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Serious games effects: an overview

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Abstract

"Games und Gamification" were declared by the "New Media Consortium" as one of the important trends in E-Leanring for the near future. If the NMC's assumptions are correct, we need a discussion on whether Games, especially so-called "Serious Games" indeed help in learning. The paper wants to give an overview on the state-of-the-art of what can be expected by Serious Games, according to the research already done.

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1. Serious Games

It is widely known that fear, stress - or also boredom, for that matter - activate the amygdala, whilst knowledge and information connected with positive emotions is absorbed by the hippocampus and then transferred to the cortex for further processing. Thus, learning content should be prepared in a way that activates the hippocampus, not the amygdala, that is, should be transmitted in a somewhat pleasant way that evokes interest and positive emotions.

In this context it seems to be manifest to use ludative methods of teaching and learning (Sanchez 2011; Knautz 2013).

Following the rise of digitalisation, games can be composed with the help of the computer, or can even be adopted for and with the computer, in order to "learn by playing" (a term used by Blumberg 2014; similar, for example, Ritterfeld 2011).

Meanwhile *Serious Games* clearly have become a genre of its own right in computer-based ludative teaching and learning (overview: Ritterfeld et al. 2009; Fromme/Unger 2012; Bredl/Bösche 2013). More so, this genre has become more and more important in recent years, as can be concluded for example from the fact that the "New Media Consortium", an international expert group with members in the fields of educational technologies who work

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in universities, museums or other (mainly American) institutions, in its latest annual reports declares "Games und Gamification" a trend most likely to make a significant impact within the near future, that is, in a time horizon of the next two or three years (NMC 2013: 20ff.; NMC 2014: 40ff.).

2. Theoretical and empirical questions

On the other hand, question is in how far games can be used for pedagogical purposes. For example, Kerres et al. (2009) discuss (insofar referring to Oerter 1999) whether a "game" that is "exploited" for didactical purposes is still a "game". The authors acknowledge that almost every game transmits experiences that can be used for reflection and thus are connected with teaching and learning (not only motor learning, but also acquiring declarative information). Therefore, it seems to be possible to utilise games for teaching and learning; however, the topic remains somewhat fuzzy (see for example Szilas / Sutter Widmer 2009).

Apart from the theoretical discussion, there are problems in appliance. For example, many learners try to avoid "learning modes" in order to as fast as possible return to a "gaming mode" (again, Kerres et al. 2009).

At least, *Serious Games* have to find a balance between the ludative element that exists for its own sake, and didactical or pedagogical goals that should neither be all too intrusive, nor lose sight of the aims.

Within these manifold and differing aspects it seems to be still uncertain whether *Serious Games* indeed help to improve learning results. In regard of what has been said before, two assumptions are possible: (1.) result might be a certain predominance of the ludative aspect that could even be so intense that it hinders learning; or, and on the other hand, (2.) result might be an intensification that, by activating the hippocampus, enforces successful teaching and learning.

Of course, the question on whether teaching and learning in the context of / with computer-based games is discussed so acutely as this question itself is quite fresh: whereas *Serious Games* exist as a didactical tool since some two decades, the games develop and change so fast and so divert that every specific assertion has to be verified again and again, as it very much depends on specific games, their character, the very medium, and thus is very much time-dependant, too (Ke 2009).

3. State-of-the-Art

In consequence, all meta-analyses we found (Squirre 2003, Kirriemuir/McFarlane 2004, Heers 2005, Vogel et al. 2006, Arnseth 2006, O'Neil et al. 2005, or, more recently, Ritterfeld et al. 2009 or Wouters et al. 2009) state that until now there exist but meager findings in regard of the teaching and learning effects of *Serious Games*; O'Neil et al. (2005) and Wouters et al. (2009: 232) both even use the drastic term of "scant". Clarke et al. (2010) state that there is no prove whatsoever that *Serious Games* enhance teaching and learning, and the result of the overview by Vogel et al. is as follows: "no significant advantage was found" (Vogel et al. 2006: 229).

The reasons for this assessment are comprehensible: Ke (2009) stresses for example the difficulties to come to basic conclusions when so many different games - and even genres of games - exist that can hardly be compared with each other. Not only the games are different, but also the topics, and the content that has to be learnt. Also, different games have different designs and structures, respectively. Thus, every game has specific possibilities of how it's effects would be.

Ke wanted to examine (1) what the cumulative qualitative and quantitative evidence for using computer games for learning would be, and (2) what the factors that weigh in an effective application of instructional gaming would be - "if any", as he added (2009: 2). Indeed he found out that the success of *Serious Games* very much seems to depend on the context and the content, but also on the pedagogical competences of the teachers who include the very game in their lessons, and the topic. Advantages were found in regard of higher-order thinking (e.g., planning and reasoning) and affective outcomes, whereas the effects of games on factual or verbal knowledge acquisition were weaker. These results correspond with the findings of Breuer and Bente (2010).

The results of a meta-study by Sitzman (2011) point in the same direction. She emphasizes the importance of an active (instead of a passive) acquisition of learning contents. Also, a game must not stand alone but should be included in a context with other learning assets. All in all, activation of the learner is the crucial criterion, according to Sitzman. However, she found that up to now computer games seem to assign the students mostly to a passive role. However, even when learners from an experimental and from a control group both were able to take over an active

part the progress of learners who did not play with a computer-based game as a rule was more convincing. Similar results were presented by Domagk et al. in 2010.

The meta article by Wouters et al. (2013) at least declared that the research situation has improved within the last five years up to then. The main reason seems to be that the technical development has improved, enabling new implementations and new realizations. Still, results are not definite. Most studies still show that when comparing a test group with a control group that learnt in an ordinary classroom context the results don't differ from those found out already by Ke (2005) or Sitzman (2011): Learning in the context of digital games needs training as well as suitable preparation and follow-up activities in order to be successful. - Quite interesting is the fact that the achievements were higher for example with language learning then with other topics, according to Wouters et al. (2013). The content or the topics thus seem to be an equally important factor (see also Cruz-Lara et al. 2011).

Language learning itself touches different areas, the majority of them not belonging to the sphere of higher-order thinking where Ke (2005) found the most convincing results in game-based learning. So it is quite surprising to read with Wouters et al. (2013) that there even exists a study that proves positive results with vocabulary learning with English learners from Hong Kong, obviously even significant in the statistical sense (Yip/Kwan 2006). My own research added a similar study from Iran, according to which vocabulary learning again was significantly more effective in the context of gaming (Alemi 2010). So it seems language learning is a sphere were computer-based games are quite convincing. A French study saw positive motivational effects with language learning in a three-dimensional game (Amoia et al. 2012). - Other studies quoted by Wouters et al. (2013) that proved positive effects of game-based learning in languages refer to reading competences (with children from Chile: Rosas et al. 2003) or with hearing, reading and writing comprehension (in Korea: Sug et al. 2010).

Yet another very recent meta article is by Hamari et al. (2014). The authors examine 24 empirical studies focussing on *gamification* for learning purposes. Again it could be shown that digital games are able to boost the learner's motivation and interest, and yet again that embedment and user behaviour are crucial aspects for the success of g*amification* in education.

4. Future Tasks

All in all, the overview showed that *gaming* itself is not clearly defined and might refer to very different ways of how to proceed. The research papers use the general term for example for “Video Games” (Rosas et al. 2003), “Websites with Online-Games” (Yip/Kwan 2006) or a “massive multiplayer online role-playing game” (Suh et al. 2010). In regard of these multifold possibilities to play on and with the computer in a learning context (and assuming that these multifold possibilities might be a cause for success or failure), Ke (2005) already stressed that all empirical results are time-based, or rather dependant on the technical development and the tools used. Thus the current state-of-the-art should not primarily lead to the question of *whether* games should be integrated in a learning environment (or not), but on *how* this could be done best, with what topic, at what opportunity, in what embedment (thus, with what kind of "instructional game design"), maybe even with what kind of learners. In any case a careful planning of the external and internal support is compulsory, external support referring to the classes and the game's embedment, a positive gaming environment, and well structurized cooperative gaming scenarios; internal support referring to elaborated ways to give feedback or the multimodal presentation of the learning content.

Thus, we are still far away from a general result on whether computer-based gaming or *Serious Games*, for that matter, are successful or not. Of course, a convincing integration of gaming and learning is compulsory in each new effort to create a computer-generated game. However, success is not guaranteed, nor is failure necessary. We still have to "try out", as Petko said already in 2008 (11).

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