goals, encouragements) are connected with game design elements derived from the Social Cognitive Theory (Bandura, 2006) and the Theory of Multiple Intelligences (Gardner, 1983). According to the model of Starks, this leads to the factors that make games both enjoyable and educational, which are engagement, challenge, flow, persistence, and mastery. All of these factors have been extensively researched from a psychological perspective. For example, the flow concept (Csikszentmihalyi & LeFevre, 1989) describes a situation when people are highly engaged and lose track of time, which often happens, when skills and challenges are balanced.

While all these concepts are important and helpful for increasing the performance in serious games, there is a distinction between performance and learning (VandeWalle et al, 1999; Fisher & Ford, 1998). For example, there is a difference if, a the goal of a game is to learn about topic and acquire knowledge or just to complete tasks and challenges not related to learning topics. Supporting and assessment of learning requires a clear model of learning activities and the processes involved toward learning goals.

This paper presents a modular approach for learning support that takes into account these psychological aspects and relates them into a design of software components that can be included in educational games.

2. Learning Support in Educational Games

2.1 Overall Approach

The overall approach for learning support in educational games is depicted in Figure 1. Basically the game with its story, user interface, and environment is separated from the educational components. This separation enables the re-use of the educational components for different games and thus makes the development of new games faster and more efficient. The educational components include the learning aspects of competence development, motivation support, reflection support, and personality-based game configuration. All of them provide adaptation features to personalize the game based on the learner's actions and behavior. Together they provide learning support on different levels and modalities including the learning goals in terms of knowledge and competences, the maintenance of the motivational state, reflection during the game, and pre-configuration of the game based on personality traits. In order to realize this approach, a set of software components have been developed that support these aspects.

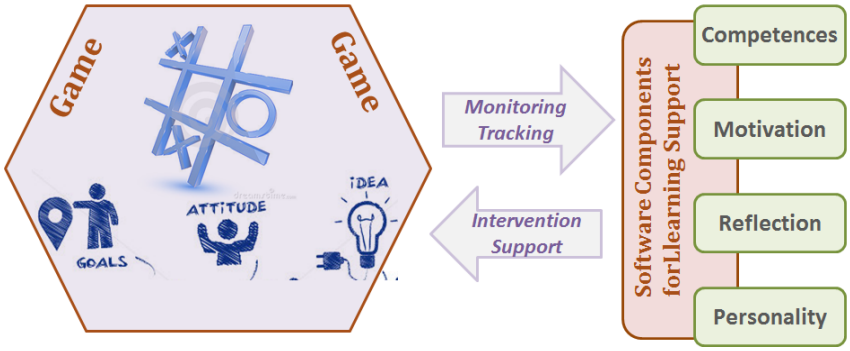

Figure 1. Overall approach for learning support in educational games.

2.2 Components for Learning Support

The first component is the competence-based adaptation component that monitors the player's behavior, automatically assesses the competences, and recommends game activities using the assessed competences. Task performance and problem solving behavior in game levels and game situations is monitored while a learner plays a game. Based on this information, a competence state is calculated using a pre-defined competence model created during game development. Given the identified competence state of a player meaningful recommendations can be delivered to the game about which game situation, level, or task should be presented next. An authoring tool allows to model the competences and how they are related to game activities. This approach is based on Competence-based Knowledge Space Theory, which is a mathematical-psychological framework for knowledge and competence representation, assessment, and recommendation (Heller et al., 2006).

Similar to the competence-adaptation component the motivation-based adaptation component consists in a non-invasive motivational monitoring part and an intervention part. The motivation assessment is done by tracking a player's activities and calculating the motivational state (attention, confidence, satisfaction) out of this information. Based on the motivational state messages are triggered, for instance to encourage the player to carry on or congratulating on successful performance. The inclusion of motivational aspects in applied games is crucial. Instead of only assuming that games are motivating per se, it is important to design games in a way to enhance the player's engagement. Due to the dynamic nature of motivation, game feedback or changes aiming at keeping the player engaged should be adapted to the needs of the player. The adaptation model is based on the theoretical framework for motivational adaptation developed in the 80Days project (Steiner et al., 2012).

In order to provide cognitive and meta-cognitive support, the behavior of the players is tracked in terms of the tasks and activities they the doing. If it is detected that a player is carrying out a task in a wrong way or omits required activities, messages can be triggered and sent to the player. These messages shall prompt reflection on the learning and game experience at certain points. The messages

are based on a catalogue of intervention types developed in the 80Days project (Kickmeier-Rust et al., 2011). An authoring tool allows to model the wanted and not wanted behavior and which interventions should be triggered.

The last component is the player profiling component that adapts the game before the player starts. Pre-game adaptation is made by presenting a short personality questionnaire when first entering the game. Based on the analysis of the players' response, personality traits are identified and the game features and versions may be tailored to a player's characteristics. An authoring tool allows the creation of such questionnaires and how they are translated into pedagogical meaning.

3. Conclusion and Outlook

This poster paper presented an approach for providing learning support on different levels in educational games. This approach is realized by a set of software components that support different learning aspects. The modular design enables the use of these components by game developers, which makes the development process more efficient, professional, and cheaper.

The next step is the integration of these software components with an educational game, in order to test and evaluate our approach. This integration tests both the technical aspect if the components function correctly and the pedagogical aspect if the components support learning as they should. Moreover, a user-centric evaluation will be conducted to validate the usefulness and learning effect.

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