DESIGNING AND EVALUATING EDUCATIONAL CHEMISTRY GAMES

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Current chemistry education leans on a social constructivist perspective of learning: pupils construct new knowledge by discussing and exploring together. Every pupil has an active and accountable role in the learning process. A teacher´s role, in turn, is to guide and support this process. A positive perception of one´s capability and of chemistry as a school subject has been proved to enhance learning. This is one reason why it is necessary to use teaching and learning methods, which promote both the pupils´ capability in chemistry and the fact that they like chemistry as a school subject. Educational games are this kind of a teaching and learning approach.Educational games and pupils The pupil is acting the role of a player. Playing educational games provides pupils with opportunities to take a responsibility for their own learning. These games also enhance an interplay between pupils as well as a construction of meaningful knowledge together. In other words, with educational games it is possible to execute a social constructivist way of learning. But it is the teacher, who should find the suitable game for a certain task, phenomenon, skill or knowledge to be learned. Even though a competitive element is typically included in the games, it is noticed that a cooperative, collaborative or an individual aim helps the progress of learning more than competitiveness. In cooperative or collaborative play, pupils focus on a shared aim and because of that, they play more rationally and make less mistakes. Often choice-makings in cooperative or collaborative play differ from individual play. It also seems that boys are engaged in cooperative game and problem-solving during the play better than girls.

Not only luck, but also knowledge should play a role in winning the educational game. There should be a degree of uncertainty and unexpected events in every game: then the one who masters the content knowledge will not be the obvious winner. When rewards and positive feedback are alternating with challenges and conflicts in actual game situations, players will achieve alternating feelings of anxiety and boredom. These two emotions (for its part) engage pupils in the play and in learning during the play. Both, the feeling of attendance and the feeling of achieving the game objective, have a similar effect as feelings of anxiety and boredom. It has been proven that low-achieving pupils, pupils under special education and those, who lose their motivation and interest quickly, benefit most from the educational games. For higher-achieving pupils, educational games do not have similar effects, yet they also enjoy playing. The effects of gender have also been studied, and based on results the gender has an influences on how a pupil plays rather than what a pupil learns in the game session. The younger the players are, the easier, shorter and unambiguous game rules should be. And short educational games are preferred, because then it is possible to play the game more than once during a lesson.

Uality educational games give quality for learning chemistry: with them interest and enjoyment in learning will increase. New educational games should be developed especially in order to underpin a learning process for a certain phenomenon or a concept. Also criteria of quality should be set for an educational evaluation of games. A process for designing and executing a new game will take more time than expected, and this might be a problem for teachers with lots of work to do. One solution for that is a novel tool in order to develop and evaluate educational card and board games for chemistry education on lower-secondary level. This tool consists of classes and subclasses, which describe features of quality educational chemistry games. Additional details in subclasses ease an interpretation by showing alternative possibilities. Alternatives in bold are the best choices according to the research literature.Features for a quality chemistry game presented in are in consistent with criteria for a quality game in general, with demands for an effective learning environment, with the social constructivist perspective for learning and teaching chemistry as well as with aims for the 21st century skills and with the objectives in lower-secondary chemistry curricula in different countries. Based on this perception, it can be said that both digital and non-digital educational games are one suitable method for teaching chemistry.