

# Gaming Experience as a Prerequisite for the Adoption of Digital Games in the Classroom?

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## ABSTRACT

This paper addresses the question of how the gaming experiences of students and their attitudes towards gaming influence Game-based Learning in formal contexts. Based on the subject-scientific learning theory it explores how digital games can further expansive learning. The aim is to combine these issues to explain learning outcomes with digital games. For this purpose the paper presents the results of an empirical study with an Educational Game in a science class.<sup>1</sup>

## Keywords

Educational Games, Game-based Learning, Media literacy, Quantitative study

## INTRODUCTION

Newly emerging media frequently also enter – albeit with a certain time lag – formal learning contexts, such as the school classroom. Often, this is connected to the expectation that these media will help to devise more efficient learning processes or, as Paechter holds: Learning shall become faster, easier, and better (2007: 277). As a consequence, the importance of media literacy for adolescents' learning in formal educational settings is debated and the question arises how new media can be implemented into classrooms in ways that are didactically appropriate. In this context, the use of digital games in school education is being discussed on an international scale (cf. e.g. Wastiau et. al 2009; Ulicsak 2010; de Grove et al. 2012). This discussion first of all rests on the fact that digital games rank as one of the most favorite leisure activities amongst children and adolescents today.<sup>2</sup> Secondly, the discussion on digital games as learning media is grounded in the assumption that they may help to enhance students' competencies, such as cognitive, social, and personal competencies (cf. Liebermann 2006; Gebel 2009). Moreover, particularly so-called Educational Games<sup>3</sup> are supposed to facilitate learning (cf. Wilson et al 2009; Wouters et al. 2009: 238). Accordingly, Educational Games are expected to have a positive effect, yet empirical studies can only partially confirm this. In a comprehensive meta-analysis on the effectiveness of Serious Games<sup>4</sup>, Wouters et al. (2013) identified only a marginal difference in comparison to the control group. On top of that, players tend to better remember the content. However, Young et al. arrive at a contrasting conclusion in their meta-analysis: "there is limited evidence to suggest how educational games can be used to solve the problems inherent in the structure of traditional K-12 schooling and academia. Indeed, if you are looking for data to support that argument, then we are sorry, but your princess is in another castle" (2012: 62).

Proceedings of DiGRA 2015: Diversity of play: Games – Cultures – Identities

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In the light of this heterogeneous state of research it is essential to study in greater depth why Educational Games do apparently not fully reach the potentials ascribed to them. Beyond the technical and didactic barriers to their implementation in lessons (cf. Egenfeldt-Nielsen 2006; Rice 2007), the learners' perspectives need to be considered. From their points of view the following questions need to be analyzed: How do the attitude towards Educational Games and previous gaming experiences influence students' learning with Educational Games in the classroom? What is the correlation between the skills adolescents have acquired in the course of their everyday media activity (digital games during their leisure time) and learning in formal educational contexts (digital games in the classroom)?

## **(IN)VOLUNTARY GAMING AND LEARNING IN THE CLASSROOM**

When digital games are integrated into lessons, the boundaries between formal and informal learning are blurred. A medium that, when it is used during leisurely activities, is characterized by purposelessness and voluntary action (cf. Huizinga 1997; Caillois 1960: 12ff.) and thus facilitates in particular incidental learning (cf. Ritterfeld/Weber 2006: 408f.) may in the classroom rather be conceived as a "serious" activity than a playful one (cf. Oerter 1993). In how far this discrepancy between learning and gaming may influence the learning outcomes when Educational Games are used may be described in greater detail with the help of Holzkamp's subject science of learning and his notion of expansive learning (1993). Holzkamp emphasizes that learning is generally dependent on the individual's attitude so that the incitement of learning processes in formal learning contexts may not necessarily lead to the acquisition of knowledge and skills. Learners will only engage in learning activities when they experience a discrepancy and realize that they will not succeed without taking further actions and therefore continue to concentrate on the subject matter (cf. Holzkamp 1993: 212ff.). For this purpose, learners will choose between the strategies of expansive and defensive learning (cf. Holzkamp 2004: 30). The latter is applied in order to avoid external harm (e.g. at school in form of grades) with as little commitment as possible. These learners lack interest in a continuing occupation with the subject. In contrast to this, expansive learning aims at restoring and expanding learners' agency. From the learners' perspective it appears profitable to keep engaging with the learning content. Educational Games, it is argued, may incite this form of learning because through their playful approach they allow for an easy access to the topic and enable students to bring in the gaming experiences they have acquired in their leisure time. More than that, the medium may also help learners to assess the game as something of interest and relevance to them so that they do not choose a defensive learning strategy. In particular, this may occur when students are open-minded about Educational Games and are willing to use them for learning. On this basis, one may infer that their attitudes towards Educational Games and their previous gaming experiences, as well as the strategy of expansive learning are pivotal for the question whether students learn something through the use of Educational Games. Consequently, three hypotheses may be devised:

H1: Learners' experiences with digital games in their leisure time influence the outcome of their learning process with Educational Games.

H2: The attitude towards Educational Games, too, influences the outcome of the learning process with these games.

H3: The incitement of expansive learning positively affects the outcome of the learning process.

## METHOD UND SAMPLE

In order to investigate these hypotheses, a quantitative study in seven classes of the ninth grade at four German high schools (“Gymnasium”) was conducted in the spring of 2013 ( $n = 176$ ). Regarding the students’ gender the study could achieve an almost equal distribution – 48 % of the participants are female. Their average age was 15 years ( $M = 14.7$ ;  $SD = 0.589$ ). The Educational Game *Energetika* (Dialogik/Takomat 2010) was used during three physics lessons and data were collected in form of a pre-, respectively a post-questionnaire. *Energetika* is a simulation game in which the players manage a country’s power supply and thereby simulate the energy transition from 2010 to 2050.

The questionnaires predominantly resorted to already established charts for the collection of factors.<sup>5</sup> Following Wechselberger (2012), the students’ attitude towards Educational Games was measured with five items (e.g. “I find Educational Games boring”). In order to assess their previous experience with digital games in their leisure time, questions derivative of the MPFS’s JIM-study (2013) were asked. These questions focused on the type of games the learners played (PC games, video games, online games, etc.), their weekly periods of use, and on the duration of a game session. Additionally, during the pre- and the post-test, identical multiple choice knowledge questions were posed which had been developed together with the students’ teachers in order to assess the objective outcome of the learning process. Furthermore, the students were asked to evaluate their own learning progress according to Hochholdinger et al. (2008). Finally, the post-questionnaire included four items on expansive learning, which had been formulated on the basis of Holzkamp’s theory.

## RESULTS

This section will first of all present the findings on the adolescents’ use of games during their leisure time as well as their attitudes towards Educational Games. In a second step, it will be described in how far Educational Games incite expansive learning and the relationships between these factors and the objectively and subjectively perceived learning outcomes will be illustrated.

### Gaming in Their Leisure Time – Adolescents’ Experiences with Gaming

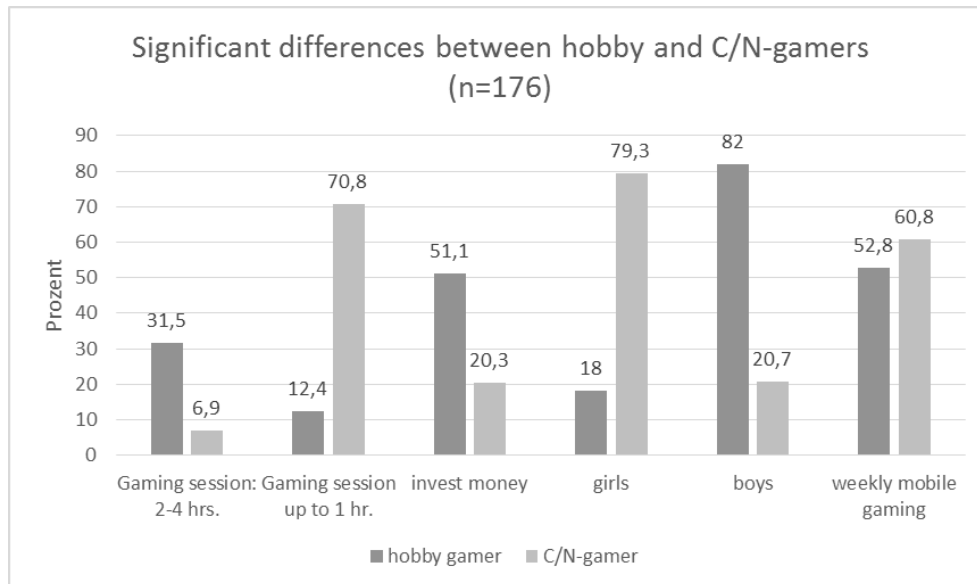
As was to be expected and comparable to the findings of a representative survey amongst German adolescents in the ages of 14 to 17 years by Quandt et al. (2013), almost all of the students interviewed play digital games at least seldom in their spare time (92.6 %). Therefore, there are hardly any non-gamers in the group of adolescents. However, there do exist great differences in the intensity and their form of use – and hence in their gaming experiences. About 76.1 % of the adolescents report playing video, computer, online or mobile games daily or several times a week. On average, they play for nine hours per week ( $M = 9.0$ ;  $SD = 9.172$ ;  $n = 161$ ), at which a number of frequent gamers who play for more than 20 hours per week significantly raise the mean value. About a

third of the gamers use the medium for short time spans: 21 % spend only up to one hour gaming and another 13 % play up to two hours every week. Thus, the temporal scope of the adolescents' use of games in their leisure time is similar to the results of the JIM-study (MPFS 2013: 47), which finds that on average, adolescents play for 76 minutes on weekdays and 101 minutes during the weekends. The study by Quandt et al. (2013) shows a slightly lower daily usage of 70 minutes amongst 14 to 17-year-olds.

Of all the forms of games, adolescents favor mobile gaming – a total of 82 % use online games and 52 % of the interviewees play them several times a week. Students who reported playing only for short periods of time (up to two hours per week), almost exclusively use mobile games (90 %). Mobile games thus seem to particularly attract adolescents who would by trend not use digital games, because these amusing games are especially popular during breaks or waiting times due to their low threshold and their constant availability. This is in stark contrast to online games, such as League of Legends, which rank second in the list of game forms adolescents frequently engage in and seem to polarize, since they are either played on a regular basis or not at all: 26 % of the students play them weekly, whereas 56 % do not play online games at all.

Summarizing these gaming habits, one may differentiate between hobby gamers, who play computer or video games on a weekly basis, and non- and occasional gamers (commonly referred to as casual gamers), who do not at all, or not on a weekly basis (see figure 1)<sup>6</sup>. Hobby gamers invest significantly more time in their hobby ( $t(160) = -6.171$ ;  $p < .01$ ). While they play for 14 hours per week on average, casual gamers only spend four hours gaming. Accordingly, hobby gamers also play longer in one session: 31.5 % play between two and four hours, a time span reported by only 6.9 % of the C/N-gamers (Cramer's  $V = 0.602$ ;  $p < 0.001$ ). In the latter group, 71 % play only up to one hour. Moreover, hobby gamers are more likely to invest money in digital games: 51.1 % of them spent money on games every month, but only 20.3 % amongst the C/N-gamers do so (Cramer's  $V = 0.394$ ;  $p < 0.001$ ). Finally, the gender-specific differences in the adolescents' gaming behavior already outlined in the JIM-study become very clear here: 79 % of the girls interviewed are casual gamers and non-gamers, whereas 82 % of the boys can be characterized as hobby gamers (Cramer's  $V = 0.614$ ;  $p < 0.001$ ).

Both groups share an interest in mobile games. For C/N-gamers, these constitute the predominant mode of gaming, yet hobby gamers, too, use mobile games: 61 % of the casual gamers and 53 % of the hobby gamers play on their smart phones several times a week. This juxtaposition shows that by now, the majority of adolescents have acquired some gaming experiences, yet it also illustrates that the intensity and the form of use (computer and video games vs. mobile games) considerably differ. Accordingly, one may assume that hobby gamers are more experienced in their use of digital games than C/N-gamers. More than that, the survey conducted in the classrooms elucidated that adolescent casual gamers do not see themselves as "gamers," since they do not understand their occasional dawdling around on their smart phones as gaming in the traditional sense.



**Figure 1: Gaming habits of hobby and C/N-gamers**

### **Attitudes towards Educational Games**

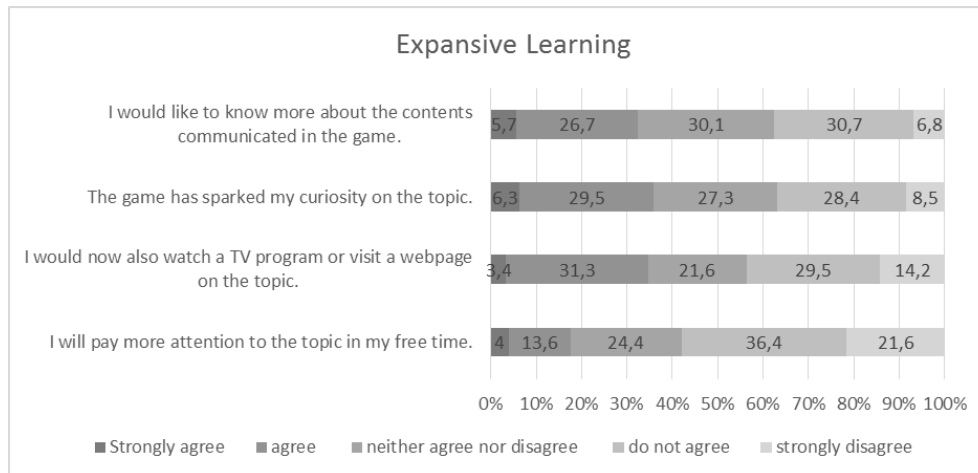
Besides the students' previous gaming experiences, their attitudes towards the medium may also well have an impact on the learning outcomes. On the whole, 60.2 % of the adolescents interviewed rather like them, 22.2 % have a neutral opinion, and 17.6 % had a rather negative attitude before playing *Energetika*. Wagner and Mitgutsch (2008), for instance, observe similar tendencies and their study reveals that 80 % of the students participating in their survey support the use of Serious Games in the classroom, yet only once they have tried out a game during the lessons. About half of the students have already used an Educational Game during their leisure time or in other classes and report using especially Edutainment games or programs. These games differ from Educational Games, since they explicitly fore-ground learning and commonly offer game elements as a reward for completed units. Consequently, these previous experiences with ludic learning applications inform the adolescents' perspective on Educational Games.

At the same time, the findings also show a significant – however weak – correlation between their previous experiences with digital games in their leisure time and their open-mindedness towards Educational Games ( $r = 0.180$ ;  $p < 0.05$ ). For example, 49.5 % of the hobby gamers, yet only 25.2 % of the C/N-gamers agree to the statement that Educational Games are not 'real' games (Cramer's  $V = 0.272$ ;  $p < 0.05$ ). Additionally, experienced gamers perceive Educational Games as rather boring (hobby gamers: 44.9 %; C/N-gamers: 33.3 %; Cramer's  $V = 0.240$ ;  $p < 0.05$ ). However, in spite of their different attitudes, the groups do not exhibit significant differences when it comes to their previous use of Educational Games: 49.4 % of the casual gamers and 46.6 % of the hobby gamers have already tried Educational Games in their free time, which leads to the conclusion that their critical attitude towards this type of games cannot be explained by the hobby gamers' greater exposure to them. With reference to the research questions and hypotheses one may argue that, since they are already experienced gamers, hobby gamers may have an advantage in regard to the learning outcomes, but at the same time, they are also more critical of these games, which may in turn decrease the potentials of the applications to foster learning processes. Students who are less experienced in gaming

may have an advantage because of their attitude towards the learning medium, since they may be more willing to look into the contents of the game. As a result, the question arises which of these two parameters has a greater effect on the learning outcome and which of the two groups may learn more when playing the Educational Game used in this study. Before these correlations are examined in more detail, the following section will describe in how far *Energetika* may incite expansive learning in the students.

## Expansive Learning with Educational Games

Due to its design, this study could not record in how far the Educational Game indeed triggered further expansive learning actions. Instead, the participating students were asked whether they would like to continue dealing with the topic of energy and sustainability. The results show that only approximately a third of the students has a continuing interest in the subject matter, since 35.8 % state that their curiosity has been piqued and 32.4 % would like to know more about the subject (see figure 2).



**Figure 2:** Expansive Learning

The findings also show that the students' interest is not only limited to playful learning activities, but 34.8 % can imagine using other media in order to find more information. When asked directly whether they would further engage in the subject matter during their leisure time, however, only 17.6 % agree. The interest aroused by the game therefore does not suffice to spur concrete learning actions and the adolescents seem to distinguish between a rather general interest and the real intention to research more information. Simultaneously the numbers illustrate that about two thirds of the participants do not see a reason to familiarize themselves with the subject matter irrespective of the classroom requirements. In this context, a comparison to other media would be interesting, since the question needs to be posed whether Educational Games may spark the students' learning interest more than other learning media. When students in favor of Educational Games and those critical of the applications are compared, significant differences are revealed with regard to expansive learning. Adolescents who favor Educational Games are more likely to continue dealing with their content and also show a greater interest ( $t(174) = 3.589$ ;  $p < .001$ ). No differences, though, may be found concerning their previous gaming experiences, which suggests that the students' attitudes towards Educational Games has a stronger impact on their learning activities than their previous experiences with games.

## Leisure Time Gaming and Its Influences on Learning with Educational Games

In the following, it will be explored whether the factors outlined above influence the students' learning with Educational Games. For this purpose, the results of the first and second knowledge test will be compared to assess the objective outcome of the learning process. The study was consciously designed to not allow for other didactic measures before the post-test that would recap the content of the game, so that its direct effects could be determined. However, the differences in the outcomes of the students' learning process would certainly be greater when the content of the game is didactically embedded into the lesson, for instance when its results are discussed. On average, students scored 24 points on the first knowledge test ( $M = 23.91$ ;  $SD = 7.110$ ) and 28 out of 45 points on the second ( $M = 27.33$ ;  $SD = 7.885$ ). By playing *Energetika* students may thus achieve a test score with an average of four additional points, which describes a significant increase in their knowledge ( $t(173) = 6.917$ ;  $p < 0.001$ ).

Furthermore, the study reveals slightly significant correlations between the participants' previous gaming experiences and both the score they achieved in the second knowledge test ( $r = 0.156$ ,  $p < 0.05$ ) and their subjective evaluation of the learning outcome ( $r = 0.166$ ,  $p < 0.05$ ) (see table 1).

	2nd knowledge test	Objective learning outcome	Subjective evaluation of the learning outcome
Gaming experience	0.156*	n. s.	0.166*
Attitude EG	0.171*	0.201**	0.250**
Expansive Learning	0.168*	0.175*	0.437**

Pearson's Correlations Coefficient, \*\* $p < 0.01$ ; \* $p < 0.05$ ; ns  $p > 0.1$

**Table 1:** Correlation matrix – Gaming experience and attitudes towards educational games with learning outcomes.

The students' gaming experience is indeed meaningful when it comes to the objective learning outcome. Accordingly, hobby and C/N-gamers may learn an equal amount of content with *Energetika*. In contrast to their gaming experience, the adolescents' attitude towards Educational Games shows a weak, but significant correlation in all the forms of learning recorded, which suggests that a positive attitude towards the learning medium before it is being used seems to facilitate the learning process. Moreover, the study reveals another fascinating finding: In contrast to the other correlations outlined, the students' interest in expansive learning and the subjective evaluation of the learning outcomes show a moderate correlation ( $r = 0.437$ ,  $p < 0.01$ ). This result is illuminating, since it highlights that students evaluate the outcome of their learning process positively when they have further interest in the subject matter and, in turn, when they feel they have learned something, they can imagine dealing with the topic in greater depth.

Finally, in the course of a linear regression analysis, the influence of the students' gaming experience, their attitude towards Educational Games, and their expansive learning was

studied with respect to both the objective learning outcome and their subjective evaluation of the outcome of their learning process. It is assumed that these factors may positively influence the objective and subjective learning outcomes.

The regression analysis with the dependent variable objective learning outcome clearly demonstrates that neither gaming experience, nor expansive learning, but the attitude towards Educational Games has a significant impact (see table 2). However, on the whole, the variables considered cannot account for the variance of the objective learning outcome, which implies that neither gaming experience, nor the attitude towards Educational Games or the willingness for expansive learning influence the acquisition of knowledge through the game.

	<b>Regression coefficient B</b>	<b>SE</b>	<b><math>\beta</math></b>
Constant	9.393	2.089	
Gaming experience	0.374	0.991	0.029
Attitude EG	1.183	0.541	0.171*
Expansive Learning	1.006	0.605	0.128

(Corrected  $R^2 = 0.057$ ;  $N = 176$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ )

**Table 2:** Influence of gaming experience, attitude towards educational games, and expansive learning on the objective learning outcome

In a second step, another regression analysis with the dependent variable subjective evaluation of the outcome of the learning process was conducted (see table 3). In this regression model the results do indeed point into the direction of the expected correlation: all three factors included positively influence the evaluation of the learning outcome. When the other two factors are considered, expansive learning most strongly correlates with the subjective perception of learning.

	<b>Regression coefficient B</b>	<b>SE</b>	<b><math>\beta</math></b>
Constant	1.075	0.238	
Gaming experience	0.318	0.113	0.191**
Attitude EG	0.157	0.062	0.179**
Expansive Learning	0.384	0.069	0.385**

(Corrected  $R^2 = 0.231$ ;  $N = 176$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ )

**Table 3:** Influence of gaming experience, attitude towards educational games, and expansive learning on the subjective evaluation of the learning outcome



All in all, the control of H1 and H2 indicates that the adolescents' previous gaming experiences and their attitude towards Educational Games before the implementation of *Energetika* do not influence the objective learning outcome and have only little influence on the subjective evaluation of their learning process. Thus the hypotheses may not be affirmed. Yet when students do have a continuing interest in the subject matter, their subjective perception of the learning process is positively influenced, but the knowledge they actually gained through gaming remains unaffected. Hence H3 may be partially affirmed. At this point it should be noted that the interest in a topic is more important for learning with Educational Games than students' attitude towards the learning medium or their use of it during their leisure time.

## CONCLUSION

This study explored the influence of gaming during adolescents' leisure time and their learning with Educational Games in the classroom. This subject matter is particularly relevant for the discussion of digital games as learning media when digital games are used to not only increase the students' motivation, but may also constitute an alternative or a supplement to other learning media. In order to answer the research questions, a pre-post-field study with the Educational Game *Energetika* was conducted. All participating adolescents have come into contact with digital games and many of them use them with some regularity, yet the intensity of their use differs. This study identified two particular groups of users: those who see digital games as their hobby and play computer, video, or online games several times a week, and those who only spend a small amount of time playing digital games, especially on their smart phones.

The findings illustrate that – contrary to the hypotheses – the students' previous gaming experiences and their attitude towards Educational Games do not influence their learning. From a media pedagogical perspective, this is a positive result. The Educational Game used in this study appears to present an offer with a low threshold which allows students to deal with the topic of energy and sustainability. Moreover, it could be observed that the game incites expansive learning in a third of the learners. When this is the case, the students also feel that they have learned more. At the same time, the encouragement to practice expansive learning does not impact the objective learning outcome, which affirms Holzkamp's assumption that teaching and learning offers as such do not always implicate learning (cf. Holzkamp 2004: 31), but that the learners themselves decide whether they want to learn something. However, the results indicate that a stronger interest in the subject matter contributes more to the subjective learning outcome than the previous gaming experiences. Whether students have an interest in the sense of expansive learning is also connected to their attitudes towards Educational Games. In how far this also holds true for other forms of schools and other Educational Games needs to be probed by other studies. The problem remains that it is not clear how the outcome of the learning process may be explained, which necessitates the study of further parameters and mediators.

At the beginning of this article the question was raised what the correlation between the skills adolescents acquire in their everyday usage of media and their learning with media in formal educational contexts is. The findings elucidate that this correlation may be neglected in the context of the debate on the question of whether the implementation of digital games in the classroom requires some form of media competency. Digital games in the classroom are not favored by all students in equal measure, but they may well serve as an equal supplement to other learning media.

## ENDNOTES

<sup>1</sup> The study was part of an PhD-project and this article has originally been published in: merz – Medien + Erziehung Wissenschaft 58 (6), S. 18-27.

<sup>2</sup> In the following, the term ‘digital games’ will be applied to computer and video games, as well as to mobile games on tablets and smartphones.

<sup>3</sup> Serious Games describe digital games whose purposes go beyond mere entertainment and comprise learning or practicing specific skills. In correspondence to their application areas, Serious Games are also referred to as Health Games, Training Games, or Educational Games. The latter are commonly developed with the intention of integrating (learning) contents in terms of a knowledge transfer into the mechanisms of the game so that certain learning effects are made possible or enhanced. So far, standard definitions of Serious Games and the subcategory of Educational Games have not been established. For a discussion of the attempts to define the terms, please see e.g. Lampert, Schwinge and Tolks (2009).

<sup>4</sup> The meta-analysis by Wouters et al. is not limited to Educational Games, but the majority of the studies accounted for are concerned with these.

<sup>5</sup> The factors have been determined by means of an exploratory factor analysis and cross-validated through confirmatory factor analyses to ensure their one-dimensionality. Additionally, their reliability was tested on the basis of Cronbach’s alpha (setting Educational Game  $\alpha = 0.821$ ; subjective evaluation of the learning outcome  $\alpha = 0.960$ ; expansive learning  $\alpha = 0.817$ ).

<sup>6</sup> In the following, casual and non-gamers will be summarized in one group (short: C/N-gamers), since the group of non-gamers is too small to be considered separately (n=13), yet is not to be excluded from the analysis. Since the non-gamers’ attitude towards Educational Gamers is similar to that of casual gamers it is reasonable, though not entirely unproblematic, to study them as one group.

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